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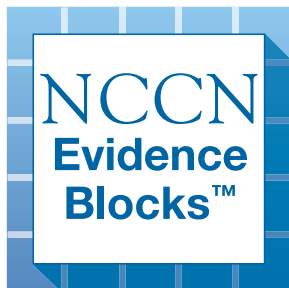
NCCN Clinical Practice Guidelines in Oncology (NCCN Guidelines®)

# Hodgkin Lymphoma

## NCCN Evidence Blocks™

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[NCCN Guidelines Panel Disclosures](#)

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‡ Internal medicine	¥ Patient advocacy
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[NCCN Evidence Blocks Definitions \(EB-1\)](#)

[Diagnosis and Workup \(HODG-1\)](#)

[Clinical Staging for Classic Hodgkin Lymphoma \(HODG-2\)](#)

Primary Treatment of Classic Hodgkin Lymphoma (CHL):

- CS I-II (Non-bulky) ([HODG-3](#), [HODG-4](#), [HODG-5](#), [HODG-6](#))
- CS I-II Unfavorable (Bulky mediastinal disease or >10 cm adenopathy) ([HODG-7](#))
- CS III-IV ([HODG-9](#))

Primary Treatment of Nodular Lymphocyte-Predominant Hodgkin Lymphoma (NLPHL):

- CS IA-IV ([HODG-12](#))

[Follow-up After Completion of Treatment and Monitoring for Late Effects \(HODG-13\)](#)

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[Principles of Systemic Therapy \(HODG-B\)](#)

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[PET 5-Point Scale \(Deauville Criteria\) \(HODG-D\)](#)

[Management of CHL in Older Adults \(HODG-E\)](#)

[Staging \(ST-1\)](#)

**Clinical Trials:** NCCN believes that the best management for any patient with cancer is in a clinical trial. Participation in clinical trials is especially encouraged.

To find clinical trials online at NCCN Member Institutions, [click here: nccn.org/clinical\\_trials/clinicians.aspx](#).

**NCCN Categories of Evidence and Consensus:** All recommendations are category 2A unless otherwise indicated.

See [NCCN Categories of Evidence and Consensus](#).

**NCCN Categories of Preference:** All recommendations are considered appropriate.

See [NCCN Categories of Preference](#).

NCCN Guidelines for Patients® are available at [www.nccn.org/patients](#).

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**NCCN EVIDENCE BLOCKS CATEGORIES AND DEFINITIONS**

5					
4					
3					
2					
1					

**E = Efficacy of Regimen/Agent**  
**S = Safety of Regimen/Agent**  
**Q = Quality of Evidence**  
**C = Consistency of Evidence**  
**A = Affordability of Regimen/Agent**

**Example Evidence Block**

5					
4	■	■		■	
3	■	■	■	■	■
2	■	■	■	■	■
1	■	■	■	■	■

**E = 4**  
**S = 4**  
**Q = 3**  
**C = 4**  
**A = 3**

**Efficacy of Regimen/Agent**

<b>5</b>	<b>Highly effective:</b> Cure likely and often provides long-term survival advantage
<b>4</b>	<b>Very effective:</b> Cure unlikely but sometimes provides long-term survival advantage
<b>3</b>	<b>Moderately effective:</b> Modest impact on survival, but often provides control of disease
<b>2</b>	<b>Minimally effective:</b> No, or unknown impact on survival, but sometimes provides control of disease
<b>1</b>	<b>Palliative:</b> Provides symptomatic benefit only

**Safety of Regimen/Agent**

<b>5</b>	<b>Usually no meaningful toxicity:</b> Uncommon or minimal toxicities; no interference with activities of daily living (ADLs)
<b>4</b>	<b>Occasionally toxic:</b> Rare significant toxicities or low-grade toxicities only; little interference with ADLs
<b>3</b>	<b>Mildly toxic:</b> Mild toxicity that interferes with ADLs
<b>2</b>	<b>Moderately toxic:</b> Significant toxicities often occur but life threatening/fatal toxicity is uncommon; interference with ADLs is frequent
<b>1</b>	<b>Highly toxic:</b> Significant toxicities or life threatening/fatal toxicity occurs often; interference with ADLs is usual and severe

**Note: For significant chronic or long-term toxicities, score decreased by 1**

**Quality of Evidence**

<b>5</b>	<b>High quality:</b> Multiple well-designed randomized trials and/or meta-analyses
<b>4</b>	<b>Good quality:</b> One or more well-designed randomized trials
<b>3</b>	<b>Average quality:</b> Low quality randomized trial(s) or well-designed non-randomized trial(s)
<b>2</b>	<b>Low quality:</b> Case reports or extensive clinical experience
<b>1</b>	<b>Poor quality:</b> Little or no evidence

**Consistency of Evidence**

<b>5</b>	<b>Highly consistent:</b> Multiple trials with similar outcomes
<b>4</b>	<b>Mainly consistent:</b> Multiple trials with some variability in outcome
<b>3</b>	<b>May be consistent:</b> Few trials or only trials with few patients, whether randomized or not, with some variability in outcome
<b>2</b>	<b>Inconsistent:</b> Meaningful differences in direction of outcome between quality trials
<b>1</b>	<b>Anecdotal evidence only:</b> Evidence in humans based upon anecdotal experience

**Affordability of Regimen/Agent (includes drug cost, supportive care, infusions, toxicity monitoring, management of toxicity)**

<b>5</b>	<b>Very inexpensive</b>
<b>4</b>	<b>Inexpensive</b>
<b>3</b>	<b>Moderately expensive</b>
<b>2</b>	<b>Expensive</b>
<b>1</b>	<b>Very expensive</b>

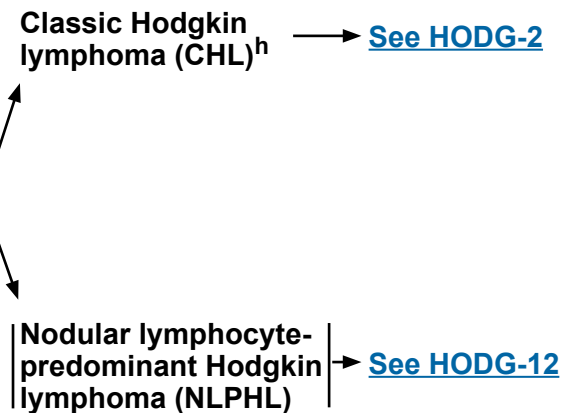


**DIAGNOSIS/WORKUP**

- Excisional biopsy (recommended)
  - Core needle biopsy may be adequate if diagnostic<sup>a</sup>
  - Immunohistochemistry evaluation<sup>b</sup>
- Essential:**
- H&P including: B symptoms (unexplained fever >38°C; drenching night sweats; or weight loss >10% of body weight within 6 mo of diagnosis), alcohol intolerance, pruritus, fatigue, performance status, examination of lymphoid regions, spleen, liver
  - CBC, differential, platelets
  - Erythrocyte sedimentation rate (ESR)
  - Comprehensive metabolic panel, lactate dehydrogenase (LDH), and liver function test (LFT)
  - Pregnancy test for women of childbearing age
  - Diagnostic CT<sup>c</sup> (contrast-enhanced)
  - PET/CT scan<sup>d</sup> (skull base to mid-thigh or vertex to feet in selected cases)
  - Counseling: Fertility, smoking cessation, psychosocial ([See NCCN Guidelines for Supportive Care](#))

- Useful in selected cases:**
- Fertility preservation<sup>e</sup>
  - Diagnostic neck CT with contrast, if neck is PET/CT+ or if neck RT contemplated
  - Pulmonary function tests (PFTs incl. diffusing capacity [DLCO])<sup>f</sup> if ABVD or escalated BEACOPP are being used
  - Pneumococcal, H-flu, meningococcal vaccines, if splenic RT contemplated
  - HIV and hepatitis B/C testing (encouraged)
  - Chest x-ray (encouraged, especially if large mediastinal mass)
  - Adequate bone marrow biopsy if there are cytopenias and negative PET<sup>g</sup>
  - Evaluation of ejection fraction if doxorubicin-based chemotherapy is indicated
  - MRI or PET/MRI (skull base to mid-thigh) with contrast unless contraindicated

**CLINICAL PRESENTATION**



<sup>a</sup>Fine-needle aspiration (FNA) alone, in distinction from a core biopsy, is insufficient for diagnosis except in unusual circumstances when in combination with immunohistochemistry it is judged adequate by a hematopathologist or cytopathologist.

<sup>b</sup>Typical immunophenotype for CHL: CD15+, CD30+, PAX-5+ (weak); CD3-, CD20- (majority), CD45-, CD79a-. Typical immunophenotype for NLPHL: CD20+, CD45+, CD79a+, BCL6+, PAX-5+; CD3-, CD15-, CD30- (Swerdlow SH, Campo E, Harris NL, et al; WHO classification of tumours of haematopoietic and lymphoid tissues. Lyon, France: IARC; 2008). An expanded panel of markers may be required, especially if equivocal diagnosis. [See NCCN Guidelines for B-Cell Lymphomas.](#)

<sup>c</sup>CT is considered diagnostic if it is IV contrast-enhanced. CT component of a conventional PET/CT is often not IV contrast-enhanced. Although the diagnostic CT will often be neck/chest/abdomen/pelvis, at minimum include the areas identified as abnormal on PET/CT.

<sup>d</sup>PET/CT should be obtained in accordance with American College of Radiology (ACR) practice guidelines. PET/CT should be done with patient on a flat table with arms up, if possible. In cases of PET positivity where sites of disease are inconsistent with usual presentation of Hodgkin lymphoma or if an unusual disease presentation (ie, HIV), additional clinical evaluation may be required to stage patient. [See \(ST-1\).](#)

<sup>e</sup>Fertility preservation options include: Semen cryopreservation, IVF, or ovarian tissue or oocyte cryopreservation and oophoropexy.

<sup>f</sup>In general, a DLCO threshold of ≥60% is acceptable for use of bleomycin.

<sup>g</sup>In most instances, if the PET/CT displays a homogeneous pattern of marrow uptake (thought to be secondary to cytokine release) bone marrow involvement is not assumed. If there are multifocal (three or more) skeletal PET/CT lesions, marrow may be assumed to be involved. In general, bone marrow biopsies are no longer indicated.

<sup>h</sup>CHL includes nodular sclerosis (NSHL), mixed cellularity (MCHL), lymphocyte-depleted (LDHL), and lymphocyte-rich (LRHL) subtypes. If grey-zone, [see NCCN Guidelines for B-Cell Lymphomas.](#)

**Note: For more information regarding the categories and definitions used for the NCCN Evidence Blocks™, see page EB-1.**

**All recommendations are category 2A unless otherwise indicated.**

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**CLINICAL STAGING OF CLASSIC HODGKIN LYMPHOMA (CHL)<sup>j</sup>**

Clinical Stage	Bulky Disease <sup>j</sup> (mediastinal or peripheral)	Number of Nodal Sites <sup>j</sup>	Erythrocyte Sedimentation Rate (ESR)	Guidelines Page
I-IIA ± extralymphatic (E) lesions <sup>k</sup>	No	<4	<50	Combined modality therapy for favorable/non-bulky disease ( <a href="#">HODG-3</a> ) or Chemotherapy alone for favorable/unfavorable/non-bulky disease ( <a href="#">HODG-4</a> )
	No	≥4	Any	Chemotherapy alone for favorable/unfavorable/non-bulky disease ( <a href="#">HODG-4</a> ) or Combined modality therapy for unfavorable/non-bulky disease ( <a href="#">HODG-6</a> )
	No	Any	≥50	Combined modality therapy for unfavorable/non-bulky disease ( <a href="#">HODG-6</a> )
	Yes	Any	Any	Therapy for unfavorable/bulky disease ( <a href="#">HODG-7</a> )
IB/IIB ± E lesions <sup>k</sup>	No	Any	Any	Combined modality therapy for unfavorable/non-bulky disease ( <a href="#">HODG-6</a> )
	Yes	Any	Any	Therapy for unfavorable/bulky disease ( <a href="#">HODG-7</a> )
III-IV	Yes/No	Any	Any	<a href="#">HODG-9</a>

<sup>j</sup>For definitions of bulky disease and lymph node regions, [see HODG-A](#).

<sup>k</sup>E-lesions are defined by the HD10 study as localized involvement of extralymphatic tissue (by continuous growth from an involved lymph node or in close anatomic relation) that is treatable by irradiation. (Engert A, et al. N Engl J Med 2010;363:640-652.)

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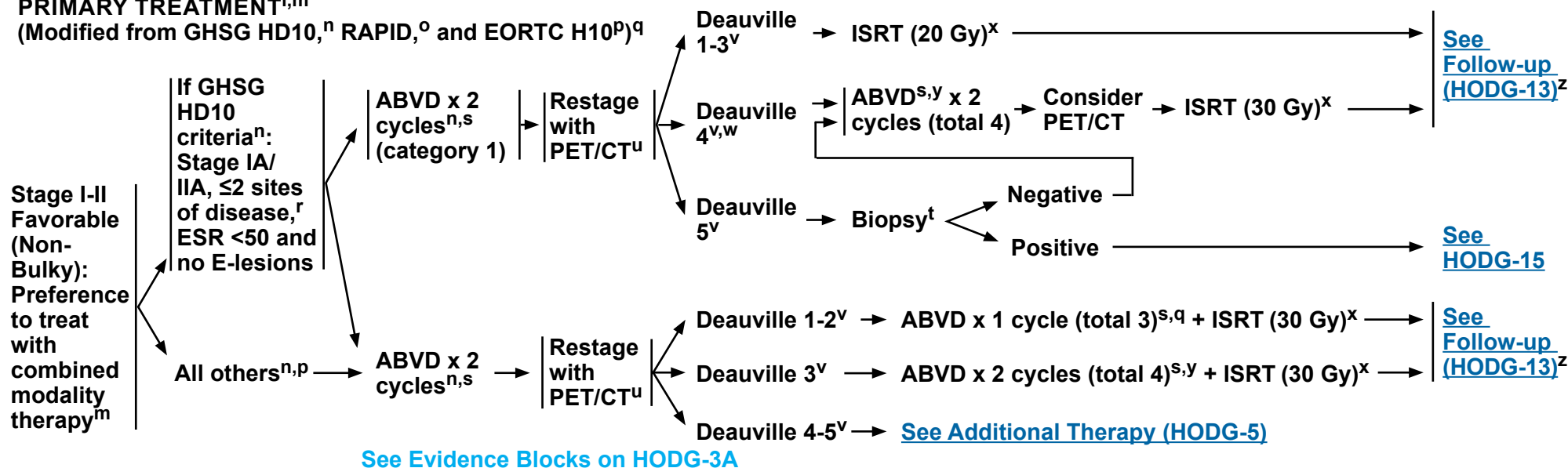
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**CLINICAL PRESENTATION:**  
**Classic Hodgkin Lymphoma<sup>h</sup>**

**Stage I, II Favorable (Non-Bulky)- Preference to Treat with Combined Modality Therapy**

**PRIMARY TREATMENT<sup>l,m</sup>**

**(Modified from GHSG HD10,<sup>n</sup> RAPID,<sup>o</sup> and EORTC H10<sup>p</sup>)<sup>q</sup>**



[See Evidence Blocks on HODG-3A](#)

**[Preference to treat with chemotherapy alone \(HODG-4\)](#)**

<sup>h</sup>CHL includes nodular sclerosis (NSHL), mixed cellularity (MCHL), lymphocyte-depleted (LDHL), and lymphocyte-rich (LRHL) subtypes. If grey-zone, [see NCCN Guidelines for B-Cell Lymphomas](#).

<sup>l</sup>Individualized treatment may be necessary for older patients and patients with concomitant disease. [See Management of Classic Hodgkin Lymphoma in Older Adults \(HODG-E\)](#).

<sup>m</sup>Other recommended primary therapy regimens include:  
 • Stanford V x 8 weeks + 30 Gy ISRT (Advani RH, et al. Ann Oncol 2013;24:1044-1048.)

<sup>n</sup>The GHSG HD10 trial did not use PET after ABVD x 2 cycles to define eligibility for ISRT. GHSG HD10 study: Engert A, et al. N Engl J Med 2010;363:640-652.

<sup>o</sup>RAPID study: Radford J et al. N Engl J Med 2015;372:1598-1607.

<sup>p</sup>EORTC/LYSA/FIL H10 Trial: Andre MPE, et al. J Clin Oncol 2017;35:1786-1794.

<sup>q</sup>In general these studies show an improvement in PFS for combined modality therapy, but no difference in overall survival.

<sup>r</sup>[See Definitions of Lymph Node Regions \(HODG-A\)](#).

<sup>s</sup>[See Principles of Systemic Therapy \(HODG-B\)](#).

<sup>t</sup>Biopsy recommended to differentiate refractory HL from discordant histology with appropriate action based upon results. If no biopsy is done, clinical judgment should define management.

<sup>u</sup>An integrated PET/CT or a PET with a diagnostic CT is recommended.

<sup>v</sup>[See PET 5-Point Scale \(Deauville Criteria\) \(HODG-D\)](#).

<sup>w</sup>Deauville 4 is often difficult to assess and treatment decisions will require clinical judgment ([See Discussion](#)).

<sup>x</sup>ISRT fields are generally smaller than IFRT fields. [See Principles of Radiation Therapy \(HODG-C\)](#).

<sup>y</sup>Consider PFTs after 4 cycles of ABVD.

<sup>z</sup>Complete response should be documented including reversion of PET to "negative" within 3 months following completion of therapy.

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**EVIDENCE BLOCKS FOR STAGE I-II FAVORABLE/NON-BULKY CLASSICAL HODGKIN LYMPHOMA  
(PREFERENCE TO TREAT WITH COMBINED MODALITY)**

STAGE	DEAUVILLE SCORE	PRIMARY TREATMENT	
<b>IA-IIA</b> Favorable (according to GHSG HD10 criteria)	1-3	ABVD x 2 cycles + ISRT	
	4-5	ABVD x 4 cycles + ISRT	
<b>I-II Favorable</b>	1-2	ABVD x 3 cycles + ISRT	
	3	ABVD x 4 cycles + ISRT	
	4	ABVD x 6 cycles + ISRT	
	4-5	ABVD x 2 cycles + Escalated BEACOPP x 4 cycles + ISRT	

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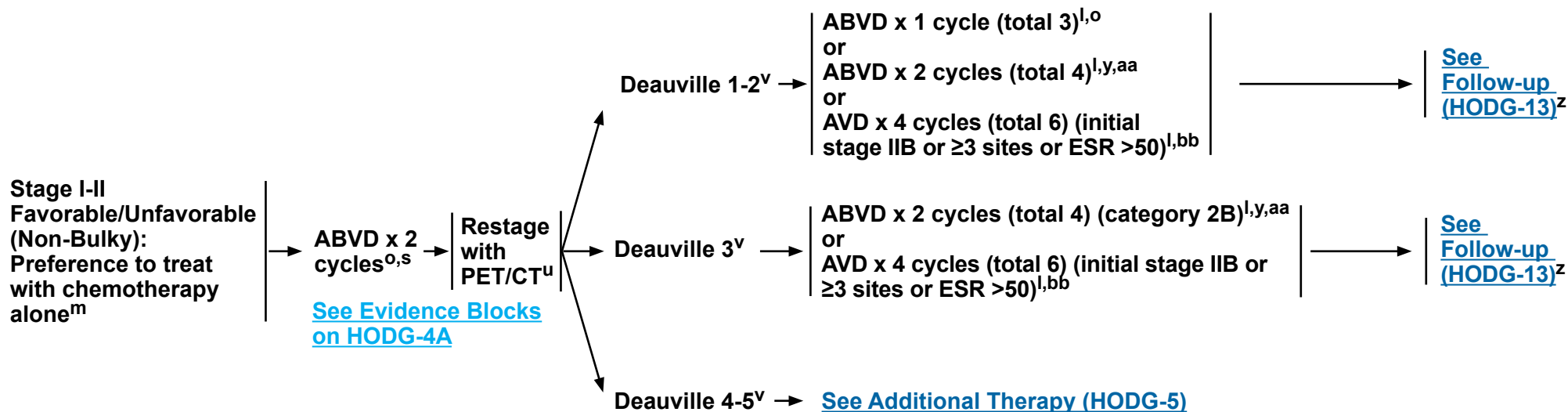
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**CLINICAL PRESENTATION:**  
**Classic Hodgkin Lymphoma<sup>h</sup>**

**Stage I, II Favorable/Unfavorable (Non-Bulky)- Preference to Treat with Chemotherapy Alone**

**PRIMARY TREATMENT<sup>l,m</sup>**

**(Modified from RAPID,<sup>o</sup> CALGB 50604,<sup>aa</sup> and RATHL<sup>bb</sup>)<sup>q</sup>**



**Preference to treat with combined modality therapy, see [favorable disease \(HODG-3\)](#); [unfavorable disease \(HODG-6\)](#)**

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<sup>l</sup>Individualized treatment may be necessary for older patients and patients with concomitant disease. [See Management of Classic Hodgkin Lymphoma in Older Adults \(HODG-E\)](#).

<sup>o</sup>RAPID study: Radford J et al. N Engl J Med 2015;372:1598-1607.

<sup>q</sup>In general these studies show an improvement in PFS for combined modality therapy, but no difference in overall survival.

<sup>s</sup>[See Principles of Systemic Therapy \(HODG-B\)](#).

<sup>u</sup>An integrated PET/CT or a PET with a diagnostic CT is recommended.

<sup>v</sup>[See PET 5-Point Scale \(Deauville Criteria\) \(HODG-D\)](#).

<sup>y</sup>Consider PFTs after 4 cycles of ABVD.

<sup>z</sup>Complete response should be documented including reversion of PET to "negative" within 3 months following completion of therapy.

<sup>aa</sup>CALGB 50604: Straus DJ, et al. Blood 2018;132:1013-1021.

<sup>bb</sup>RATHL study: Johnson PW, et al. N Engl J Med 2016;374:2419-2429.

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	E	S	Q	C	A

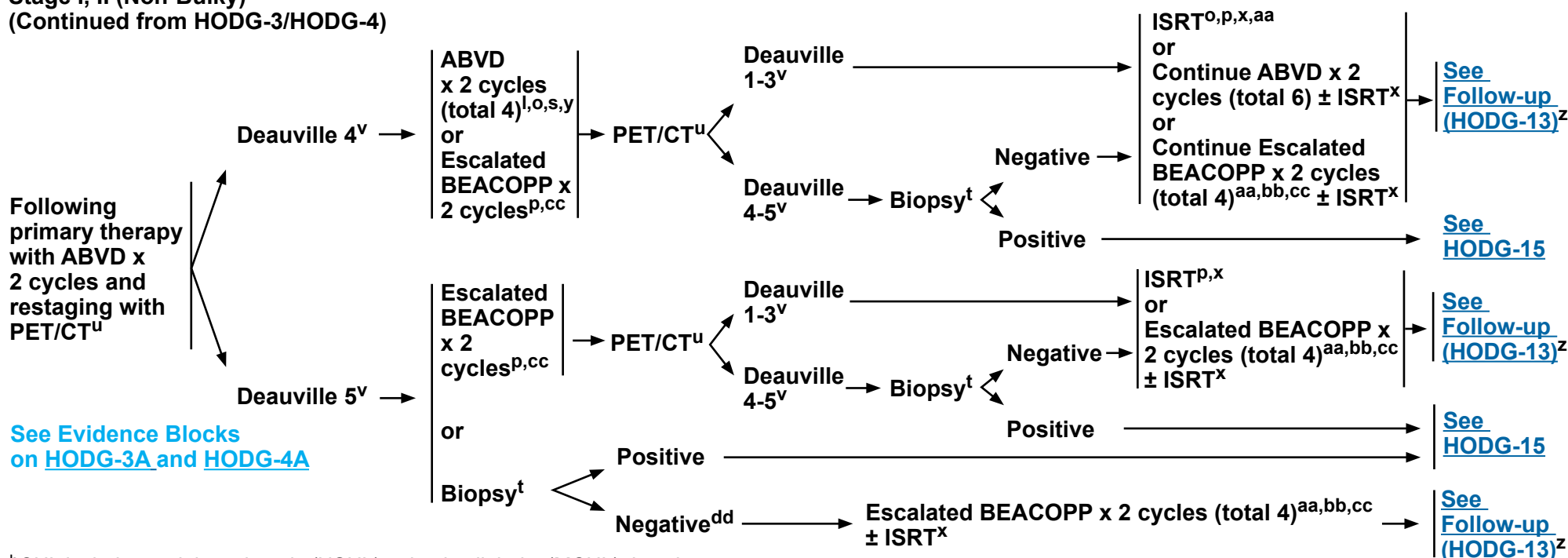
**EVIDENCE BLOCKS FOR STAGE I-II FAVORABLE/UNFAVORABLE NON-BULKY CLASSICAL HODGKIN LYMPHOMA  
(PREFERENCE TO TREAT WITH CHEMOTHERAPY ALONE)**

STAGE	DEAUVILLE SCORE	PRIMARY TREATMENT	
I-II Favorable/Unfavorable	1-2	ABVD x 3 cycles	
		ABVD X 4 cycles	
		ABVD x 2 cycles + AVD x 4 cycles (initial stage IIB or ≥3 sites or ESR>50)	
	3	ABVD x 4 cycles (category 2B)	
		ABVD x 2 cycles + AVD x 4 cycles (initial stage IIB or ≥3 sites or ESR>50)	
	4	ABVD x 6 cycles	

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**CLINICAL PRESENTATION:**  
**Classic Hodgkin Lymphoma<sup>h</sup>**  
**Stage I, II (Non-Bulky)**  
**(Continued from HODG-3/HODG-4)**

**ADDITIONAL THERAPY<sup>l</sup>**  
**(Modified from RAPID,<sup>o</sup> EORTC H10,<sup>p</sup> CALGB 50604,<sup>aa</sup> and RATHL<sup>bb</sup>)<sup>q</sup>**



See Evidence Blocks on [HODG-3A](#) and [HODG-4A](#)

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<sup>l</sup>Individualized treatment may be necessary for older patients and patients with concomitant disease. [See Management of Classic Hodgkin Lymphoma in Older Adults \(HODG-E\)](#).

<sup>o</sup>RAPID Trial: Radford J et al. N Engl J Med 2015;372:1598-1607.

<sup>p</sup>EORTC/LYSA/FIL H10 Trial: Andre MPE, et al. J Clin Oncol 2017;35:1786-1794.

<sup>q</sup>In general these studies show an improvement in PFS for combined modality therapy, but no difference in overall survival.

<sup>s</sup>[See Principles of Systemic Therapy \(HODG-B\)](#).

<sup>t</sup>Biopsy recommended to differentiate refractory HL from discordant histology with appropriate action based upon results. If no biopsy is done, clinical judgment should define management.

<sup>u</sup>An integrated PET/CT or a PET with a diagnostic CT is recommended.

<sup>v</sup>[See PET 5-Point Scale \(Deauville Criteria\) \(HODG-D\)](#).

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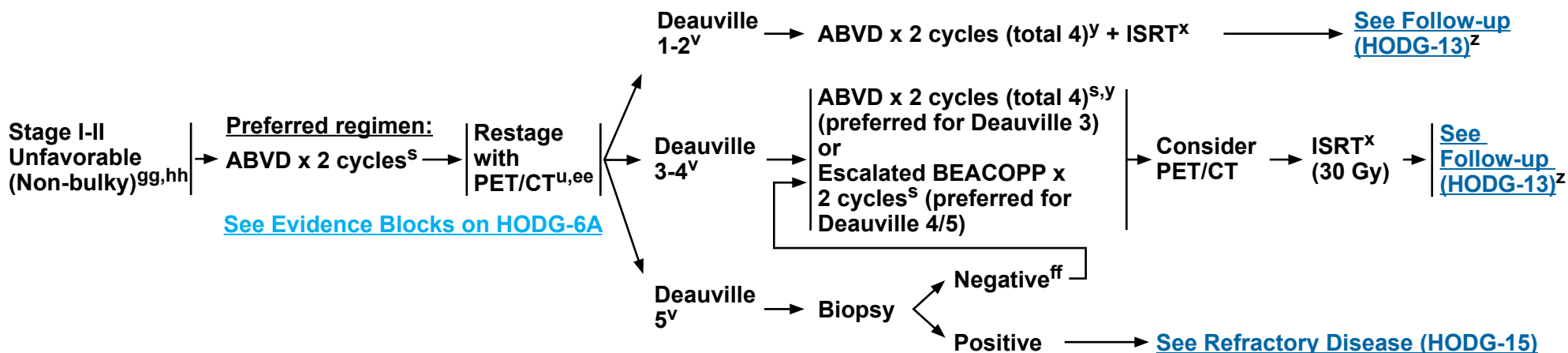
<sup>bb</sup>RATHL study: Johnson PW, et al. N Engl J Med 2016;374:2419-2429.

<sup>cc</sup>Escalated BEACOPP is only an option for those aged <60 years.

<sup>dd</sup>Use clinical judgment to determine if tissue specimen is adequate for accurate biopsy results. Confirm clinically that patient is not progressing symptomatically.

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**CLINICAL PRESENTATION:**  
**Classic Hodgkin Lymphoma<sup>h</sup>**  
**Stage I-II Unfavorable (Non-bulky)- Preference to Treat with Combined Modality Therapy**  
**PRIMARY TREATMENT<sup>l</sup>**  
**(Modified from EORTC H10<sup>p</sup>)**



**Preference to treat with chemotherapy alone (HODG-4)**

<sup>h</sup>CHL includes nodular sclerosis (NSHL), mixed cellularity (MCHL), lymphocyte-depleted (LDHL), and lymphocyte-rich (LRHL) subtypes. If grey-zone, [see NCCN Guidelines for B-Cell Lymphomas](#).

<sup>l</sup>Individualized treatment may be necessary for older patients and patients with concomitant disease. [See Management of Classic Hodgkin Lymphoma in Older Adults \(HODG-E\)](#).

<sup>p</sup>EORTC/LYSA/FIL H10 Trial: Andre MPE, et al. J Clin Oncol 2017;35:1786-1794.

<sup>s</sup>[See Principles of Systemic Therapy \(HODG-B\)](#).

<sup>u</sup>An integrated PET/CT or a PET with a diagnostic CT is recommended.

<sup>v</sup>[See PET 5-Point Scale \(Deauville Criteria\) \(HODG-D\)](#).

<sup>x</sup>ISRT fields are generally smaller than IFRT fields. [See Principles of Radiation Therapy \(HODG-C\)](#).

<sup>y</sup>Consider PFTs after 4 cycles of ABVD.

<sup>z</sup>Complete response should be documented including reversion of PET to "negative" within 3 months following completion of therapy.

<sup>ee</sup>The value of interim PET imaging is unclear for many clinical scenarios. All measures of response should be considered in the context of management decisions.

<sup>ff</sup>Use clinical judgment to determine if tissue specimen is adequate for accurate biopsy results. Confirm clinically that patient is not progressing symptomatically.

<sup>gg</sup>Other recommended primary therapy regimens include:

- Stanford V x 12 weeks + 30 Gy ISRT (Gordon LI, et al. J Clin Oncol 2013;31:684-691.)
- If GHSG HD14 unfavorable ([see HODG-A](#)): Escalated BEACOPP x 2 cycles followed by ABVD x 2 cycles + 30 Gy ISRT (von Tresckow B, et al. J Clin Oncol 2012;30:907-913.)

<sup>hh</sup>For this algorithm, NCCN unfavorable factors include B symptoms, ESR ≥50, and >3 sites of disease.

**Note: For more information regarding the categories and definitions used for the NCCN Evidence Blocks™, see page EB-1.**  
**All recommendations are category 2A unless otherwise indicated.**  
**Clinical Trials: NCCN believes that the best management of any patient with cancer is in a clinical trial. Participation in clinical trials is especially encouraged.**



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	E	S	Q	C	A

**EVIDENCE BLOCKS FOR STAGE I-II UNFAVORABLE NON-BULKY/CLASSICAL HODGKIN LYMPHOMA  
(PREFERENCE TO TREAT WITH COMBINED MODALITY)**

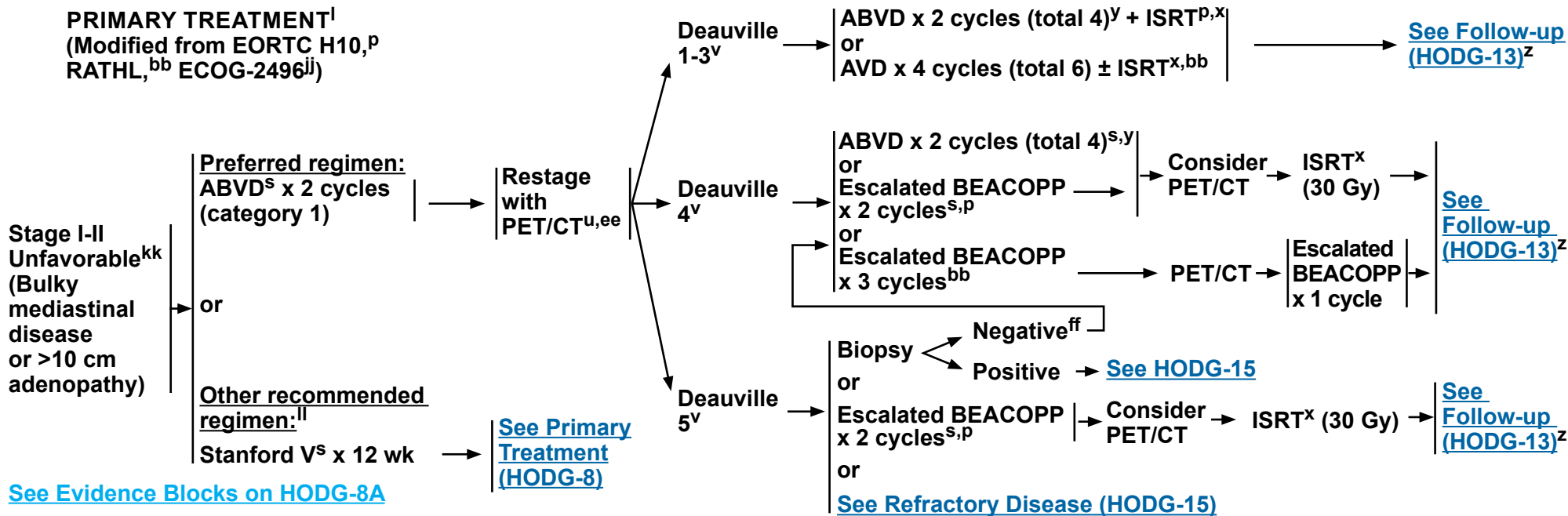
STAGE	DEAUVILLE SCORE	PRIMARY TREATMENT	
I-II Unfavorable	1-2	ABVD x 4 cycles + ISRT	
	3-4 and 5, if biopsy-negative	ABVD x 4 cycles + ISRT (preferred for Deauville 3)	
		ABVD x 2 cycles + escalated BEACOPP x 2 cycles + ISRT (preferred for Deauville 4-5)	

**Note:** For more information regarding the categories and definitions used for the NCCN Evidence Blocks™, see page [EB-1](#).

All recommendations are category 2A unless otherwise indicated.

Clinical Trials: NCCN believes that the best management of any patient with cancer is in a clinical trial. Participation in clinical trials is especially encouraged.

**CLINICAL PRESENTATION:**  
**Classic Hodgkin Lymphoma<sup>h</sup>**  
**Stage I-II Unfavorable<sup>kk</sup> (Bulky mediastinal disease or >10 cm adenopathy)**  
**Planned Combined Modality Therapy**



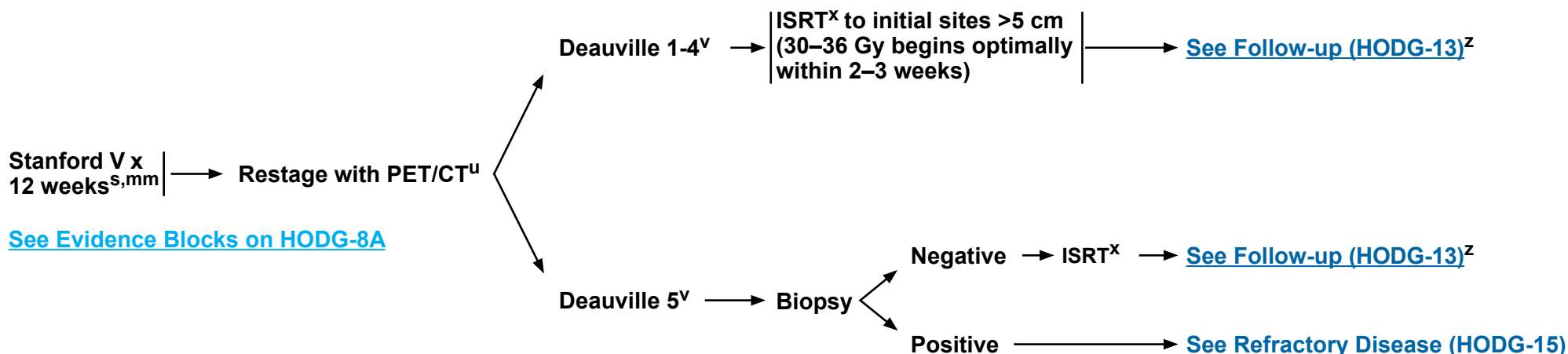
<sup>h</sup>CHL includes nodular sclerosis (NSHL), mixed cellularity (MCHL), lymphocyte-depleted (LDHL), and lymphocyte-rich (LRHL) subtypes. If grey-zone, [see NCCN Guidelines for B-Cell Lymphomas](#).  
<sup>l</sup>Individualized treatment may be necessary for older patients and patients with concomitant disease. [See Management of Classic Hodgkin Lymphoma in Older Adults \(HODG-E\)](#).  
<sup>p</sup>EORTC/LYSA/FIL H10 Trial: Andre MPE, et al. J Clin Oncol 2017;35:1786-1794.  
<sup>s</sup>[See Principles of Systemic Therapy \(HODG-B\)](#).  
<sup>u</sup>An integrated PET/CT or a PET with a diagnostic CT is recommended.  
<sup>v</sup>[See PET 5-Point Scale \(Deauville Criteria\) \(HODG-D\)](#).  
<sup>x</sup>ISRT fields are generally smaller than IFRT fields. [See Principles of Radiation Therapy \(HODG-C\)](#).  
<sup>y</sup>Consider PFTs after 4 cycles of ABVD.

<sup>z</sup>Complete response should be documented including reversion of PET to "negative" within 3 months following completion of therapy.  
<sup>bb</sup>RATHL study: Johnson PW, et al. N Engl J Med 2016;374:2419-2429.  
<sup>ee</sup>The value of interim PET imaging is unclear for many clinical scenarios. All measures of response should be considered in the context of management decisions.  
<sup>jj</sup>ECOG-2496: Gordon LI, et al. J Clin Oncol 2013;31:684-691.  
<sup>kk</sup>NCCN Unfavorable Factors include bulky mediastinal or >10 cm disease, B symptoms, ESR ≥50, and >3 sites of disease ([see HODG-A](#)).  
<sup>ll</sup>Other recommended regimens if GHSG HD14 unfavorable ([see HODG-A](#)): Escalated BEACOPP x 2 cycles followed by ABVD x 2 cycles + 30 Gy ISRT (von Tresckow B, et al. J Clin Oncol 2012;30:907-913). Patients with B symptoms in combination with bulky or extranodal disease were excluded and treated according to the algorithm for stage III-IV disease ([HODG-10](#)).

**Note: For more information regarding the categories and definitions used for the NCCN Evidence Blocks™, see page EB-1.**  
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 Clinical Trials: NCCN believes that the best management of any patient with cancer is in a clinical trial. Participation in clinical trials is especially encouraged.

**CLINICAL PRESENTATION:**  
**Classic Hodgkin Lymphoma<sup>h</sup>**  
**Stage I-II Unfavorable<sup>kk</sup> (Bulky mediastinal disease or >10 cm adenopathy)**

**PRIMARY TREATMENT<sup>l</sup>**  
**(continued from HODG-7)**  
**(Modified from ECOG-2496<sup>jj</sup>)**



[See Evidence Blocks on HODG-8A](#)

<sup>h</sup>CHL includes nodular sclerosis (NSHL), mixed cellularity (MCHL), lymphocyte-depleted (LDHL), and lymphocyte-rich (LRHL) subtypes. If grey-zone, [see NCCN Guidelines for B-Cell Lymphomas](#).

<sup>l</sup>Individualized treatment may be necessary for older patients and patients with concomitant disease. [See Management of Classic Hodgkin Lymphoma in Older Adults \(HODG-E\)](#).

<sup>s</sup>[See Principles of Systemic Therapy \(HODG-B\)](#).

<sup>u</sup>An integrated PET/CT or a PET with a diagnostic CT is recommended.

<sup>v</sup>[See PET 5-Point Scale \(Deauville Criteria\) \(HODG-D\)](#).

<sup>x</sup>ISRT fields are generally smaller than IFRT fields. [See Principles of Radiation Therapy \(HODG-C\)](#).

<sup>z</sup>Complete response should be documented including reversion of PET to "negative" within 3 months following completion of therapy.

<sup>jj</sup>ECOG-2496: Gordon LI, et al. J Clin Oncol 2013;31:684-691.

<sup>kk</sup>NCCN Unfavorable Factors include bulky mediastinal or >10 cm disease, B symptoms, ESR ≥50, and >3 sites of disease ([see HODG-A](#)).

<sup>mm</sup>The Stanford V regimen is used in this fashion for patients with bulky mediastinal disease or >10 cm disease and/or B symptoms. Patients with elevated ESR, and/or >3 sites in absence of bulky disease are treated according to the Stanford V regimen listed in footnote m on HODG-3.

**Note: For more information regarding the categories and definitions used for the NCCN Evidence Blocks™, see page EB-1.**  
**All recommendations are category 2A unless otherwise indicated.**  
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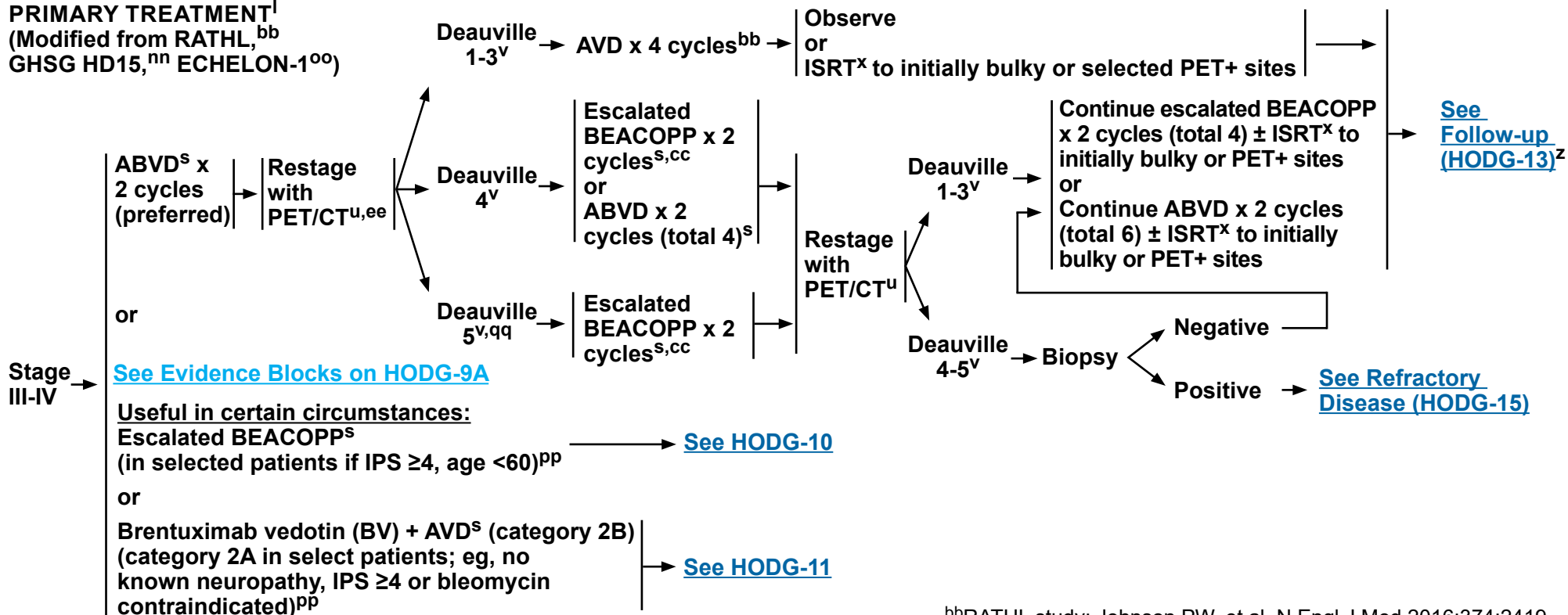
**EVIDENCE BLOCKS FOR STAGE I-II UNFAVORABLE BULKY CLASSICAL HODGKIN LYMPHOMA  
(PLANNED COMBINED MODALITY THERAPY)**

STAGE	DEAUVILLE SCORE	PRIMARY TREATMENT	
I-II Unfavorable Bulky mediastinal disease/>10 cm adenopathy	1-3	ABVD x 4 cycles + ISRT	
		ABVD x 2 cycles + AVD x 4 cycles	
		ABVD x 2 cycles + AVD x 4 cycles + ISRT	
	4 and 5, if biopsy-negative	ABVD x 4 cycles + ISRT	
		ABVD x 2 cycles + escalated BEACOPP x 2 cycles + ISRT	
		ABVD x 2 cycles + escalated BEACOPP x 4 cycles	
	5	ABVD x 2 cycles + escalated BEACOPP x 2 cycles + ISRT	
	1-5	Stanford V x 12 weeks + ISRT to sites >5 cm	
		Escalated BEACOPP x 2 cycles + ABVD x 2 cycles + ISRT	

**Note:** For more information regarding the categories and definitions used for the NCCN Evidence Blocks™, see page [EB-1](#).  
All recommendations are category 2A unless otherwise indicated.  
Clinical Trials: NCCN believes that the best management of any patient with cancer is in a clinical trial. Participation in clinical trials is especially encouraged.

**CLINICAL PRESENTATION:**  
**Classic Hodgkin Lymphoma<sup>h</sup>**  
**Stage III-IV**

**PRIMARY TREATMENT<sup>l</sup>**  
**(Modified from RATHL,<sup>bb</sup>**  
**GHSG HD15,<sup>nn</sup> ECHELON-1<sup>oo</sup>)**



<sup>h</sup>CHL includes nodular sclerosis (NSHL), mixed cellularity (MCHL), lymphocyte-depleted (LDHL), and lymphocyte-rich (LRHL) subtypes. If grey-zone, [see NCCN Guidelines for B-Cell Lymphomas](#).

<sup>l</sup>Individualized treatment may be necessary for older patients and patients with concomitant disease. [See Management of Classic Hodgkin Lymphoma in Older Adults \(HODG-E\)](#).

<sup>s</sup>[See Principles of Systemic Therapy \(HODG-B\)](#).

<sup>u</sup>An integrated PET/CT or a PET with a diagnostic CT is recommended.

<sup>v</sup>[See PET 5-Point Scale \(Deauville Criteria\) \(HODG-D\)](#).

<sup>x</sup>ISRT fields are generally smaller than IFRT fields. [See Principles of Radiation Therapy \(HODG-C\)](#).

<sup>z</sup>Complete response should be documented including reversion of PET to "negative" within 3 months following completion of therapy.

<sup>bb</sup>RATHL study: Johnson PW, et al. N Engl J Med 2016;374:2419-2429.

<sup>cc</sup>Escalated BEACOPP is only an option for those aged <60 years.

<sup>ee</sup>The value of interim PET imaging is unclear for many clinical scenarios. All measures of response should be considered in the context of management decisions.

<sup>nn</sup>GHSG HD15 trial: Engert A, et al. Lancet 2012;379(9828):1791-1799.

<sup>oo</sup>ECHELON-1: Connors JM, et al. NEJM 2018;374(4):331-344.

<sup>pp</sup>[See International Prognostic Score \(IPS\) \(HODG-A\)](#).

<sup>qq</sup>For Deauville 5, strongly consider biopsy of new sites of disease.

**Note: For more information regarding the categories and definitions used for the NCCN Evidence Blocks™, see page EB-1.**  
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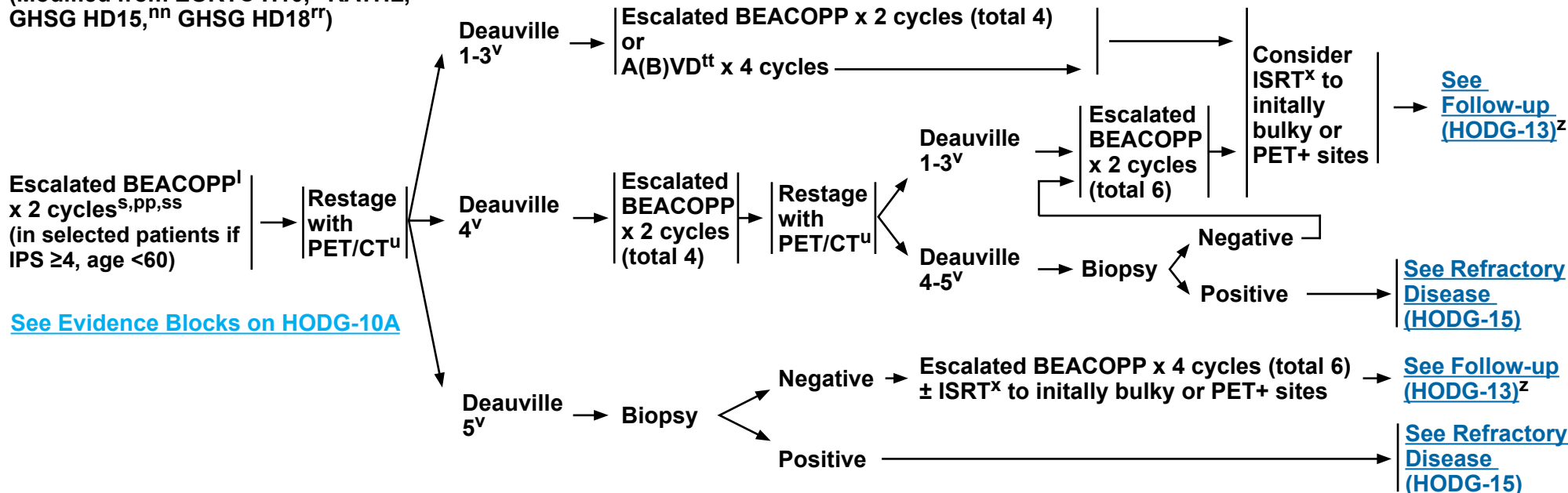
**EVIDENCE BLOCKS FOR STAGE III-IV CLASSICAL HODGKIN LYMPHOMA**

STAGE	DEAUVILLE SCORE	PRIMARY TREATMENT	
III-IV	1-3	ABVD x 2 cycles + AVD x 4 cycles	
		ABVD x 2 cycles + AVD x 4 cycles + ISRT	
	4	ABVD x 6 cycles	
		ABVD x 6 cycles + ISRT	
	4-5	ABVD x 2 cycles + escalated BEACOPP x 4 cycles	
		ABVD x 2 cycles + escalated BEACOPP x 4 cycles + ISRT	

**Note:** For more information regarding the categories and definitions used for the NCCN Evidence Blocks™, see page [EB-1](#).  
All recommendations are category 2A unless otherwise indicated.  
Clinical Trials: NCCN believes that the best management of any patient with cancer is in a clinical trial. Participation in clinical trials is especially encouraged.

**CLINICAL PRESENTATION:**  
**Classic Hodgkin Lymphoma<sup>h</sup>**  
**Stage III-IV**

**PRIMARY TREATMENT<sup>l</sup>**  
 (continued from HODG-9)  
 (Modified from EORTC H10,<sup>p</sup> RATHL,<sup>bb</sup>  
 GHSG HD15,<sup>nn</sup> GHSG HD18<sup>rr</sup>)



<sup>h</sup>CHL includes nodular sclerosis (NSHL), mixed cellularity (MCHL), lymphocyte-depleted (LDHL), and lymphocyte-rich (LRHL) subtypes. If grey-zone, [see NCCN Guidelines for B-Cell Lymphomas](#).

<sup>l</sup>Individualized treatment may be necessary for older patients and patients with concomitant disease. [See Management of Classic Hodgkin Lymphoma in Older Adults \(HODG-E\)](#).

<sup>p</sup>EORTC/LYSA/FIL H10 Trial: Andre MPE, et al. J Clin Oncol 2017;35:1786-1794.

<sup>s</sup>[See Principles of Systemic Therapy \(HODG-B\)](#).

<sup>u</sup>An integrated PET/CT or a PET with a diagnostic CT is recommended.

<sup>v</sup>[See PET 5-Point Scale \(Deauville Criteria\) \(HODG-D\)](#).

<sup>x</sup>ISRT fields are generally smaller than IFRT fields. [See Principles of Radiation Therapy \(HODG-C\)](#).

<sup>z</sup>Complete response should be documented including reversion of PET to "negative" within 3 months following completion of therapy.

<sup>bb</sup>RATHL study: Johnson PW, et al. N Engl J Med 2016;374:2419-2429.

<sup>nn</sup>GHSG HD15 trial: Engert A, et al. Lancet 2012; 379(9828):1791-1799.

<sup>pp</sup>[See International Prognostic Score \(IPS\) \(HODG-A\)](#).

<sup>rr</sup>GHSG HD18: Borchmann P, et al. Lancet 2018;390(10114):2790-2802.

<sup>ss</sup>Interim restaging with PET/CT may be considered after 2 cycles of escalated BEACOPP with a possible de-escalation of therapy (4 cycles of ABVD) in patients with a negative interim PET/CT. (Avigdor A, et al. Ann Oncol 2010;21:126-132.)

<sup>tt</sup>Bleomycin is optional.

**Note: For more information regarding the categories and definitions used for the NCCN Evidence Blocks™, see page EB-1.**

**All recommendations are category 2A unless otherwise indicated.**

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# NCCN Guidelines Version 2.2019 Hodgkin Lymphoma (Age ≥18 years) NCCN Evidence Blocks™

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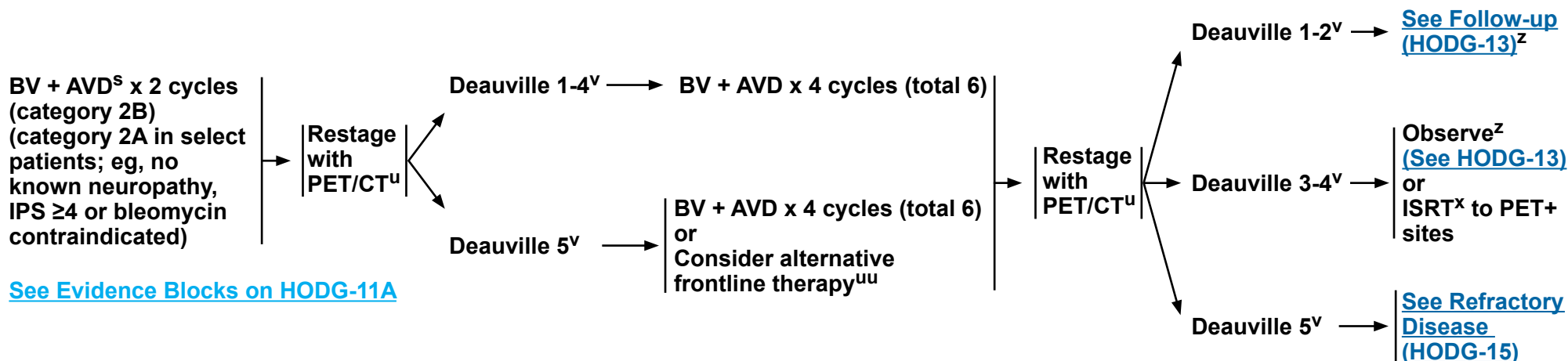
## EVIDENCE BLOCKS FOR STAGE III-IV CLASSICAL HODGKIN LYMPHOMA (IN SELECT PATIENTS IF: IPS ≥4, AGE <60 years)

STAGE	DEAUVILLE SCORE	PRIMARY TREATMENT	
III-IV (in select patients if IPS ≥4, age <60 years)	1-3	Escalated BEACOPP x 4 cycles + ISRT	
		Escalated BEACOPP x 2 cycles + ABVD x 4 cycles + ISRT	
		Escalated BEACOPP x 2 cycles + AVD x 4 cycles + ISRT	
	4	Escalated BEACOPP x 6 cycles + ISRT	
	5, if biopsy-negative	Escalated BEACOPP x 6 cycles	
		Escalated BEACOPP x 6 cycles + ISRT	

**Note:** For more information regarding the categories and definitions used for the NCCN Evidence Blocks™, see page [EB-1](#).  
All recommendations are category 2A unless otherwise indicated.  
Clinical Trials: NCCN believes that the best management of any patient with cancer is in a clinical trial. Participation in clinical trials is especially encouraged.

**CLINICAL PRESENTATION:**  
**Classic Hodgkin Lymphoma<sup>h</sup>**  
**Stage III-IV**

**PRIMARY TREATMENT<sup>i</sup>**  
**(continued from HODG-9)**  
**(Modified from ECHELON-1 Trial)<sup>oo</sup>**



[See Evidence Blocks on HODG-11A](#)

<sup>h</sup>CHL includes nodular sclerosis (NSHL), mixed cellularity (MCHL), lymphocyte-depleted (LDHL), and lymphocyte-rich (LRHL) subtypes. If grey-zone, [see NCCN Guidelines for B-Cell Lymphomas](#).

<sup>i</sup>Individualized treatment may be necessary for older patients and patients with concomitant disease. [See Management of Classic Hodgkin Lymphoma in Older Adults \(HODG-E\)](#).

<sup>s</sup>[See Principles of Systemic Therapy \(HODG-B\)](#).

<sup>u</sup>An integrated PET/CT or a PET with a diagnostic CT is recommended.

<sup>v</sup>[See PET 5-Point Scale \(Deauville Criteria\) \(HODG-D\)](#).

<sup>x</sup>ISRT fields are generally smaller than IFRT fields. [See Principles of Radiation Therapy \(HODG-C\)](#).

<sup>z</sup>Complete response should be documented including reversion of PET to "negative" within 3 months following completion of therapy.

<sup>oo</sup>ECHELON-1: Connors JM, et al. NEJM 2018;374(4):331-344.

<sup>uu</sup>Options may include escalated BEACOPP (category 2B) or therapy for refractory disease ([see HODG-15](#)).

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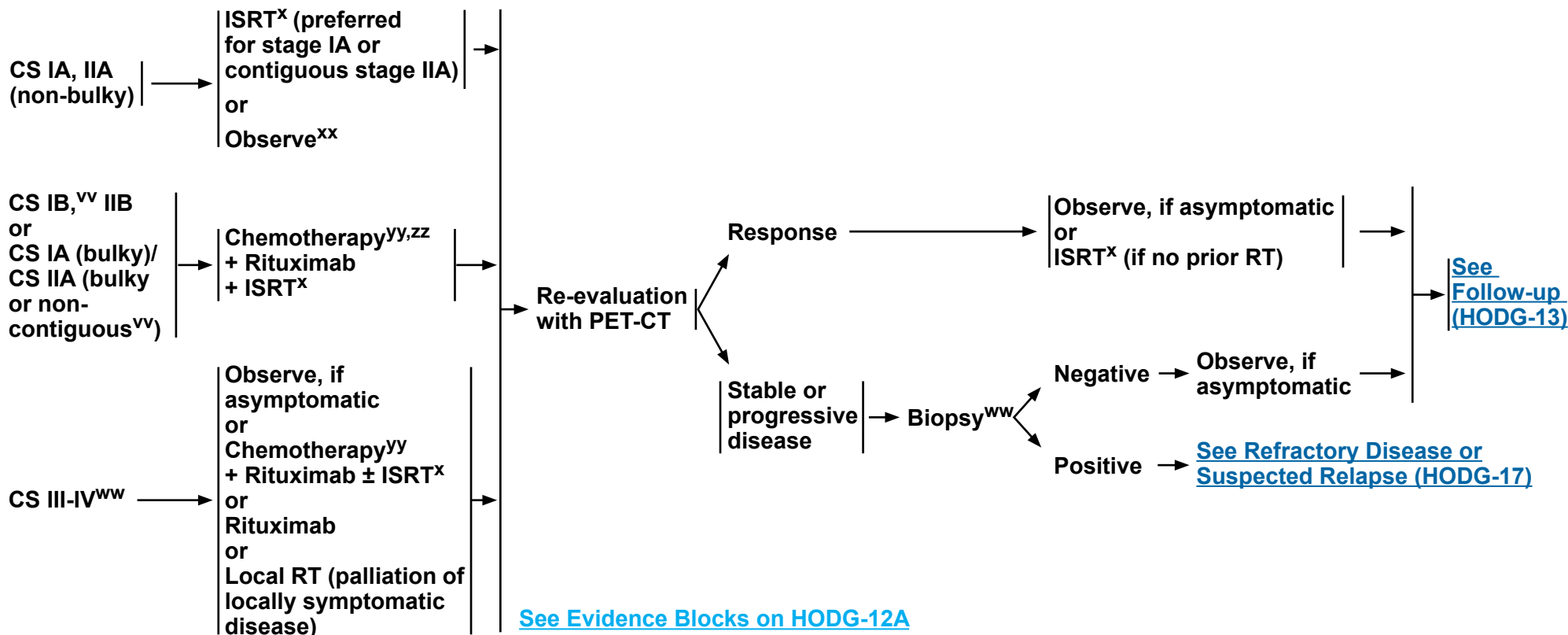
**EVIDENCE BLOCKS FOR STAGE III-IV CLASSICAL HODGKIN LYMPHOMA  
(IN SELECT PATIENTS, EG: NO KNOWN NEUROPATHY, IPS ≥4, OR BLEOMYCIN CONTRAINDICATED)**

STAGE	DEAUVILLE SCORE	PRIMARY TREATMENT	
III-IV (in select patients, eg, no known neuropathy, IPS ≥4, or bleomycin contraindicated)	1-5	Brentuximab vedotin (BV) + AVD (6 cycles)	
		BV + AVD (6 cycles) + ISRT to PET+ sites	

**Note:** For more information regarding the categories and definitions used for the NCCN Evidence Blocks™, see page [EB-1](#).  
All recommendations are category 2A unless otherwise indicated.  
Clinical Trials: NCCN believes that the best management of any patient with cancer is in a clinical trial. Participation in clinical trials is especially encouraged.

**CLINICAL PRESENTATION:**  
**Nodular Lymphocyte-Predominant Hodgkin Lymphoma<sup>i</sup>**

**PRIMARY TREATMENT**



<sup>i</sup>NLPHL has a different natural history and response to therapy than CHL, especially stages I-II. For that reason, separate guidelines are presented for NLPHL. Patients who present with bulky disease, subdiaphragmatic disease, or splenic involvement have a high risk for initial or later transformation to large cell lymphoma. Data suggest outcomes differ for typical immunoarchitectural patterns (A/B) versus variant patterns (C/D/E/F).

<sup>x</sup>ISRT fields are generally smaller than IFRT fields. [See Principles of Radiation Therapy \(HODG-C\)](#).

<sup>vv</sup>For select patients with CS IB, or CS IIA non-contiguous disease, ISRT alone may be an option.

<sup>ww</sup>Consider biopsy of persistent or new subdiaphragmatic sites to rule out transformation.

<sup>xx</sup>Observation may be an option for stage IA patients with a completely excised solitary lymph node. [See Follow-up \(HODG-13\)](#).

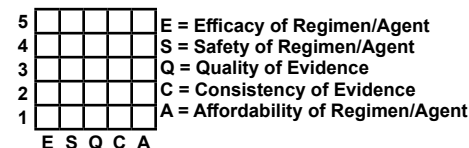
<sup>yy</sup>[See Principles of Systemic Therapy \(HODG-B 2 of 4\)](#).

<sup>zz</sup>Generally a brief course of chemotherapy (3–4 months) would be given with radiation therapy.

**Note: For more information regarding the categories and definitions used for the NCCN Evidence Blocks™, see page EB-1.**

**All recommendations are category 2A unless otherwise indicated.**

**Clinical Trials: NCCN believes that the best management of any patient with cancer is in a clinical trial. Participation in clinical trials is especially encouraged.**



**EVIDENCE BLOCKS FOR NODULAR LYMPHOCYTE-PREDOMINANT HODGKIN LYMPHOMA**

PRIMARY TREATMENT	STAGE		
	CS IA*, IIA*,**	CS IB, IIB	CS III, IV
ABVD/Rituximab	—	—	
ABVD/Rituximab + ISRT			
CHOP/Rituximab	—	—	
CHOP/Rituximab + ISRT			
CVP/Rituximab	—	—	
CVP/Rituximab + ISRT			
Rituximab	—	—	
Rituximab + ISRT	—	—	

\*Bulky

\*\*Noncontiguous

**Note:** For more information regarding the categories and definitions used for the NCCN Evidence Blocks™, see page [EB-1](#).

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**FOLLOW-UP AFTER COMPLETION OF TREATMENT AND MONITORING FOR LATE EFFECTS**

- Complete response should be documented including reversion of PET to "negative" within 3 months following completion of therapy.
- It is recommended that the patient be provided with a treatment summary at the completion of his/her therapy, including details of radiation therapy (RT), organs at risk (OARs), and cumulative anthracycline dosage given.
- Follow-up with an oncologist is recommended and should be coordinated with the primary care provider, especially during the first 5 years after treatment to detect recurrence, and then annually due to the risk of late complications including second cancers and cardiovascular disease ([see NCCN Guidelines for Survivorship](#)).<sup>aaa,bbb</sup> Late relapse or transformation to large cell lymphoma may occur in NLPHL.
- The frequency and types of tests may vary depending on clinical circumstances: age and stage at diagnosis, social habits, treatment modality, etc. There are few data to support specific recommendations; these represent the range of practice at NCCN Member Institutions.

**Follow-up After Completion of Treatment up to 5 Years**

- Interim H&P: Every 3–6 mo for 1–2 y, then every 6–12 mo until year 3, then annually
- Annual influenza vaccine and other vaccines as clinically indicated ([see NCCN Guidelines for Survivorship](#))
- Laboratory studies:
  - ▶ CBC, platelets, ESR (if elevated at time of initial diagnosis), chemistry profile as clinically indicated.
  - ▶ Thyroid-stimulating hormone (TSH) at least annually if RT to neck.
- Acceptable to obtain a neck/chest/abdomen/pelvis CT scan with contrast at 6, 12, and 24 mo following completion of therapy, or as clinically indicated. PET/CT only if last PET was Deauville 4-5, to confirm complete response.
- Counseling: Reproduction, health habits, psychosocial, cardiovascular, breast self-exam, skin cancer risk, end-of-treatment discussion.
- Surveillance PET should not be done routinely due to risk for false positives. Management decisions should not be based on PET scan alone; clinical or pathologic correlation is needed.

Suspected Relapse CHL ([HODG-16](#)) or NLPHL ([HODG-17](#))[Follow-Up and Monitoring After 5 Years \(HODG-14\)](#)

<sup>aaa</sup>Mauch P, Ng A, Aleman B, et al. Report from the Rockefeller Foundation-sponsored International Workshop on reducing mortality and improving quality of life in long-term survivors of Hodgkin's disease: July 9-16, 2003, Bellagio, Italy. Eur J Haematol 2005;75(s66).

<sup>bbb</sup>Appropriate medical management should be instituted for any abnormalities.

**Note: For more information regarding the categories and definitions used for the NCCN Evidence Blocks™, see page [EB-1](#).**

**All recommendations are category 2A unless otherwise indicated.**

**Clinical Trials: NCCN believes that the best management of any patient with cancer is in a clinical trial. Participation in clinical trials is especially encouraged.**

**FOLLOW-UP AFTER COMPLETION OF TREATMENT AND MONITORING FOR LATE EFFECTS****Follow-up and Monitoring After 5 Years**<sup>aaa,bbb</sup>

- **Interim H&P: Annually**
  - ▶ Annual blood pressure, aggressive management of cardiovascular risk factors
  - ▶ Pneumococcal, meningococcal, and Haemophilus influenzae type b revaccination after 5–7 y, if patient treated with splenic RT or previous splenectomy (according to CDC recommendations)
  - ▶ Annual influenza vaccine and other vaccines as clinically indicated ([see NCCN Guidelines for Survivorship](#))
- **Cardiovascular symptoms may emerge at a young age.**
  - ▶ Consider stress test/ECHO at 10-y intervals after treatment is completed.
  - ▶ Consider carotid ultrasound at 10-y intervals if neck irradiation.
- **Laboratory studies:**
  - ▶ CBC, platelets, chemistry profile annually
  - ▶ TSH at least annually if RT to neck
  - ▶ Biannual lipids
  - ▶ Annual fasting glucose
- **Annual breast screening: Initiate 8–10 y post-therapy, or at age 40, whichever comes first, if chest or axillary radiation. The NCCN Hodgkin Lymphoma Guidelines Panel recommends breast MRI in addition to mammography for women who received irradiation to the chest between ages 10–30 y, which is consistent with the American Cancer Society (ACS) Guidelines. Consider referral to a breast specialist.**
- **Perform other routine surveillance tests for cervical, colorectal, endometrial, lung, and prostate cancer as per the NCCN Guidelines for Detection, Prevention, and Risk Reduction and the ACS Cancer Screening Guidelines.**
- **Counseling: Reproduction, health habits, psychosocial, cardiovascular, breast self-exam, and skin cancer risk.**
- **Treatment summary and consideration of transfer to PCP.**
- **Consider a referral to a survivorship clinic.**
- **Screening for secondary cancers as clinically indicated ([See NCCN Guidelines for Survivorship](#)).**

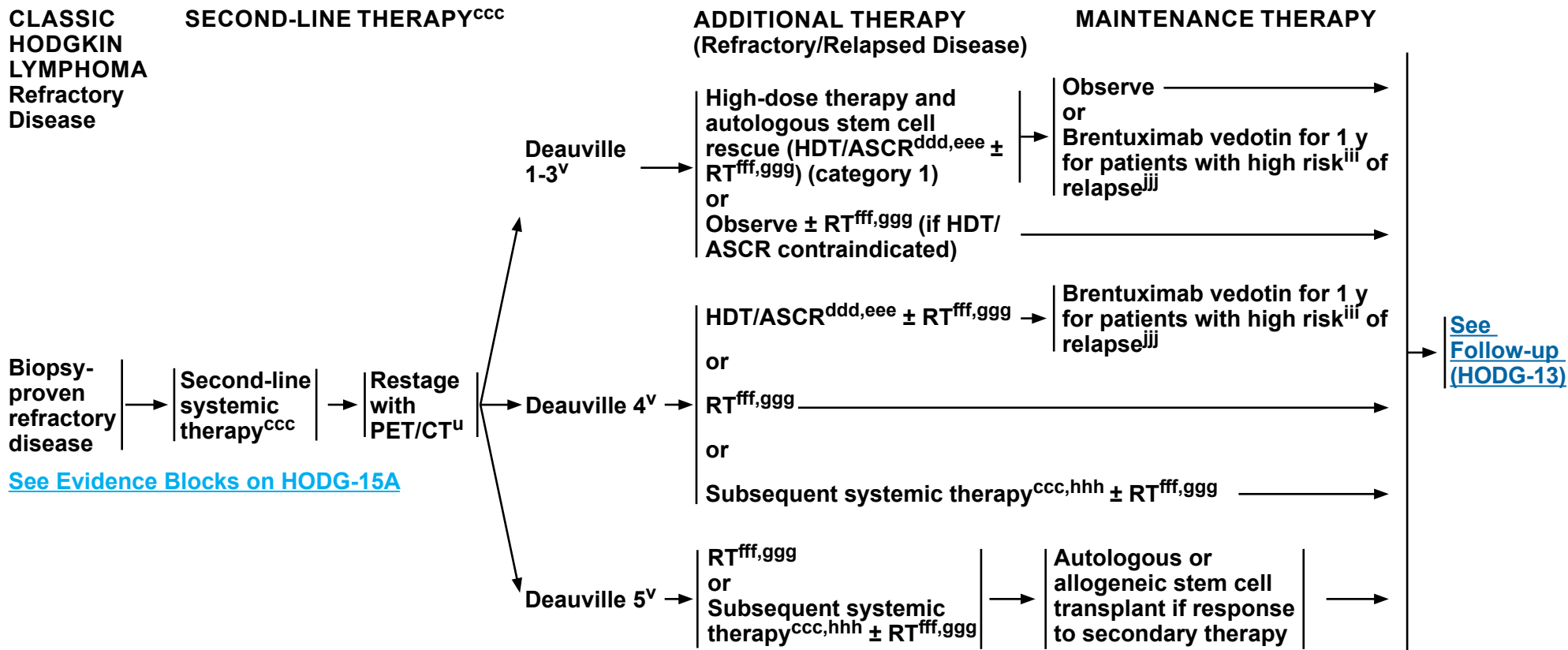
<sup>aaa</sup>Mauch P, Ng A, Aleman B, et al. Report from the Rockefeller Foundation-sponsored International Workshop on reducing mortality and improving quality of life in long-term survivors of Hodgkin's disease: July 9-16, 2003, Bellagio, Italy. Eur J Haematol 2005;75(s66).

<sup>bbb</sup>Appropriate medical management should be instituted for any abnormalities.

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**All recommendations are category 2A unless otherwise indicated.**

**Clinical Trials: NCCN believes that the best management of any patient with cancer is in a clinical trial. Participation in clinical trials is especially encouraged.**



<sup>u</sup>An integrated PET/CT or a PET with a diagnostic CT is recommended.

<sup>v</sup>See PET 5-Point Scale (Deauville Criteria) (HODG-D).

<sup>ccc</sup>See Principles of Systemic Therapy for Relapsed or Refractory Disease (HODG-B 3 of 4).

<sup>ddd</sup>Strongly consider radiation therapy for selected sites that have not been previously irradiated. In a radiation-naive patient, TLI may be an appropriate component of HDT.

<sup>eee</sup>Allotransplant is an option in select patients as a category 3 recommendation.

<sup>fff</sup>Conventional-dose chemotherapy may precede high-dose therapy. Timing of RT may vary.

<sup>ggg</sup>See Principles of Radiation Therapy (HODG-C).

<sup>hhh</sup>Subsequent systemic therapy options include second-line therapy options that were not previously used (see HODG-B).

<sup>iii</sup>Patients with 2 or more of the following risk factors are considered high risk: Remission duration less than 1 year, extranodal involvement, PET+ response at time of transplant, B symptoms, and/or >1 salvage/subsequent therapy regimen.

<sup>jjj</sup>Moskowitz CH, Nademanee A, Masszi T, et al. Brentuximab vedotin as consolidation therapy after autologous stem-cell transplantation in patients with Hodgkin's lymphoma at risk of relapse or progression (AETHERA): a randomised, double-blind, placebo-controlled, phase 3 trial. Lancet 2015;385:1853-1862.

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# NCCN Guidelines Version 2.2019 Hodgkin Lymphoma (Age ≥18 years) NCCN Evidence Blocks™

5					E = Efficacy of Regimen/Agent
4					S = Safety of Regimen/Agent
3					Q = Quality of Evidence
2					C = Consistency of Evidence
1					A = Affordability of Regimen/Agent
	E	S	Q	C	A

## EVIDENCE BLOCKS FOR REFRACTORY CLASSICAL HODGKIN LYMPHOMA

STAGE	MAINTENANCE THERAPY	
Deauville 1-3 prior to HDT/ASCR	Brentuximab vedotin for 1 year (for patients with high risk of relapse)	
Deauville 4 prior to HDT/ASCR	Brentuximab vedotin for 1 year (for patients with high risk of relapse)	

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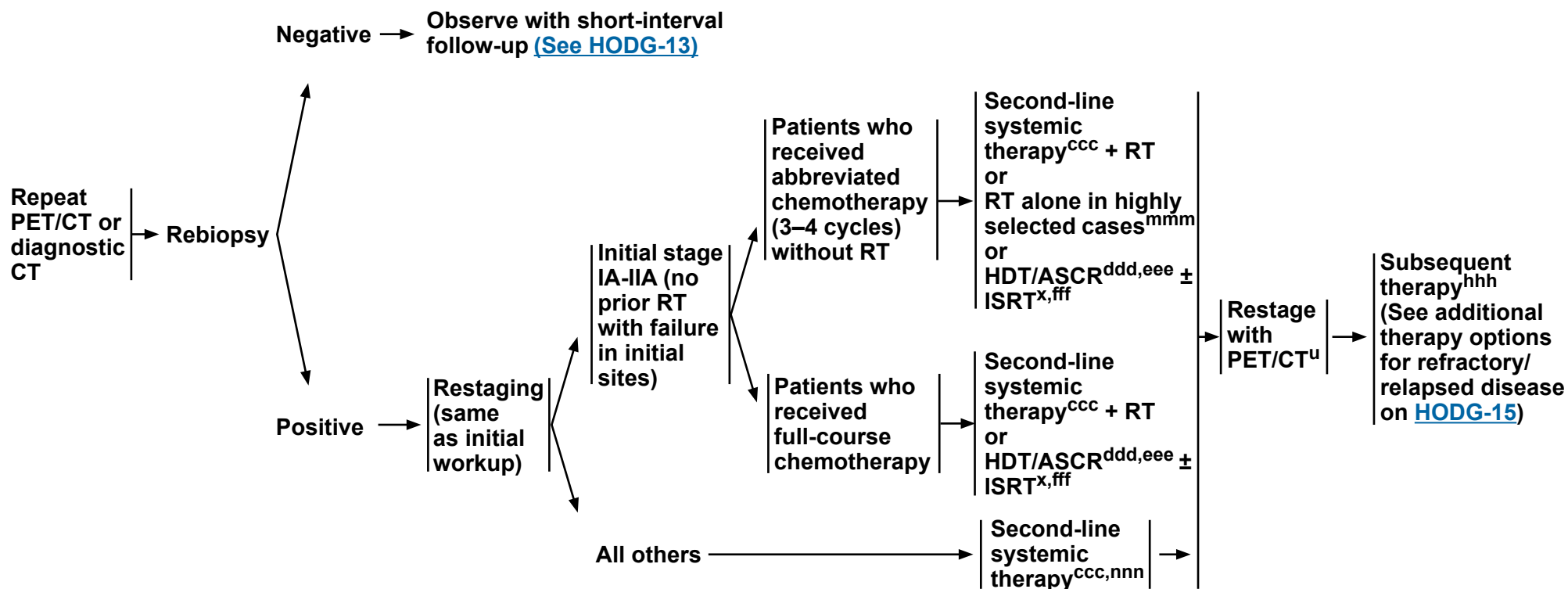
# NCCN Guidelines Version 2.2019

## Hodgkin Lymphoma (Age ≥18 years)

### NCCN Evidence Blocks™

#### CLASSIC HODGKIN LYMPHOMA SUSPECTED RELAPSE

#### SECOND-LINE THERAPY<sup>III</sup>



<sup>u</sup>An integrated PET/CT or a PET with a diagnostic CT is recommended.

<sup>x</sup>ISRT fields are generally smaller than IFRT fields. [See Principles of Radiation Therapy \(HODG-C\).](#)

<sup>ccc</sup>[See Principles of Systemic Therapy for Relapsed or Refractory Disease \(HODG-B 3 of 4\).](#)

<sup>ddd</sup>Strongly consider radiation therapy for selected sites that have not been previously irradiated. In a radiation-naïve patient, TLI may be an appropriate component of HDT.

<sup>eee</sup>Allotransplant is an option in select patients as a category 3 recommendation.

<sup>fff</sup>Conventional-dose chemotherapy may precede high-dose therapy. Timing of RT may vary.

<sup>hhh</sup>Subsequent therapy options include second-line therapy options that were not previously used. ([See HODG-B](#)).

<sup>III</sup>There are no data to support a superior outcome with any of the treatment modalities. Individualized treatment is recommended.

<sup>mmm</sup>For patients not considered suitable for more aggressive therapy, radiation therapy can be used alone as a second-line therapy and conventional involved-field or extended-field treatment is indicated.

<sup>nnn</sup>For select patients with long disease-free interval and other favorable features, selection of chemotherapy should be individualized.

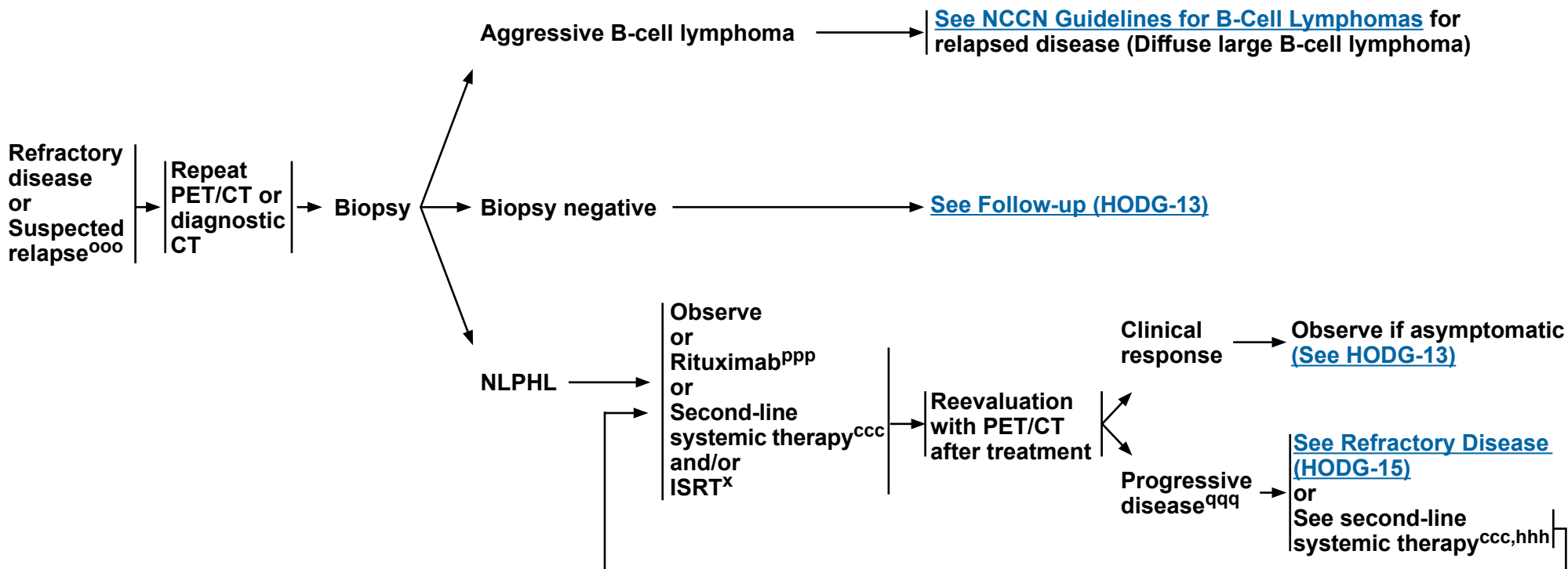
**Note:** For more information regarding the categories and definitions used for the NCCN Evidence Blocks™, see page [EB-1](#).

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**NODULAR LYMPHOCYTE-PREDOMINANT HODGKIN LYMPHOMA REFRACTORY OR SUSPECTED RELAPSE**

**SECOND-LINE THERAPY<sup>III</sup>**



<sup>x</sup>ISRT fields are generally smaller than IFRT fields. [See Principles of Radiation Therapy \(HODG-C\)](#).

<sup>ccc</sup>[See Principles of Systemic Therapy for Relapsed or Refractory Disease \(HODG-B 3 of 4\)](#).

<sup>hhh</sup>Subsequent therapy options include second-line therapy options that were not previously used. ([See HODG-B](#)).

<sup>III</sup>There are no data to support a superior outcome with any of the treatment modalities. Individualized treatment is recommended.

<sup>ooo</sup>At relapse, patient should be considered for re-biopsy because of risk for transformation, especially if intraabdominal or splenic disease. Some patients with NLPHL have a chronic indolent course that may not require aggressive re-treatment. These asymptomatic patients may be observed.

<sup>ppp</sup>In some patients treated with rituximab alone, maintenance rituximab may be considered for 2 years.

<sup>qqq</sup>Consider rebiopsy to rule out transformation.

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# NCCN Guidelines Version 2.2019

## Hodgkin Lymphoma (Age ≥18 years)

### NCCN Evidence Blocks™

#### UNFAVORABLE RISK FACTORS FOR STAGE I-II CLASSIC HODGKIN LYMPHOMA

Risk Factor	GHSG	EORTC	NCCN
Age		≥50	
Histology			
ESR and B symptoms	>50 if A; >30 if B	>50 if A; >30 if B	≥50 or any B symptoms
Mediastinal mass	MMR > .33	MTR > .35	MMR > .33
# Nodal sites	>2*	>3*	>3
E lesion	any		
Bulky			>10 cm

GHSG = German Hodgkin Study Group  
EORTC = European Organization for the  
Research and Treatment of Cancer

MMR = Mediastinal mass ratio, maximum width of mass/maximum intrathoracic diameter  
MTR = Mediastinal thoracic ratio, maximum width of mediastinal mass/intrathoracic diameter at T5-6

#### Definitions of Lymph Node Regions\*

	Ann Arbor	EORTC	GHSG
R Cervical/SCL			
R ICL/Subpec			
R Axilla			
L Cervical/SCL			
L ICL/Subpec			
L Axilla			
Mediastinum			
R Hilum			
L Hilum			
<b>Total</b>	<b>9</b>	<b>5</b>	<b>5</b>

\*Note that the EORTC includes the infraclavicular/subpectoral area with the axilla while the GHSG includes it with the cervical. Both EORTC and GHSG combine the mediastinum and bilateral hila as a single region.

#### International Prognostic Score (IPS) 1 point per factor (advanced disease)<sup>†</sup>

- Albumin <4 g/dL
- Hemoglobin <10.5 g/dL
- Male
- Age ≥45 years
- Stage IV disease
- Leukocytosis (white blood cell count at least 15,000/mm<sup>3</sup>)
- Lymphocytopenia (lymphocyte count less than 8% of white blood cell count, and/or lymphocyte count less than 600/mm<sup>3</sup>)

<sup>†</sup>From: Hasenclever D, Diehl V. A prognostic score for advanced Hodgkin's disease: International Prognostic Factors Project on Advanced Hodgkin's Disease. N Engl J Med 1998;339:1506-1514. Copyright © 1998 Massachusetts Medical Society. Adapted with permission.

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**PRINCIPLES OF SYSTEMIC THERAPY**  
**Primary Systemic Therapy Regimens****Classic Hodgkin Lymphoma**

- **The most common variants of chemotherapy used at NCCN Member Institutions include ABVD and Stanford V.**
- **Routine use of growth factors is not recommended with ABVD.**
- **Leukopenia is not a factor for delay of treatment or reduction of dose intensity (except for escalated BEACOPP).**

**Regimens and References****ABVD (doxorubicin, bleomycin, vinblastine, and dacarbazine) ± ISRT**

Engert A, Plutschow A, Eich HT, et al. Reduced treatment intensity in patients with early-stage Hodgkin's lymphoma. *N Engl J Med* 2010;363:640-652.

Radford J, Illidge T, Counsell N, et al. Results of a trial of PET-directed therapy for early-stage Hodgkin's lymphoma. *N Engl J Med* 2015;372:1598-1607.

Andre MPE, Girinsky T, Federico M, et al. Early positron emission tomography response-adapted treatment in stage I and II Hodgkin lymphoma: Final results of the randomized EORTC/LYSA/FIL H10 trial. *J Clin Oncol* 2017;35:1786-1794.

Eich HT, Diehl V, Gorgen H, et al. Intensified chemotherapy and dose-reduced involved-field radiotherapy in patients with early unfavorable Hodgkin's lymphoma: final analysis of the German Hodgkin Study Group HD 11 trial. *J Clin Oncol* 2010;28:4199-4206.

Straus DJ, Jung SH, Pitcher B, et al. CALGB 50604: risk-adapted treatment of nonbulky early-stage Hodgkin lymphoma based on interim PET. *Blood* 2018;132:1013-1021.

**ABVD followed by escalated BEACOPP (bleomycin, etoposide, doxorubicin, cyclophosphamide, vincristine, procarbazine, and prednisone) ± ISRT**

Straus DJ, Jung SH, Pitcher B, et al. CALGB 50604: risk-adapted treatment of nonbulky early-stage Hodgkin lymphoma based on interim PET. *Blood* 2018;132:1013-1021.

**Stanford V (doxorubicin, vinblastine, mechlorethamine, etoposide, vincristine, bleomycin, and prednisone)<sup>a</sup>**

Advani RH, Hoppe RT, Baer D, et al. Efficacy of abbreviated Stanford V chemotherapy and involved-field radiotherapy in early-stage Hodgkin lymphoma: mature results of the G4 trial. *Ann Oncol* 2013;24:1044-1048.

Gordon LI, Hong F, Fisher RI, et al. Randomized phase III trial of ABVD versus Stanford V with or without radiation therapy in locally extensive and advanced-stage Hodgkin lymphoma: an intergroup study coordinated by the Eastern Cooperative Oncology Group (E2496). *J Clin Oncol* 2013;31:684-691.

Advani RH, Hong F, Fisher RI, et al. Randomized phase III trial comparing ABVD plus radiotherapy with the Stanford V regimen in patients with stages I or II locally extensive, bulky mediastinal Hodgkin lymphoma: a subset analysis of the north american intergroup E2496 trial. *J Clin Oncol* 2015;33:1936-1942.

Edwards-Bennett SM, Jacks LM, Moskowitz CH, et al. Stanford V program for locally extensive and advanced Hodgkin lymphoma: the Memorial Sloan-Kettering Cancer Center experience. *Ann Oncol* 2010;21:574-581.

**Escalated BEACOPP**

Engert A, Haverkamp H, Cobe C, et al. Reduced-intensity chemotherapy and PET-guided radiotherapy in patients with advanced stage Hodgkin's lymphoma (HD15 trial): a randomised, open-label, phase 3 non-inferiority trial. *Lancet* 2012;379(9828):1791-1799.

**Escalated BEACOPP followed by ABVD with ISRT**

von Tresckow B, Plutschow A, Fuchs M, et al. Dose-intensification in early unfavorable Hodgkin's lymphoma: final analysis of the German Hodgkin Study Group HD14 trial. *J Clin Oncol* 2012;30:907-913.

**Brentuximab vedotin + AVD (doxorubicin, vinblastine, and dacarbazine)**

Connors JM, Jurczak W, Straus DJ, et al. Brentuximab vedotin with chemotherapy for stage III or IV Hodgkin's lymphoma. *N Engl J Med* 2018;378(4):331-344.

[See Principles of Systemic Therapy for NLPHL \(HODG-B 2 of 4\)](#)

[See Principles of Systemic Therapy for Relapsed or Refractory Disease \(HODG-B 3 of 4\)](#)

<sup>a</sup>Cyclophosphamide may be used as an alternate to nitrogen mustard.

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**PRINCIPLES OF SYSTEMIC THERAPY**  
**Primary Systemic Therapy Regimens**

**Nodular Lymphocyte-Predominant Hodgkin Lymphoma**

• **The most common chemotherapies used at NCCN Member Institutions for NLPHL are listed below.<sup>b</sup>**

**Regimens and References**

**ABVD (doxorubicin, bleomycin, vinblastine, dacarbazine) + rituximab**

Savage KJ, Skinnider B, Al-Mansour M, et al. Treating limited stage nodular lymphocyte predominant Hodgkin lymphoma similarly to classical Hodgkin lymphoma with ABVD may improve outcome. *Blood* 2011;118:4585-4590.

Canellos GP, Mauch P. What is the appropriate systemic chemotherapy for lymphocyte-predominant Hodgkin's Lymphoma? *J Clin Oncol* 2010;28:e8.

**CHOP (cyclophosphamide, doxorubicin, vincristine, prednisone) + rituximab**

Fanale MA, Cheah CY, Rich A, et al. Encouraging activity for R-CHOP in advanced stage nodular lymphocyte-predominant Hodgkin lymphoma. *Blood* 2017;130:472-477.

**CVP (cyclophosphamide, vinblastine, prednisolone) + rituximab**

Shankar A, Hall GW, Gorde-Grosjean S, et al. Treatment outcome after low intensity chemotherapy [CVP] in children and adolescents with early stage nodular lymphocyte predominant Hodgkin's lymphoma - an Anglo-French collaborative report. *Eur J Cancer* 2012;48:1700-1706.

**Rituximab**

Advani RH, Hoppe RT. How I treat nodular lymphocyte predominant Hodgkin lymphoma. *Blood* 2013;122:4182-4188.

Advani RH, Horning SJ, Hoppe RT, et al. Mature results of a phase II study of rituximab therapy for nodular lymphocyte-predominant Hodgkin lymphoma. *J Clin Oncol* 2014;32:912-918.

Schulz H, Rehwald U, Morschhauser F, et al. Rituximab in relapsed lymphocyte-predominant Hodgkin lymphoma: long-term results of a phase 2 trial by the German Hodgkin Lymphoma Study Group (GHSG). *Blood* 2008;111(1):109-111.

Eichenauer DA, Fuchs M, Plutschow A, et al. Phase 2 study of rituximab in newly diagnosed stage IA nodular lymphocyte-predominant Hodgkin lymphoma: a report from the German Hodgkin Study Group. *Blood* 2011;118:4363-4365.

Eichenauer DA, Plutschow A, Fuchs M, et al. Long-Term Course of Patients With Stage IA Nodular Lymphocyte-Predominant Hodgkin Lymphoma: A Report From the German Hodgkin Study Group. *J Clin Oncol* 2015;33:2857-2862.

<sup>b</sup>Ongoing clinical trials will help to clarify the role of a watch-and-wait strategy or systemic therapy, including anthracycline (epirubicin or doxorubicin), bleomycin, and vinblastine-based chemotherapy or antibody-based approaches, in the treatment of these patients.

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**PRINCIPLES OF SYSTEMIC THERAPY**  
**Relapsed or Refractory Disease**

Relapsed/Refractory Disease		
	Second-Line Options (in alphabetical order)	Subsequent Options <sup>c</sup> (in alphabetical order)
<b>CHL</b>	<ul style="list-style-type: none"> <li>• Brentuximab vedotin<sup>1</sup></li> <li>• Brentuximab vedotin + bendamustine<sup>2</sup></li> <li>• Brentuximab vedotin + nivolumab (category 2B)<sup>3</sup></li> <li>• DHAP (dexamethasone, cisplatin, high-dose cytarabine)<sup>4,5</sup></li> <li>• ESHAP (etoposide, methylprednisolone, high-dose cytarabine, cisplatin)<sup>6,7,8</sup></li> <li>• Gemcitabine/bendamustine/vinorelbine<sup>9</sup></li> <li>• GVD (gemcitabine, vinorelbine, liposomal doxorubicin)<sup>10</sup></li> <li>• ICE (ifosfamide, carboplatin, etoposide)<sup>5,11</sup></li> <li>• IGEV (ifosfamide, gemcitabine, vinorelbine)<sup>12</sup></li> </ul>	<ul style="list-style-type: none"> <li>• Bendamustine<sup>13</sup></li> <li>• C-MOPP (cyclophosphamide, vincristine, procarbazine, prednisone) (category 2B)</li> <li>• Everolimus<sup>14</sup></li> <li>• GCD (gemcitabine, carboplatin, dexamethasone)<sup>15,16</sup></li> <li>• Lenalidomide<sup>17</sup></li> <li>• MINE (etoposide, ifosfamide, mesna, mitoxantrone)<sup>18</sup></li> <li>• Mini-BEAM (carmustine, cytarabine, etoposide, melphalan)<sup>19,20</sup></li> <li>• Nivolumab<sup>21,22</sup> (see indications below)</li> <li>• Pembrolizumab<sup>23</sup> (see indications below)</li> </ul>
<b>NLPHL<sup>c</sup></b>	<ul style="list-style-type: none"> <li>• R (rituximab) + DHAP<sup>4,5</sup></li> <li>• R + ESHAP<sup>6,7,8</sup></li> <li>• R + ICE<sup>5,11</sup></li> <li>• R + IGEV<sup>12</sup></li> </ul>	

**General Guidelines for Checkpoint Inhibitors (CPI) for Relapsed/Refractory CHL<sup>d,e</sup>**

- CPI are recommended for any patients with CHL that has relapsed or progressed after autologous HSCT ± brentuximab vedotin.
- CPI are also an option for patients with relapsed/refractory CHL who are transplant-ineligible based on comorbidity or failure of second-line chemotherapy.
- Post-allogeneic transplant, patients can receive either nivolumab or pembrolizumab. There are limited data regarding the use of CPI following allogeneic transplantation; CPI should be used with caution before allogeneic transplantation due to increased risk of GVHD (graft-versus-host disease) and other immunologic complications.

<sup>c</sup>Subsequent systemic therapy options include second-line therapy options that were not previously used (see HODG-B).

<sup>d</sup>National Institutes of Health. Nivolumab package insert. Available at: <https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=f570b9c4-6846-4de2-abfa-4d0a4ae4e394>. Accessed December 20, 2017.

<sup>e</sup>National Institutes of Health. Pembrolizumab package insert. Available at: <https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=9333c79b-d487-4538-a9f0-71b91a02b287>. Accessed December 20, 2017.

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**References**

**PRINCIPLES OF SYSTEMIC THERAPY FOR RELAPSED OR REFRACTORY DISEASE****References**

- <sup>1</sup>Younes A, Gopal AK, Smith SE, et al. Results of a pivotal phase II study of brentuximab vedotin for patients with relapsed or refractory Hodgkin's lymphoma. *J Clin Oncol* 2012;30:2183-2189.
- <sup>2</sup>O'Connor OA, Lue JK, Sawas A, et al. Brentuximab vedotin plus bendamustine in relapsed or refractory Hodgkin's lymphoma: an international, multicentre, single-arm, phase 1-2 trial. *Lancet Oncol* 2018;19:257-266.
- <sup>3</sup>Herrera AF, Moskowitz AJ, Bartlett NL, et al. Interim results of brentuximab vedotin in combination with nivolumab in patients with relapsed or refractory Hodgkin lymphoma. *Blood* 2018;131:1183-1194.
- <sup>4</sup>Josting A, Rudolph C, Reiser M, et al. Time-intensified dexamethasone/cisplatin/cytarabine: an effective salvage therapy with low toxicity in patients with relapsed and refractory Hodgkin's disease. *Ann Oncol* 2002;13(10):1628-1635.
- <sup>5</sup>Abali H, Urün Y, Oksüzöğlü B, Budakoğlu B, et al. Comparison of ICE (ifosfamide-carboplatin-etoposide) versus DHAP (cytosine arabinoside-cisplatin-dexamethasone) as salvage chemotherapy in patients with relapsed or refractory lymphoma. *Cancer Invest* 2008;26(4):401-406.
- <sup>6</sup>Aparicio J, Segura A, Garcera S, et al. ESHAP is an active regimen for relapsing Hodgkin's disease. *Ann Oncol* 1999;10(5):593-595.
- <sup>7</sup>Fernández de Larrea C, Martínez C, et al. Salvage chemotherapy with alternating MINE-ESHAP regimen in relapsed or refractory Hodgkin's lymphoma followed by autologous stem cell transplantation. *Ann Oncol* 2010;21(6):1211-1216.
- <sup>8</sup>Labrador J, Cabrero-Calvo M, Perez-Lopez E, et al. ESHAP as salvage therapy for relapsed or refractory Hodgkin's lymphoma. *Ann Hematol* 2014;93:1745-1753.
- <sup>9</sup>Santoro A, Mazza R, Pulsoni A, et al. Bendamustine in combination with gemcitabine and vinorelbine is an effective regimen as induction chemotherapy before autologous stem-cell transplantation for relapsed or refractory Hodgkin lymphoma: final results of a multicenter phase II study. *J Clin Oncol* 2016;34:3293-3299.
- <sup>10</sup>Bartlett N, Niedzwiecki D, Johnson J, et al. Gemcitabine, vinorelbine, and pegylated liposomal doxorubicin (GVD), a salvage regimen in relapsed Hodgkin's lymphoma: CALGB 59804. *Ann Oncol* 2007;18(6):1071-1079.
- <sup>11</sup>Moskowitz CH, Nimer SD, Zelenetz AD, et al. A 2-step comprehensive high-dose chemoradiotherapy second-line program for relapsed and refractory Hodgkin disease: analysis by intent to treat and development of a prognostic model. *Blood* 2001;97(3):616-623.
- <sup>12</sup>Santoro A, Magagnoli M, Spina M, et al. Ifosfamide, gemcitabine, and vinorelbine: a new induction regimen for refractory and relapsed Hodgkin's lymphoma. *Haematologica* 2007;92(1):35-41.
- <sup>13</sup>Moskowitz AJ, Hamlin PA, Perales M-A, et al. Phase II study of bendamustine in relapsed and refractory Hodgkin lymphoma. *J Clin Oncol* 2013;31:456-460.
- <sup>14</sup>Johnston PB, Inwards DJ, Colgan JP, et al; A Phase II trial of the oral mTOR inhibitor everolimus in relapsed Hodgkin lymphoma. *Am J Hematol*. 2010;85(5):320-4.
- <sup>15</sup>Crump M, Kuruvilla J, Couban S, et al. Randomized comparison of gemcitabine, dexamethasone, and cisplatin versus dexamethasone, cytarabine, and cisplatin chemotherapy before autologous stem-cell transplantation for relapsed and refractory aggressive lymphomas: NCIC-CTG LY.12. *J Clin Oncol* 2014;32:3490-3496.
- <sup>16</sup>Gopal AK, Press OW, Shustov AR, et al. Efficacy and safety of gemcitabine, carboplatin, dexamethasone, and rituximab in patients with relapsed/refractory lymphoma: a prospective multi-center phase II study by Puget Sound Oncology Consortium. *Leuk Lymphoma* 2010;51:1523-1529.
- <sup>17</sup>Fehniger TA, Larson S, Trinkaus K, et al; A phase 2 multicenter study of lenalidomide in relapsed or refractory classical Hodgkin lymphoma. *Blood* 2011;118(19):5119-25.
- <sup>18</sup>Rodriguez MA, Cabanillas FC, Hagemester FB, et al. A phase II trial of mesna/ifosfamide, mitoxantrone and etoposide for refractory lymphomas. *Ann Oncol* 1995;6(6):609-611.
- <sup>19</sup>Colwill R, Crump M, Couture F, et al. Mini-BEAM as salvage therapy for relapsed or refractory Hodgkin's disease before intensive therapy and autologous bone marrow transplantation. *J Clin Oncol* 1995;13:396-402.
- <sup>20</sup>Martín A, Fernández-Jiménez MC, Caballero MD, et al. Long-term follow-up in patients treated with Mini-BEAM as salvage therapy for relapsed or refractory Hodgkin's disease. *Br J Haematol* 2001;113(1):161-171.
- <sup>21</sup>Ansell SM, Lesokhin AM, Borrello I, et al. PD-1 Blockade with nivolumab in relapsed or refractory Hodgkin's lymphoma. *N Engl J Med* 2015;372:311-9.
- <sup>22</sup>Timmerman J, Armand P, Lesokhin AM, et al. Nivolumab in patients with relapsed or refractory lymphoid malignancies and classical Hodgkin lymphoma: Updated results of a phase 1 study (CA 209-039) [abstract]. *Hematol Oncol* 2015;33:Abstract 010.
- <sup>23</sup>Armand P, Shipp MA, Ribrag V, et al. Programmed Death-1 blockade with pembrolizumab in patients with classical Hodgkin lymphoma after brentuximab vedotin failure. *J Clin Oncol* 2016; 34(31):3733-3739.

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**PRINCIPLES OF RADIATION THERAPY****General Principles**

- Treatment with photons, electrons, or protons may all be appropriate, depending on clinical circumstances.
- Advanced RT technologies such as intensity-modulated RT (IMRT)/volumetric modulated arc therapy (VMAT), breath hold or respiratory gating, and/or image-guided RT (IGRT), or proton therapy may offer significant and clinically relevant advantages in specific instances to spare important organs at risk (OAR) such as the heart (including coronary arteries, valves, and left ventricle), lungs, kidneys, spinal cord, esophagus, carotid artery, bone marrow, breasts, stomach, muscle/soft tissue, and salivary glands and decrease the risk for late, normal tissue damage while still achieving the primary goal of local tumor control.
- The demonstration of significant dose-sparing for these OARs reflects best clinical practice, as it reduces the risk of late complications from normal tissue damage. Achieving highly conformal dose distributions is especially important for patients who are being treated with curative intent or who have long life expectancies following therapy.
- In mediastinal Hodgkin lymphoma (HL), the use of 4D-CT for simulation and the adoption of strategies to deal with respiratory motion and minimize dose to OARs are essential, especially deep inspiration breath-hold techniques, respiratory gating, and image-guided RT during treatment delivery. Breath-hold techniques have been shown to decrease incidental dose to the heart and lungs in many disease presentations.
- Since the advantages of these techniques include tightly conformal doses and steep gradients next to normal tissues, target definition and delineation and treatment delivery verification require careful monitoring to avoid the risk of tumor geographic miss and subsequent decrease in tumor control. Initial diagnostic imaging with contrast-enhanced CT, MRI, PET, ultrasound, and other imaging modalities facilitate target definition. Image guidance may be required to provide assurance of accurate daily delivery.
- Randomized studies to test these concepts are unlikely to be done since these techniques are designed to decrease late effects, which take 10+ years to develop. In light of that, the modalities and techniques that are found to best reduce the doses to the OARs in a clinically meaningful way without compromising target coverage should be considered.

**Involved-site Radiation Therapy (ISRT) Dose**

- **Combined Modality Therapy**
  - ▶ Non-bulky disease (stage I-II): 20\*–30 Gy (if treated with ABVD); 1.5–2.0 Gy per fraction
  - ▶ Non-bulky disease (stage IB-IIIB): 30 Gy; 1.5–2.0 Gy per fraction
  - ▶ Bulky disease sites (all stages): 30–36 Gy; 1.5–2.0 Gy per fraction
  - ▶ Sites of partial response to chemotherapy: 36–45 Gy
- **ISRT Alone (uncommon, except for NLPHL)**
  - ▶ Involved regions: 30–36 Gy (the dose of 30 Gy is mainly used for NLPHL); 1.5–2.0 Gy per fraction
  - ▶ Uninvolved regions: 25–30 Gy; 1.5–2.0 Gy per fraction. ISRT for NLPHL includes extension to clinically relevant initially uninvolved nodes.
- **Palliative RT: 4–30 Gy**

\*A dose of 20 Gy following ABVD x 2 is sufficient if the patient has non-bulky stage I-IIA disease with an ESR <50, no extralymphatic lesions, and only one or two lymph node regions involved. See [HODG-A](#) for definition of nodal sites according to GHSG.

**Note:** For more information regarding the categories and definitions used for the NCCN Evidence Blocks™, see page [EB-1](#).

All recommendations are category 2A unless otherwise indicated.

Clinical Trials: NCCN believes that the best management of any patient with cancer is in a clinical trial. Participation in clinical trials is especially encouraged.

**Continued**  
**References**

**HODG-C**  
**1 OF 3**

**PRINCIPLES OF RADIATION THERAPY****Volumes**

- **ISRT is recommended as the appropriate field for HL.**
  - ▶ **Planning for ISRT requires modern CT-based simulation and treatment planning capabilities.**
  - ▶ **Incorporating other modern imaging such as PET and MRI often enhances treatment volume determination.**
- **ISRT targets the site of the originally involved lymph node(s).**
  - ▶ **The volume encompasses the original or suspected extent of disease prior to chemotherapy or surgery. However, it spares adjacent uninvolved organs (eg, lungs, bone, muscle, kidney) when lymphadenopathy regresses following chemotherapy.**
- **The pre-chemotherapy or pre-biopsy gross tumor volume (GTV) provides the basis for determining the clinical target volume (CTV).**
  - ▶ **Concerns for questionable subclinical disease and uncertainties in original imaging accuracy or localization may lead to expansion of the CTV and are determined individually using clinical judgment.**
- **For NLPHL, often treated with RT alone, treatment should extend beyond the PET-positive or CT-enlarged nodes.**
  - ▶ **The CTV definition for treating NLPHL with RT alone will be greater than that employed for CHL with similar disease distribution being treated with combined modality therapy.**
- **Possible movement of the target by respiration as determined by 4D-CT or fluoroscopy (internal target volume, ITV) should also influence the final CTV.**
- **The planning target volume (PTV) is an additional expansion of the CTV that accounts only for setup variations and may differ by site and immobilization technique.**
  - ▶ **See ICRU definitions: Gregoire V, Mackie TR. State of the art on dose prescription, reporting and recording in Intensity-Modulated Radiation Therapy (ICRU report No. 83). Cancer Radiother 2011;15:555-559.**
- **OARs should be outlined for optimizing treatment plan decisions.**
- **The treatment plan can be designed using conventional, 3-D conformal, or IMRT techniques using clinical treatment planning considerations of coverage and normal tissue avoidance.**
- **The treatment of extranodal disease is individualized, but similar principles of GTV/CTV/PTV definition should be applied as for nodal disease.**
  - ▶ **Chest wall extension – effort should be made to include regions of initial chest wall extension to definitive doses.**
  - ▶ **Lung involvement – areas of extension into the lung from mediastinal or hilar disease may be treated with lower doses (~15 Gy) unless the relative volume is small, in which case higher doses may be utilized. Careful consideration of partial lung tolerance is essential. Pulmonary nodular disease is usually not treated following chemotherapy unless residual disease is present.**
  - ▶ **Pleural or pericardial effusions are not included in the GTV. Nodular pericardial involvement may be included with consideration of cardiac tolerance.**
  - ▶ **Bone – Areas of osseous disease may be treated with a CTV expansion beyond the GTV defined by imaging. In the presence of vertebral body disease, the entire vertebra is generally treated.**

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**Clinical Trials: NCCN believes that the best management of any patient with cancer is in a clinical trial. Participation in clinical trials is especially encouraged.**

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**Note:** For more information regarding the categories and definitions used for the NCCN Evidence Blocks™, see page [EB-1](#).

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# NCCN Guidelines Version 2.2019

## Hodgkin Lymphoma (Age ≥18 years)

### NCCN Evidence Blocks™

#### PET 5-POINT SCALE (DEAUVILLE CRITERIA)

Score	PET/CT scan result
1	No uptake
2	Uptake ≤ mediastinum
3	Uptake > mediastinum but ≤ liver
4	Uptake moderately higher than liver
5	Uptake markedly higher than liver and/or new lesions
X	New areas of uptake unlikely to be related to lymphoma

With kind permission from Springer International Publishing: Barrington SF, Mikhaeel NG, Kostakoglu L, et al. Role of imaging in the staging and response assessment of lymphoma: consensus of the International Conference on Malignant Lymphomas Imaging Working Group. J Clin Oncol 2014;32(27):3048-3058.

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**MANAGEMENT OF CLASSIC HODGKIN LYMPHOMA IN OLDER ADULTS (AGE >60)**

- CHL in older adult patients is associated with poorer disease outcomes.<sup>1</sup> B-symptoms, poor performance status, mixed cellularity, histologic subtype, EBV+ disease, and medical comorbidities are more frequent in this population.<sup>2</sup>
- Standard chemotherapy regimens are associated with dose reductions, treatment toxicity, and treatment-related mortality in older patients.<sup>3-6</sup>
- There are limited prospective data evaluating alternatives to standard therapies for older patients. Selection of standard versus alternate first-line therapy for an older patient should be based on clinical judgment, with the goal of minimizing toxicity while maximizing efficacy.
- The regimens listed below should be considered in older patients to lessen/minimize toxicity. These regimens have not been proven to overcome the poorer disease outcomes observed in the older patients.
- Clinical trial is recommended when available.
- ISRT alone is an option when systemic therapy is not considered feasible or safe.

**SUGGESTED TREATMENT REGIMENS**  
(Listed in alphabetical order)**Stage I-II Favorable Disease**

- A(B)VD<sup>a</sup> (2 cycles) ± AVD (2 cycles) + 20–30 Gy ISRT (preferred)<sup>7,8,9</sup>
- CHOP (4 cycles) + 30 Gy ISRT<sup>10</sup>
- VEPEMB (vinblastine, cyclophosphamide, prednisolone, procarbazine, etoposide, mitoxantrone, and bleomycin) ± 30 Gy ISRT<sup>11</sup>

**Stage I-II Unfavorable or Stage III-IV Disease**

- A(B)VD<sup>a</sup> (2 cycles) followed by AVD (4 cycles),<sup>b</sup> if PET scan is negative after 2 cycles of ABVD.<sup>12</sup>
  - Patients with a positive PET scan after 2 cycles of ABVD need individualized treatment.
- Brentuximab vedotin + DTIC (dacarbazine)<sup>13,14</sup>
- CHOP (6 cycles) ± 30 Gy ISRT<sup>10</sup>
- PVAG (6 cycles) (prednisone, vinblastine, doxorubicin, and gemcitabine)<sup>15</sup> ± 30 Gy ISRT
- VEPEMB (6 cycles) ± 30 Gy ISRT<sup>11,16</sup>

**Relapsed or Refractory Disease**

- Outcomes are uniformly poor for patients with relapsed or refractory disease.<sup>17</sup>
- No uniform recommendation can be made, although clinical trials or possibly single-agent therapy with a palliative approach is recommended.
- Individualized treatment is necessary. Palliative therapy options include:
  - Bendamustine
  - Brentuximab vedotin
  - ISRT
  - Nivolumab [See Checkpoint Inhibitors \(CPI\) HODG-B 3 of 4](#)
  - Pembrolizumab [See Checkpoint Inhibitors \(CPI\) HODG-B 3 of 4](#)
  - Second-line and subsequent therapy options (only for CHL) as listed on [Principles of Systemic Therapy for Relapsed or Refractory Disease HODG-B \(3 of 4\)](#)

<sup>a</sup>Bleomycin should be used with caution as it may not be tolerated in older adults.<sup>b</sup>If stage I-II unfavorable, consider a total of 4 cycles.**Note: For more information regarding the categories and definitions used for the NCCN Evidence Blocks™, see page [EB-1](#).**

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**References**

**MANAGEMENT OF CLASSIC HODGKIN LYMPHOMA IN OLDER ADULTS (AGE >60)**  
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**HODGKIN LYMPHOMA STAGING<sup>1</sup>****Table 1****Definitions of Stages in Hodgkin's Disease<sup>2</sup>**

**Stage I** Involvement of a single lymph node region (I) or localized involvement of a single extralymphatic organ or site (I<sub>E</sub>).

**Stage II** Involvement of two or more lymph node regions on the same side of the diaphragm (II) or localized involvement of a single associated extralymphatic organ or site and its regional lymph node(s), with or without involvement of other lymph node regions on the same side of the diaphragm (II<sub>E</sub>).

Note: The number of lymph node regions involved may be indicated by a subscript (eg, II<sub>3</sub>).

**Stage III** Involvement of lymph node regions on both sides of the diaphragm (III), which may also be accompanied by localized involvement of an associated extralymphatic organ or site (III<sub>E</sub>), by involvement of the spleen (III<sub>S</sub>), or by both (III<sub>E+S</sub>).

**Stage IV** Disseminated (multifocal) involvement of one or more extralymphatic organs, with or without associated lymph node involvement, or isolated extralymphatic organ involvement with distant (nonregional) nodal involvement.

A No systemic symptoms present

B Unexplained fevers >38°C; drenching night sweats; or weight loss >10% of body weight (within 6 months prior to diagnosis)

Adapted with permission from the American Association for Cancer Research: Carbone PP, Kaplan HS, Musshoff K, et al. Report of the Committee on Hodgkin's Disease Staging Classification. *Cancer Res* 1971;31(11):1860-1.

<sup>1</sup>For additional information regarding the staging of Hodgkin lymphoma, refer to: Cheson BD, Fisher RI, Barrington SF, et al. Recommendations for initial evaluation, staging, and response assessment of Hodgkin and non-Hodgkin lymphoma: the Lugano Classification. *J Clin Oncol* 2014;32:3059-3068.

<sup>2</sup>PET scans are useful for upstaging in stage I-II disease. If there is PET positivity outside of disease already identified, further clinical investigation is recommended to confirm or refute the observation. PET scans are usually positive in patients with HIV infection, even in the absence of Hodgkin lymphoma.



# NCCN Guidelines Version 2.2019 Hodgkin Lymphoma

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## Discussion

### NCCN Categories of Evidence and Consensus

**Category 1:** Based upon high-level evidence, there is uniform NCCN consensus that the intervention is appropriate.

**Category 2A:** Based upon lower-level evidence, there is uniform NCCN consensus that the intervention is appropriate.

**Category 2B:** Based upon lower-level evidence, there is NCCN consensus that the intervention is appropriate.

**Category 3:** Based upon any level of evidence, there is major NCCN disagreement that the intervention is appropriate.

**All recommendations are category 2A unless otherwise indicated.**

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### Overview

Hodgkin lymphoma (HL) is an uncommon malignancy involving lymph nodes and the lymphatic system. Most patients are diagnosed between 15 and 30 years of age, followed by another peak in adults aged 55 years or older. In 2019, an estimated 8110 people will be diagnosed with HL in the United States and 1000 people will die from the disease.<sup>1</sup> The WHO classification divides HL into 2 main types: classic Hodgkin lymphoma (CHL) and nodular lymphocyte-predominant Hodgkin lymphoma (NLPHL).<sup>2</sup> In Western countries, CHL accounts for 95% and NLPHL accounts for 5% of all HL.

CHL is divided into 4 subtypes: nodular sclerosis CHL; mixed cellularity; lymphocyte-depleted CHL; and lymphocyte-rich CHL. CHL is characterized by the presence of Reed-Sternberg cells in an inflammatory background, whereas NLPHL lacks Reed-Sternberg cells but is characterized by the presence of lymphocyte-predominant cells, sometimes termed *popcorn cells*.

The past few decades have seen significant progress in the management of patients with HL; it is now curable in at least 80% of patients. The advent of more effective treatment options has improved the 5-year survival rates, which have been unmatched in any other cancer over the past 4 decades. Every patient with newly diagnosed HL has an overwhelming likelihood of being cured with the appropriate treatment. In fact, cure rates for HL have increased so markedly that overriding treatment considerations often relate to long-term toxicity, especially for patients with early- or intermediate-stage disease. Clinical trials still emphasize improvement in cure rates for patients with advanced disease, but the potential long-term effects of treatment remain an important consideration.

The NCCN Guidelines discuss the clinical management of patients with CHL and NLPHL, focusing on adult patients 18 years and older who do not have serious intercurrent disease. The guidelines do not address HL in pediatric or older patients or those with unusual situations, such as HIV positivity or pregnancy. Individualized treatment may be necessary for older patients and those with concomitant disease. Consistent with NCCN philosophy, participation in clinical trials is always encouraged.

### Literature Search Criteria and Guidelines Update Methodology

Prior to the update of this version of the NCCN Guidelines® for Hodgkin Lymphoma, an electronic search of the PubMed database was performed to obtain key literature in Hodgkin Lymphoma since the previous Guidelines update, using the following search terms: Hodgkin lymphoma, classic Hodgkin lymphoma, nodular lymphocyte predominant, early stage, advanced stage, imaging, PET, positron emission tomography, response assessment, Deauville, treatment, late effects, follow-up, and surveillance. The PubMed database was chosen as it remains the most widely used resource for medical literature and indexes peer-reviewed biomedical literature.<sup>3</sup>

The search results were narrowed by selecting studies in humans published in English. Results were confined to the following article types: Clinical Trial, Phase II; Clinical Trial, Phase III; Clinical Trial, Phase IV; Guideline; Randomized Controlled Trial; Meta-Analysis; Systematic Reviews; and Validation Studies.

The data from key PubMed articles as well as articles from additional sources deemed as relevant to these Guidelines and discussed by the panel have been included in this version of the Discussion section (eg, e-publications ahead of print, meeting abstracts). Recommendations for which high-level evidence is lacking are based on the panel's review of lower-level evidence and expert opinion.



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## Hodgkin Lymphoma

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The complete details of the Development and Update of the NCCN Guidelines are available at [www.NCCN.org](http://www.NCCN.org).

### Staging and Prognosis

Staging for HL is based on the Ann Arbor staging system.<sup>4,5</sup> Each stage is subdivided into A and B categories. “A” indicates that no systemic symptoms are present and “B” is assigned to patients with unexplained fevers >38°C, drenching night sweats, or weight loss of >10% of their body weight within 6 months of diagnosis.

Patients with HL are usually classified into 3 groups: early-stage favorable (stage I–II with no unfavorable factors); early-stage unfavorable (stage I–II with any of the unfavorable factors such as large mediastinal adenopathy, >3 nodal sites of disease, B symptoms, extranodal involvement, or significantly elevated erythrocyte sedimentation rate [ESR] ≥50); and advanced-stage disease (stage III–IV).

Mediastinal bulk, an unfavorable prognostic factor in patients with early-stage HL, is measured most commonly using the mediastinal mass ratio (MMR).<sup>6</sup> The MMR is the ratio of the maximum width of the mass and the maximum intrathoracic diameter. Any mass with MMR greater than 0.33 is defined as bulky disease. This is the definition used most commonly in North America and also by the German Hodgkin Study Group (GHSg). Another definition of bulk is any single node or nodal mass that is 10 cm or greater in diameter. According to the Cotswolds modification of the Ann Arbor staging system, bulky disease is defined as a mediastinal mass exceeding one third of the internal transverse diameter of the thorax at the T5–T6 interspace on a posteroanterior chest radiograph.<sup>7</sup> This is the definition used by the European Organisation for Research and Treatment of Cancer (EORTC).

The early-stage unfavorable factors are based largely on the definition of unfavorable prognostic groups from the clinical trials conducted by the

EORTC, GHSg, and the National Cancer Institute of Canada (NCIC).<sup>8,9</sup> The NCCN unfavorable factors for stage I–II disease include bulky mediastinal disease (MMR >0.33) or bulky disease >10 cm, B symptoms, ESR ≥50, and >3 nodal sites of disease.

An international collaborative effort evaluating more than 5000 patients with advanced CHL (stage III–IV) identified 7 adverse prognostic factors, each of which reduced survival rates by 7% to 8% per year:<sup>10</sup>

- Age 45 years or older
- Male gender
- Stage IV disease
- Albumin level below 4 g/dL
- Hemoglobin level below 10.5 g/dL
- Leukocytosis (white blood cell count >15,000/mm<sup>3</sup>)
- Lymphocytopenia (lymphocyte count <8% of the white blood count and/or lymphocyte count <600/mm<sup>3</sup>)

The International Prognostic Score (IPS) is defined by the number of adverse prognostic factors present at diagnosis.<sup>10</sup> The IPS helps to determine the clinical management and predict prognosis for patients with stage III–IV disease.<sup>10</sup>

### Response Criteria

Clinical management of patients with CHL involves initial treatment with chemotherapy or combined modality therapy, followed by restaging at the completion of chemotherapy to assess treatment response. Assessment of response to initial treatment is essential because the need for additional treatment is based on the treatment response.

The original Cotswolds response criteria included the response category, CR (complete response) unconfirmed/uncertain (CRu), which denoted patients in whom the remission status was unclear. There was “no clinical

evidence of Hodgkin's disease but some radiological abnormality, not consistent with the effects of therapy, [that] persist[ed] at the site of previous disease."<sup>7</sup> This designation indicated that it was not possible to determine whether residual masses identified on CT scan represented residual HL, scarring, or some other nonmalignant process. The International Working Group (IWG) published the guidelines for response criteria in 1999.<sup>11</sup> These criteria are based on the size reduction of enlarged lymph nodes as measured on CT scan, and the extent of bone marrow involvement determined using bone marrow aspirate and biopsy.

In 2007, the IWG guidelines were revised by the International Harmonization Project (IHP) to incorporate immunohistochemistry (IHC), flow cytometry, and PET scans into the definition of response.<sup>12,13</sup> The revised guidelines eliminated CRu based partly on the ability of PET scans to further characterize residual masses detected with CT. Using the revised system, response is categorized as CR, partial response (PR), stable disease, relapsed disease, or progressive disease.<sup>12</sup> The IHP response criteria were initially developed for the interpretation of PET scans at the completion of treatment. In recent years, these criteria have also been used for interim response assessment.<sup>14</sup>

In 2009, the Deauville criteria were defined for the interpretation of interim and end-of-treatment PET scans based on the visual assessment of <sup>18</sup>F-fluorodeoxyglucose (FDG) uptake in the involved sites. These criteria use a 5-point scale (5-PS) to determine the FDG uptake in the involved sites relative to that of the mediastinum and the liver.<sup>15-17</sup> In the 5-PS (Deauville criteria), scores of 1 to 4 refer to initially involved sites and a score of 5 refers to an initially involved site and/or new lesions related to lymphoma.<sup>15,16</sup> PET scans with a score of 1 or 2 are considered "negative" and PET scans with a score of 4 and 5 are considered "positive."<sup>18</sup> In some situations, a score of 3 may be considered negative; however, for de-escalation of therapy based on interim PET scans, a threshold for

positivity that includes a score of 3 using the mediastinal blood pool uptake as the reference is appropriate (PET scans with a score of 1–2 are considered negative and PET scans with a score of 3–5 are considered positive).<sup>19</sup> A score of 4 can be difficult to assess when FDG uptake in mediastinal masses cannot clearly be differentiated from thymic uptake or inflammatory reactions,<sup>17,20,21</sup> and treatment decisions in these cases will require clinical judgment. The 5-PS (Deauville criteria) has been validated in international multicenter trials for PET-guided interim response assessment and risk-adapted therapy in patients with HL.<sup>22-26</sup>

### Role of PET Scans

PET imaging including integrated PET and CT (PET/CT) has become an important tool for initial staging and response assessment at the completion of treatment in patients with HL.<sup>14,17</sup> In a meta-analysis, PET scans showed high positivity and specificity when used to stage and restage patients with lymphoma.<sup>27</sup> PET positivity at the end of treatment has been shown to be a significant adverse risk factor in patients with early-stage as well as advanced-stage disease.<sup>28-30</sup> In a study of 73 patients (the majority of whom had stage I–IIA disease), Sher et al reported that the actuarial 2-year failure-free survival (FFS) rate was 95% for those who were PET-negative at the end of chemotherapy, and 69% for the PET-positive group.<sup>30</sup> In the HD15 trial, positive PET after chemotherapy with BEACOPP was associated with a higher risk of subsequent treatment failure. The progression-free survival (PFS) at 48 months was 92.6% and 82.6%, respectively, for PET-negative and PET-positive patients ( $P = .022$ ).<sup>31</sup> In this study, PET-positive patients received radiation therapy (RT) to the PET-positive sites.

The NCCN PET Task Force and the NCCN Guidelines recommend PET scans for initial staging and for evaluating residual masses at the end of treatment.<sup>32</sup> An integrated PET scan plus a diagnostic CT is recommended for initial staging, although a separate diagnostic CT is not

needed if it was part of the integrated PET scan. PET scans are not recommended for routine surveillance due to the risk of false-positive findings and unnecessary diagnostic interventions and/or radiation exposure.<sup>33-36</sup>

### Interim PET Scans

PET scans are increasingly being used to assess treatment response during therapy. Interim PET scans may be useful to identify a subgroup of patients with early-stage disease that can be treated with chemotherapy alone.<sup>26</sup> The NCCN Guidelines emphasize that the value of interim PET scans remains unclear for many clinical scenarios and all measures of response should be considered in the context of management decisions. It is important that the Deauville score be incorporated into the nuclear medicine PET scan report, since subsequent management is often dependent upon that score.

The guidelines recommend biopsy for all patients with a score of Deauville 5 (markedly increased uptake compared to liver at any initially involved site and/or new lesions). In general, patients with a positive biopsy should be managed as described for refractory disease and for those with a negative biopsy, CR should be documented including reversion of PET to "negative" within 3 months following completion of therapy.

### Stage IA-IIA (Favorable Disease)

Initial results from retrospective analyses failed to demonstrate the prognostic significance of interim PET scans in patients with stage I–II favorable disease.<sup>30,37-39</sup>

In one study that included a majority of patients with stage I–IIA disease (43 out of 73), the actuarial 2-year FFS rate was 95% for those who were PET-negative at the end of chemotherapy, and was 69% for the PET-positive group.<sup>30</sup> However, among the 46 patients who underwent interim PET imaging after 2 or 3 cycles of chemotherapy, 20 patients had

positive interim PET scans and 13 of these 20 patients (65%) had negative PET scans at the completion of chemotherapy. The actuarial 2-year FFS rate was 92% for this group compared to 96% for patients with negative PET scans during and after completion of chemotherapy.

Barnes et al also showed that interim PET scans did not predict outcome in patients with non-bulky stage I–II disease. The 4-year PFS rate was 91% for those with a negative interim PET scan and 87% for those with a positive interim PET scan ( $P = .57$ ).<sup>38</sup>

However, other reports have confirmed the prognostic significance of interim PET scans after 2 or 3 cycles of chemotherapy in patients with early-stage disease based on the 5-PS (Deauville criteria).<sup>40-42</sup> In a retrospective analysis that included 147 patients with early-stage disease, Zinzani et al reported the best predictive value for interim PET scans after 2 cycles of ABVD (PET-2) in patients with early-stage favorable disease.<sup>40</sup> At a median follow-up of 45 months, 97.6% of patients with a negative PET-2 scan remained in CR, whereas only 21% of patients with a positive PET-2 scan remained in CR at a median follow-up of 28 months. The 9-year PFS rate was also significantly higher for patients with a negative PET-2 scan than for those with a positive PET-2 scan (94.7% and 31.3%, respectively). The corresponding 9-year overall survival (OS) rates were 100% and 85.2%, respectively ( $P = .0001$ ) for the 2 groups.

### NCCN Recommendations

Based on these findings, the panel consensus was to incorporate the Deauville criteria (5-PS) for interim response assessment with PET scans after 2 to 4 cycles of ABVD for patients receiving combined modality therapy and after 2 cycles of ABVD for patients receiving chemotherapy alone. In patients receiving the Stanford V regimen, interim response assessment is usually performed after completion of chemotherapy (8 weeks) prior to the initiation of involved-site RT (ISRT).

### Stage I–II (Unfavorable Disease) and Stage III–IV Disease

Early interim PET imaging after chemotherapy has been shown to be a sensitive prognostic indicator of treatment outcome in patients with advanced-stage disease (stage II disease with unfavorable risk factors [with or without bulky disease] or stage III–IV disease).<sup>43,44</sup>

In two prospective studies, the PET scan after 2 cycles of standard ABVD chemotherapy was a strong and independent prognostic factor of PFS in patients with advanced-stage and extranodal disease.<sup>45,46</sup> In a combined report from these two prospective studies (190 patients with stage IIB–IVB; 70 patients with stage IIA with adverse prognostic factors), the 2-year PFS was significantly better for patients with negative PET after 2 cycles of ABVD than for those with positive PET (95% vs. 13%).<sup>47</sup>

Cerci et al reported similar findings in a prospective study of 102 patients with stage II–IV disease (35% had stage IV disease; 58% had bulky disease; and 63.5% had B symptoms). The 3-year event-free survival (EFS) rate was 53% for patients with positive PET after 2 cycles of ABVD and 90.5% for those with negative PET ( $P < .001$ ).<sup>48</sup>

A retrospective international multicenter study confirmed that interim response assessment based on the 5-PS after 2 cycles of ABVD was predictive of FFS in patients with stage IIB–IVB disease (207 patients) or stage IIA disease with adverse prognostic factors (53 patients).<sup>23,24</sup> After a median follow-up of 37 months, the 3-year PFS rate was 83% for the entire study population (95% for patients with a negative PET scan [score 1–3] and 28% for those with a positive PET scan [score 4–5];  $P < .0001$ ).<sup>24</sup> The 3-year OS rate was 97% for the entire study population (99% for patients with a negative PET scan and 87% for those with a positive PET scan).<sup>24</sup>

In a retrospective analysis of 81 patients with stage I/II (non-bulky or bulky mediastinal disease) and stage III/IV disease treated with the Stanford V

regimen, Advani and colleagues showed that PET positivity after 8 and 12 weeks of chemotherapy was a significant predictor of PFS even after controlling for bulky disease and IPS >2. At a median follow-up of 4 years, the freedom from progression (FFP) was 96% in those with negative PET scans compared with 33% in those with positive PET scans at the completion of chemotherapy.<sup>49</sup>

Markova and colleagues demonstrated that interim PET scans after 4 cycles of BEACOPP (PET-4) is a strong prognostic marker for PFS in patients with early-stage unfavorable (stages IIB with large mediastinal mass or extranodal disease) or advanced-stage (stages III and IV) disease.<sup>50</sup> At a median follow-up of 55 months, the 4-year PFS for PET-4 negative ( $n = 51$ ) and PET-4 positive ( $n = 18$ ) patients was 96% and 78%, respectively ( $P = .016$ ). PET scans at 3 months after the completion of chemotherapy was of limited value when the interim PET-4 was negative.

The Israeli Study Group has evaluated the utility of interim PET scans to develop risk-adapted and/or response-adapted treatment in small cohorts of patients with early-stage unfavorable and advanced-stage disease.<sup>51–53</sup> Avigdor and colleagues evaluated response-adapted de-escalation of therapy (escalated-dose BEACOPP followed by ABVD) in patients with advanced-stage disease and IPS  $\geq 3$ .<sup>52</sup> Forty-five patients were initially treated with 2 cycles of escalated-dose BEACOPP followed by interim PET scan. Patients with a negative interim PET scan received 4 cycles of ABVD, and those with a positive interim PET scan were removed from the study and considered for second-line therapy followed by high-dose chemotherapy and autologous stem cell transplantation (ASCT). After a median follow-up of 48 months, the PFS and OS rates were 78% and 95%, respectively, for patients who completed 4 cycles of ABVD. The 4-year PFS for PET-negative patients ( $n = 31$ ) and PET-positive patients ( $n = 13$ ) were 87% and 53%, respectively ( $P = .01$ ). Long-term follow-up of this study also confirmed that patients with advanced-stage disease with

an IPS  $\geq 3$  who achieved CR after 2 cycles of escalated BEACOPP (as determined by interim PET scan using the revised response criteria) had a favorable outcome after de-escalation of therapy to 4 cycles of ABVD.<sup>54</sup> The 5-year OS rate was significantly higher for patients in CR after early interim PET scan than those with PR (98% vs. 79%;  $P = .015$ ). The Israeli H2 study also showed that de-escalation of therapy is feasible in patients with advanced-stage disease with negative PET scan after 2 cycles of escalated BEACOPP.<sup>55</sup>

Dann and colleagues evaluated a risk-adapted approach with BEACOPP based on the results of interim PET scans for patients with early-stage unfavorable and advanced-stage disease ( $n = 124$ ).<sup>51,53</sup> Patients with advanced disease (stage I–II bulky with B symptoms and stage III–IV) with an IPS  $\geq 3$  were treated with 2 cycles of escalated-dose BEACOPP, and those with an IPS  $\leq 2$  received 2 cycles of standard-dose BEACOPP followed by restaging. Those with a positive interim PET scan received 4 additional cycles of escalated-dose BEACOPP, whereas 4 cycles of standard-dose BEACOPP were given to patients with a negative interim PET scan. The 10-year PFS rate was 83% for patients with a positive interim PET scan and 93% for those with a negative interim PET scan.<sup>53</sup>

### **NCCN Recommendations**

Although the prognostic significance of interim PET scans has been established in patients with advanced disease, the timing of the interim PET scans is still unclear. In one of the prospective studies, there was no significant difference between the prognostic value of interim PET scans after 2 and 4 cycles of chemotherapy.<sup>46</sup> However, a prospective study demonstrated that interim PET imaging after 2 cycles of ABVD was highly predictive of treatment success in patients with stage I–II unfavorable disease and stage III–IV disease; the difference in 3-year EFS was significant for patients with stage III–IV disease ( $P < .001$ ) and for those with stage I–II disease ( $P = .002$ ).<sup>48</sup>

The panel consensus was to incorporate the Deauville criteria (5-PS) for interim response assessment with PET scans for patients with stage I–II (unfavorable, bulky, or non-bulky) disease and patients with stage III–IV disease. The guidelines recommend interim response assessment with PET after 2 or 4 cycles of ABVD or after 4 cycles of escalated-dose BEACOPP. In patients receiving the Stanford V regimen, interim response assessment is usually performed after completion of chemotherapy (8 or 12 weeks) prior to the initiation of RT.

### **Principles of Radiation Therapy**

RT can be delivered with photons, electrons, or protons, depending upon clinical circumstances. Advanced RT techniques emphasize tightly conformal doses and steep gradients adjacent to normal tissues; therefore, target definition, delineation and treatment delivery verification require careful monitoring. Initial diagnostic imaging with contrast-enhanced CT, MRI, PET, ultrasound (US), and other imaging modalities facilitate target definition. Preliminary results from single-institution studies have shown that significant dose reduction to organs at risk (OARs; eg, lungs, heart, breasts, kidneys, spinal cord, esophagus, carotid artery, bone marrow, stomach, muscle, soft tissue and salivary glands) can be achieved with advanced RT planning and delivery techniques such as four-dimensional CT (4D-CT) simulation, intensity-modulated RT (IMRT)/volumetric modulated arc therapy (VMAT), image-guided RT (IGRT), respiratory gating, or deep inspiration breath hold.<sup>56,57</sup> These techniques offer significant and clinically relevant advantages in specific instances to spare OARs and decrease the risk for normal tissue damage and late effects without compromising the primary goal of local tumor control.<sup>58-64</sup>

Randomized prospective studies to test these concepts are unlikely to be done since these techniques are designed to decrease late effects, which usually develop  $\geq 10$  years after completion of treatment. Therefore, the

guidelines recommend that RT delivery techniques that are found to best reduce the doses to the OARs in a clinically meaningful manner without compromising target coverage should be considered in these patients, who are likely to enjoy long life expectancies following treatment.

ISRT and involved-node RT (INRT) are being used as alternatives to involved-field RT (IFRT) in an effort to restrict the size of the RT fields and to further minimize the radiation exposure to adjacent uninvolved organs and the potential long-term toxicities associated with radiation exposure.<sup>65-67</sup> ISRT targets the originally involved nodal sites and possible extranodal extensions, which generally defines a smaller field than the classical IFRT.<sup>68</sup>

ISRT targets the initially involved nodal and extranodal sites as defined by the pre-treatment evaluation (physical examination, CT and PET imaging). However, it is intended to spare the adjacent uninvolved organs (such as lungs, bone, muscle, or kidney) when lymphadenopathy regresses following chemotherapy. Treatment planning for ISRT requires the use of CT-based simulation. The incorporation of additional imaging techniques such as PET and MRI often enhances the treatment planning. The optimized treatment plan for ISRT is designed using conventional, 3-D conformal RT or IMRT techniques using clinical treatment planning considerations of coverage and dose reductions for OARs. The gross tumor volume defined by PET/CT imaging prior to chemotherapy or surgery provides the basis for determining the clinical target volume (CTV). The planning target volume (PTV) is an additional expansion of the CTV to account for any setup variations and internal organ motion.<sup>69</sup> PTV margins should be defined individually for each disease site.

In the setting of combined modality therapy, the panel recommends an RT dose of 30 to 36 Gy when combined with ABVD or Stanford V for patients with bulky disease (all stages).<sup>70,71</sup> In patients with stage I–II non-bulky disease, the recommended RT dose is 20 to 30 Gy following ABVD.<sup>71,72</sup>

For patients treated with RT alone (uncommon, except for NLPHL) the recommended dose is 30 to 36 Gy for the involved regions and 25 to 30 Gy for uninvolved regions. The panel recommends that high cervical regions in all patients and axillae in women always be excluded from RT fields, if those regions are uninvolved.

## Treatment Guidelines

### Diagnosis

The panel recommends that an excisional lymph node biopsy generally be performed and a core needle biopsy may be adequate if diagnostic. Although fine-needle aspiration (FNA) biopsy, which is distinct from a core needle biopsy, is widely used in the diagnosis of malignant neoplasms, its role in the diagnosis of lymphoma is still controversial and a diagnosis of lymphoma cannot be ruled out by a negative FNA biopsy.<sup>73-75</sup> A diagnostic assessment based solely on FNA biopsy is insufficient except in unusual circumstances when in combination with IHC it is judged to be diagnostic of HL by an expert hematopathologist or cytopathologist.

IHC evaluation is recommended. The Reed-Sternberg cells of CHL express CD15 and CD30 in the majority of patients and are usually negative for CD3 and CD45. CD20 may be detectable in less than 40% of patients. Immunostaining for CD3, CD15, CD20, CD30, CD45, CD79a, and PAX5 is recommended for CHL. NLPHL cells are usually CD45+ and CD20+, do not express CD3 or CD15, and rarely express CD30. In addition, NLPHL cells also express epithelial membrane antigen, which is usually not present in CHL. For NLPHL, the guidelines recommend staining for CD3, CD15, CD20, CD30, CD45, CD79a, BCL6, and PAX5. An expanded panel of markers may be required, especially for equivocal diagnosis.

### Workup

Workup should include a thorough history and physical examination (including determination of B symptoms: unexplained fevers  $>38^{\circ}\text{C}$ , drenching night sweats or weight loss of  $>10\%$  of their body weight within 6 months of diagnosis, alcohol intolerance, pruritus, fatigue, performance status, and examination of the lymphoid regions, spleen, and liver); standard laboratory tests (complete blood count [CBC], differential, platelets, ESR, serum lactate dehydrogenase [LDH], albumin, and liver and renal function tests); PET/CT scan (skull base to mid-thigh or vertex to feet in selected cases); and diagnostic contrast-enhanced CT. Chest x-ray is encouraged for patients with large mediastinal mass. Although diagnostic CT scans will often include neck, chest, abdomen, or pelvis, at minimum they should include involved areas identified as abnormal on PET scan. The NCCN Guidelines recommend using PET scans to define the extent of disease and the panel recommends that they should be obtained in accordance with the American College of Radiology (ACR) practice guidelines.<sup>76-78</sup> However, it should be noted that PET scans may be positive in sites of infection or inflammation, even in the absence of HL. In patients with PET-positive sites outside of the disease already identified, or if the PET-positive sites are inconsistent with the usual presentation of HL, additional clinical or pathologic evaluation is recommended. In patients with newly diagnosed HL undergoing pretreatment staging with PET/CT, routine bone marrow biopsy is not required if the PET scan is negative or displays a homogenous pattern of bone marrow uptake, which may be secondary to cytokine release.<sup>79,80</sup> The bone marrow may be assumed to be involved if the PET scan displays multifocal (three or more) skeletal lesions.<sup>79,81</sup> However, a bone marrow biopsy may be performed if cytopenias are present. In select cases, MRI and PET/MRI with contrast (skull base to mid-thigh) may also be considered for anatomical imaging, unless contraindicated.

Evaluation of ejection fraction is recommended for most patients undergoing doxorubicin-based chemotherapy. HIV and hepatitis B or C testing should be encouraged for patients with risk factors for HIV or unusual disease presentations. Pulmonary function tests, including the test of the diffusing capacity of the lungs for carbon monoxide (DLCO), are recommended for patients receiving bleomycin-based chemotherapy. In general, a DLCO threshold of at least 60% is acceptable for bleomycin use.<sup>82,83</sup> H-flu, pneumococcal, and meningococcal vaccines are recommended if splenic RT is contemplated. A diagnostic neck CT scan with contrast is useful in select cases of patients if the neck is positive on PET/CT or in whom RT to the neck is planned.

A pregnancy test should be performed before women of childbearing age undergo treatment. Alkylating agent-based chemotherapy is associated with a higher risk of premature ovarian failure than chemotherapy with non-alkylating agent-based chemotherapy.<sup>84</sup> The guidelines recommend fertility preservation (semen cryopreservation in male patients, ovarian tissue or oocyte cryopreservation in female patients) prior to the initiation of chemotherapy with alkylating agents or pelvic RT.<sup>85,86</sup> Oophoropexy should be considered to preserve ovarian function in pre-menopausal women if pelvic RT is contemplated.<sup>87</sup>

### Classic Hodgkin Lymphoma

Patients are divided into the following groups after initial diagnosis and workup:

- Stage I–II
- Stage III–IV

Patients with stage I–II are further classified into the following subgroups depending on the presence or absence of NCCN unfavorable factors:

- Stage IA–IIA (favorable)

- Stage I–II (unfavorable with non-bulky disease)
- Stage I–II (unfavorable with bulky disease)

### **Stage I–II Favorable Disease**

RT alone was a standard treatment option for patients with early-stage HL for many decades.<sup>88</sup> However, the potential long-term toxicity of high-dose, large-field irradiation includes an increased risk for heart disease, pulmonary dysfunction, and secondary cancers.<sup>89</sup> With the incorporation of chemotherapy regimens routinely used in advanced disease (ABVD and Stanford V) into the management of patients with early-stage disease, combined modality therapy (chemotherapy and RT) has replaced RT alone as the treatment of choice for patients with early-stage, favorable disease.

The ABVD regimen was developed as an alternative to MOPP (mechlorethamine, vincristine, prednisone, and procarbazine) and is associated with lower rates of sterility and leukemia.<sup>70</sup> The Stanford V regimen is a brief but dose-intensive regimen with significantly lower cumulative doses of doxorubicin and bleomycin than those used in ABVD, alternating MOPP/ABVD, BEACOPP, or other hybrid regimens, thereby reducing the risks for chemotherapy-related infertility, secondary neoplasms, and cardiac and pulmonary toxicity.<sup>90,91</sup> RT is an integral part of the Stanford V regimen.<sup>92</sup>

Bonadonna and colleagues initially established the safety and efficacy of ABVD (4 cycles) followed by 36 Gy IFRT as the standard treatment for patients with early-stage disease.<sup>70</sup> The HD10 trial from the GHSG investigated the reduction of the number of cycles of ABVD as well as the IFRT dose in patients with stage I–II disease with no risk factors.<sup>72</sup> The definitions of unfavorable risk factors and lymph node sites used to determine clinical disease staging are outlined in HODG-A. It is worth noting that the GHSG and EORTC do not define the lymph node regions strictly according to the Ann Arbor criteria. Patients were not eligible if they

had 3 or more sites of disease, any E-lesions, bulky mediastinal adenopathy, ESR >50, or ESR >30 in conjunction with B symptoms. In this trial, 1370 patients were randomized to one of the 4 treatment groups: 4 cycles of ABVD followed by 30 Gy or 20 Gy of IFRT or 2 cycles of ABVD followed by 30 Gy or 20 Gy of IFRT.<sup>72</sup> The final analysis of this trial showed that (with a median follow-up of 79–91 months) there were no significant differences between 4 and 2 cycles of ABVD in terms of 5-year OS (97.1% and 96.6%), freedom from treatment failure (FFTF) (93.0% vs. 91.1%), and PFS (93.5% vs. 91.2%). With respect to the dose of IFRT, the OS (97.7% vs. 97.5%), FFTF (93.4% vs. 92.9%), and PFS (93.7% vs. 93.2%) were also not significantly different between 30 Gy and 20 Gy IFRT.<sup>72</sup> More importantly, there were also no significant differences in OS, PFS, and FFTF among the four treatment arms. The results of the HD10 study confirm that 2 cycles of ABVD with 20 Gy of IFRT is an effective primary treatment for patients with a very favorable presentation of early-stage disease with no risk factors, thereby minimizing the risk of late effects.

Two studies from Europe have evaluated the value of interim PET scans in defining the need for IFRT in patients with stage I–II favorable disease (the UK RAPID trial and the EORTC H10 trial).<sup>26,93,94</sup> The interim analysis of the EORTC H10 trial (n = 1137; 444 patients with stage I–II favorable disease; 693 patients with stage I–II unfavorable disease) showed that combined modality therapy (ABVD + INRT) resulted in fewer early progressions compared to treatment with ABVD alone, even in patients with early-stage favorable disease and a negative PET scan after 2 cycles of ABVD.<sup>94</sup> The final results of the EORTC H10 trial demonstrated that in patients with stage I–II favorable and unfavorable disease, a PET-positive response after 2 cycles of ABVD facilitates early treatment adaptation to 2 cycles of escalated BEACOPP + INRT.<sup>95</sup> In patients with PET-positive disease after 2 cycles of ABVD, escalated BEACOPP + INRT improved

the 5-year PFS when compared to 2 additional cycles of ABVD + INRT (90.6% vs. 77.4%, respectively).<sup>95</sup>

The Response-Adapted Therapy in Advanced Hodgkin Lymphoma (RATHL) trial has also examined the use of interim PET to guide treatment for patients with advanced disease, which included 500 patients (41.6%) who had stage II with various risk factors (B symptoms, bulky disease, or at least 3 involved sites).<sup>22,96</sup> In the randomized trial, 1119 patients with stage II–IV disease received 2 cycles of ABVD and underwent interim PET scans. Patients with a Deauville score of 1 to 3 were assigned in a 1:1 ratio to continue treatment with 4 cycles of either ABVD or AVD. At a median of 41 months, the 3-year PFS and OS rates between the ABVD and AVD groups did not differ significantly (85.7% vs. 84.4% and 97.2% vs. 97.6%, respectively). However, the omission of bleomycin from the ABVD regimen after negative PET results (ie, Deauville score of 1–3) led to a decrease in the incidence of pulmonary toxic effects when compared to continued ABVD.<sup>96</sup>

Chemotherapy with ABVD alone has also been investigated as a treatment option for patients with early-stage non-bulky disease (stage I–II). The RAPID trial showed that patients with stages IA–IIA disease with a negative PET scan after 3 cycles of ABVD have an excellent outcome with or without IFRT.<sup>26</sup> In this study (n = 602; 426 patients had a negative PET scan after 3 cycles of ABVD), patients with stage IA–IIA favorable disease (no B symptoms or mediastinal bulky disease) and a Deauville score of 1 to 2 on interim PET scan after 3 cycles ABVD were randomized to either IFRT (n = 209) or observation (n = 211). After a median follow-up of 60 months, the estimated 3-year PFS rate was 94.6% for those treated with IFRT compared to 90.8% for those who received no further treatment. The corresponding 3-year OS rates were 97.1% and 99.0%, respectively,<sup>26</sup> suggesting a benefit for combined modality therapy but not necessarily a superiority over chemotherapy alone with this regimen. The CALGB 50604

trial examined the use of interim PET to guide treatment of patients with non-bulky stage I–II HL using chemotherapy alone or combined-modality therapy.<sup>97</sup> Patients received 2 cycles of ABVD followed by PET. Patients with a PET-negative response (Deauville score of 1–3) were given 2 more cycles of ABVD, whereas patients with a PET-positive response were treated with escalated BEACOPP plus IFRT.<sup>97</sup> With a median follow-up time of 3.8 years, the estimated 3-year PFS for the PET-negative and PET-positive groups were 91% and 66%, respectively.<sup>97</sup>

### ***NCCN Recommendations for Stage I–II Favorable, Non-Bulky Disease***

Combined modality therapy treatment options for patients with stage I–II favorable disease (absence of all NCCN unfavorable risk factors: bulky mediastinal or >10 cm disease, B symptoms, ESR ≥50, and >3 nodal sites of disease) include: ABVD plus ISRT [category 1], or ABVD plus escalated BEACOPP plus ISRT (if interim PET is Deauville 4), or Stanford V chemotherapy plus ISRT (as an alternative option, presently included in the NCCN Guidelines as a footnote).<sup>26,71,72,95</sup> If the intent is to treat with chemotherapy alone, the options include: ABVD alone or ABVD and escalated BEACOPP.<sup>26,96,97</sup>

### ***Preference to Treat with Combined Modality Therapy***

If there is a preference to treat patients with combined modality therapy, for patients who fulfill the GHSG HD10 criteria for favorable stage IA–IIA disease (no bulky disease or extralymphatic lesions, ≤2 sites of nodal disease, and an ESR <50 without E-lesions), 2 cycles of ABVD followed by interim restaging with PET is recommended [category 1]. For patients with a Deauville score of 1 to 3, a planned course of ISRT (20 Gy) is recommended.<sup>72</sup> For patients with a Deauville score of 4, 2 additional cycles of ABVD followed by interim PET/CT may be considered prior to ISRT (30 Gy). Biopsy is recommended for all patients with a score of Deauville 5 after completion of chemotherapy. If the biopsy is negative, patients may be treated with 2 additional cycles of ABVD followed by

interim PET/CT and ISRT (30 Gy). If the biopsy is positive, patients should be managed as described for refractory disease.

In other cases of non-bulky, favorable stage I–II disease patients are administered 2 cycles of ABVD and restaged with PET. An additional cycle of ABVD (total of 3) and ISRT (30 Gy) is recommended for patients with a Deauville score of 1 to 2. Patients with a Deauville score of 3 can be treated with 2 additional cycles of ABVD (total of 4) and ISRT (30 Gy).

In patients with an interim PET Deauville score of 4, the recommended treatment options are 2 additional cycles of ABVD (total of 4) or 2 cycles of escalated BEACOPP followed by restaging with PET.<sup>26,95</sup> If the Deauville score is 1 to 3, the treatment options are to receive ISRT alone or in combination with an additional 2 cycles of ABVD (if previously given, for a total of 6 cycles), or an additional 2 cycles of escalated BEACOPP (if previously given, for a total of 4 cycles).<sup>26,95-97</sup> If the Deauville score is 4 to 5, and a biopsy is negative, patients should be managed as described above for a Deauville score of 1 to 3. If the biopsy is positive, patients should be managed as described for refractory disease.

A Deauville score of 5 warrants a biopsy, and if negative, one treatment option is to administer 2 cycles of escalated BEACOPP alone or combined with ISRT.<sup>96,97</sup> If the biopsy is positive, patients should be managed as described for refractory disease. Alternatively, patients with a Deauville score of 5 may receive 2 cycles of escalated BEACOPP followed by restaging with PET. If the resulting Deauville score is 1 to 3, the recommended options are ISRT alone or combined with an additional 2 cycles of escalated BEACOPP (total of 4). If the Deauville score is 4 to 5, and a biopsy is negative, patients should be managed as described above for a Deauville score of 1 to 3. If the biopsy is positive, patients should be managed as described for refractory disease.

An additional combined modality therapy option for patients with non-bulky, favorable stage IA–IIA disease is the Stanford V regimen for 8 weeks followed by interim PET restaging. A Deauville score of 1 to 4 is treated with 30 Gy ISRT, which is optimally instituted within 3 weeks of completion of chemotherapy.<sup>71</sup> A Deauville score of 5 warrants a biopsy and if negative, patients are treated with 30 Gy ISRT. If the biopsy is positive, patients should be managed as described for refractory disease. The Stanford V regimen is included as an “other recommended” regimen in the NCCN Guidelines as a footnote and offers an alternative in contexts where it is desirable to limit the patient’s exposure to bleomycin.<sup>71</sup>

### *Preference to Treat with Chemotherapy Alone*

If there is a preference to treat patients with chemotherapy alone, an initial administration of 2 cycles of ABVD is followed by interim restaging with PET. After interim restaging patients with a Deauville score of 1 or 2 may receive an additional 1 to 2 cycles of ABVD (total of 3 or 4)<sup>26,97</sup> or 4 cycles of AVD (for initial stage IIB or ≥3 sites)<sup>96</sup>. For patients with a Deauville score of 3, an additional 2 cycles of ABVD (total of 4 [category 2B])<sup>97</sup> or 4 cycles of AVD (for initial stage IIB or ≥3 sites)<sup>96</sup> is recommended.

In patients with a Deauville score of 4, the recommended treatment options are 2 additional cycles of ABVD (total of 4) or 2 cycles of escalated BEACOPP followed by restaging with PET.<sup>26,95</sup> If the Deauville score is 1 to 3, the treatment options are to an additional 2 cycles of ABVD (if previously given, for a total of 6 cycles), or an additional 2 cycles of escalated BEACOPP (if previously given, for a total of 4 cycles).<sup>26,95-97</sup> If the Deauville score is 4 to 5, and a biopsy is negative, patients should be managed as described above for Deauville 1 to 3. If the biopsy is positive, patients should be managed as described for refractory disease.

A Deauville score of 5 warrants a biopsy, and if negative, one treatment option is to administer 2 cycles of escalated BEACOPP.<sup>96,97</sup> If the biopsy is positive, patients should be managed as described for refractory disease.

Alternatively, patients with a Deauville score of 5, may receive 2 cycles of escalated BEACOPP followed by restaging with PET. If the resulting Deauville score is 1 to 3, the recommended option is an additional 2 cycles of escalated BEACOPP (total of 4). If the Deauville score is 4 to 5, and a biopsy is negative, patients should be managed as described above for Deauville 1 to 3. If the biopsy is positive, patients should be managed as described for refractory disease.

### **Stage I–II Unfavorable Disease**

The HD8 trial from the GHSG investigated the efficacy of IFRT vs. extended-field RT (EFRT) in the context of combined modality therapy for patients with early-stage unfavorable HL with one or more risk factors (large mediastinal mass; extranodal disease; splenic involvement; elevated ESR with or without B symptoms; and >2 lymph node areas of involvement).<sup>93</sup> There were no significant differences in FTF or OS when larger radiation fields were employed. IFRT was also associated with less acute toxicity and fewer secondary malignancies. This established combined modality therapy with IFRT as the standard of care for these patients.<sup>93,98</sup>

To investigate the number of cycles of chemotherapy required for maximal efficacy in combined modality therapy, the EORTC-H9U trial randomized 808 patients with stage I–II unfavorable disease to 3 treatment arms and compared 6 cycles of ABVD, 4 cycles of ABVD, and 4 cycles of BEACOPP, followed by IFRT (30 Gy) in all arms.<sup>99</sup> At 4 years of follow-up, when the number of ABVD cycles was reduced from 6 to 4, the trial showed similar EFS (94% vs. 89%) and OS (96% vs. 95%) rates, but increased toxicity was observed in the BEACOPP arm.<sup>99</sup>

The EORTC H10 trial (n = 1137; 444 patients with stage I–II favorable disease; 693 patients with stage I–II unfavorable disease) aimed to demonstrate prognostic significance of early interim PET after 2 cycles of chemotherapy.<sup>94</sup> The H10U trial within this study randomized patients into

2 treatment arms. In the standard arm, patients were treated with 2 cycles of ABVD, underwent interim PET, and were treated with 2 additional cycles of ABVD with INRT (30–36 Gy). In the experimental arm, patients were treated with 2 cycles of ABVD, underwent interim PET scans, and if found to be PET-negative, were treated with an additional 4 cycles of ABVD. If patients were found to be PET-positive after the initial 2 cycles of ABVD, chemotherapy was intensified with 2 cycles of escalated BEACOPP with INRT (30–36 Gy). Although interim analysis demonstrated that chemotherapy alone is a viable treatment option, PET scans showed that combined modality therapy (ABVD + INRT) resulted in fewer early progressions compared to treatment with ABVD alone.<sup>94</sup> As previously mentioned, the final results of the EORTC H10 trial demonstrated that in patients with stage I–II favorable and unfavorable disease, a PET-positive response after 2 cycles of ABVD facilitates early treatment adaptation to 2 cycles of escalated BEACOPP + INRT.<sup>95</sup>

The results of the prospective study conducted by the Stanford group demonstrated the efficacy of the Stanford V regimen followed by RT to initially bulky sites for patients with locally extensive and advanced-stage disease.<sup>100</sup> In this study, 142 patients with locally extensive mediastinal stage I or II disease or stage III or IV disease were treated with Stanford V chemotherapy (12 weeks) followed by RT (36 Gy) to initial bulky sites (≥5 cm) or macroscopic splenic disease. With a median follow-up of 5.4 years, the 5-year FFS and OS rates were 89% and 96%, respectively. No patients progressed during treatment and there were no treatment-related deaths or secondary leukemia. Among 16 patients who relapsed, the freedom from second relapse was 69% at 5 years.

The phase III intergroup trial (E2496) confirmed that there were no significant differences between ABVD and Stanford V in terms of response rates, FFS, OS, and toxicity in patients with locally extensive (stage I–IIA/B and bulky mediastinal disease) and stage III–IV disease.<sup>101,102</sup> In this trial,

854 patients were randomized to ABVD (n = 428; 6–8 cycles plus 36 Gy RT only for patients with bulky mediastinal disease) or Stanford V (n = 426; 12 weeks of chemotherapy plus 36 Gy RT for sites ≥5 cm or for macroscopic splenic disease). The primary endpoint was FFS, defined as the time from randomization to progression, relapse, or death, whichever occurred first. With a median follow-up of 6.4 years, there was no difference in overall response rate (ORR) (clinical CR rates were 72.7% for ABVD and 68.7% for Stanford V), OS (88% at 5 years for both ABVD and Stanford V;  $P = .86$ ), or FFS (74% for ABVD and 71% for Stanford V at 5 years;  $P = .32$ ) between the two arms. Toxicity was also similar in both groups. The planned subgroup analysis showed that the outcome of patients with locally extensive disease was significantly better than that of patients with stage III–IV disease.<sup>102</sup> The 3-year and 5-year FFS rates were 82% for patients with locally extensive disease. The corresponding survival rates were 71% and 67%, respectively, for patients with stage III–IV disease ( $P = .001$ ). The 5-year OS rates were 94% and 85%, respectively ( $P < .001$ ). A planned subgroup analysis in patients with locally extensive disease comparing both ABVD (n = 135) and Stanford V (n = 129) showed that there were no significant differences in CR rates (75% for ABVD and 81% for Stanford V;  $P = .30$ ) and ORR (83% for ABVD and 88% for Stanford V;  $P = .40$ ).<sup>101</sup>

The HD14 trial of the GHSG demonstrated that BEACOPP followed by ABVD and IFRT significantly improved tumor control and PFS in patients with early-stage unfavorable disease (stage IA, IB, or IIA HL with at least one of the following risk factors: bulky mediastinal mass; extranodal involvement; ESR ≥50 [without B symptoms] or ESR ≥30 [with B symptoms]; or ≥3 involved lymph nodes) and stage IIB disease with either of the latter two risk factors.<sup>103</sup> In this trial, 1528 patients were randomized to 4 cycles of ABVD (n = 765) or 2 cycles of escalated-dose BEACOPP followed by 2 cycles of ABVD (n = 763). Chemotherapy was followed by 30 Gy of IFRT in both arms. At a median follow-up of 43 months, the

5-year FFS rate was 94.8% compared to 87.7% for ABVD ( $P < .001$ ). The 5-year PFS rate was 95.4% and 89.1%, respectively ( $P < .001$ ). The 5-year OS rate was not significantly different between the 2 arms (97.2% and 96.8%, respectively;  $P = .731$ ). The rate of progression or relapse was also lower in patients treated with BEACOPP followed by ABVD (2.5% vs. 8.4%;  $P < .001$ ).

Overall, these results suggest that ABVD plus 30 Gy IFRT remains the standard of care for patients with early-stage unfavorable disease. Stanford V (when given as described with RT) or BEACOPP followed by ABVD are acceptable alternatives for some patients.

### **NCCN Recommendations for Stage I–II Unfavorable Disease**

#### *Stage I–II (Unfavorable Non-bulky Disease)*

For patients with stage I–II unfavorable non-bulky disease, combined modality treatment options include: ABVD (preferred) followed by ISRT<sup>94</sup> or ABVD followed by escalated BEACOPP and ISRT.<sup>94</sup> Other recommended options (presently included in the Guidelines as a footnote) include: Stanford V plus ISRT,<sup>100,102</sup> or escalated BEACOPP (2 cycles) followed by ABVD (2 cycles), and ISRT for selected patients <60 years.<sup>103</sup> If the intent is to treat with chemotherapy alone, treatment options include the options include: ABVD alone or ABVD and escalated BEACOPP.<sup>26,96,97</sup>

#### *Preference to treat with combined modality therapy*

If there is a preference to treat patients with combined modality therapy, the preferred regimen, ABVD, is initially administered for 2 cycles followed by interim restaging with PET. Patients with a Deauville score of 1 to 2 can be treated with 2 additional cycles of ABVD (total of 4) and ISRT. Patients with a Deauville score of 3 to 4 are treated with either 2 additional cycles of ABVD alone (total of 4; preferred if Deauville 3) or 2 cycles of escalated BEACOPP (preferred for Deauville 4 or 5). PET restaging may be considered at this point and patients are followed up with ISRT (30 Gy).

Biopsy is recommended for patients with a Deauville score of 5 after initial treatment with 2 cycles of ABVD. If the biopsy is negative, patients are treated as described for patients with a Deauville score of 3 to 4. All patients with a positive biopsy should be managed as described for refractory disease.

Another recommended combined modality therapy option is the Stanford V regimen, which is administered for 12 weeks (3 cycles) followed by ISRT (30–36 Gy) for patients with stage I–II unfavorable non-bulky disease based on presence of B symptoms.<sup>102</sup> Patients are restaged with PET at the completion of chemotherapy. ISRT to initial sites >5 cm is recommended for all patients with a Deauville score of 1 to 4. ISRT should be instituted within 2 to 3 weeks of completion of chemotherapy. Biopsy is recommended for all patients with a Deauville score of 5 after completion of therapy. ISRT should be given if the biopsy is negative. Patients with a positive biopsy should be managed as described for refractory disease. Patients with other unfavorable factors (elevated ESR or >3 sites of disease) are treated with 8 weeks of Stanford V followed by restaging and treated with ISRT (30 Gy) as described for stage IA–IIA favorable disease.<sup>71</sup>

Alternatively, patients may receive escalated BEACOPP (2 cycles) and ABVD (2 cycles) and are restaged after completion of chemotherapy. ISRT is recommended for those with a Deauville score of 1 to 4 and biopsy is recommended for patients with a Deauville score of 5. ISRT should be given if the biopsy is negative. Patients with a positive biopsy should be managed as described for refractory disease.

### *Preference to treat with chemotherapy alone*

If there is a preference to treat patients with chemotherapy alone, the treatment recommendations are as described earlier (See *Stage I–II Favorable, Non-Bulky Disease, Preference to treat with chemotherapy alone*).

### *Stage I–II (Unfavorable Bulky Mediastinal Disease or Adenopathy >10 cm)*

ABVD followed by ISRT (category 1)<sup>94</sup>, ABVD followed by escalated BEACOPP and ISRT<sup>94</sup>, Stanford V plus ISRT<sup>100,102</sup> or escalated BEACOPP (2 cycles) followed by ABVD (2 cycles) and ISRT for selected patients <60 years<sup>103</sup> are included as options for patients with stage I–II unfavorable bulky disease. In the HD14 trial that evaluated escalated BEACOPP followed by ABVD and ISRT, patients with bulky disease in combination with either B symptoms or extranodal disease were excluded.<sup>103</sup> These patients are managed as described for stage III–IV disease.

The preferred regimen, ABVD, is initially administered for 2 cycles followed by interim restaging with PET. Patients with a Deauville score of 1 to 3 are treated with a combination of 2 additional cycles of ABVD (total of 4) and ISRT or with 4 cycles of AVD (total of 6) with or without ISRT.<sup>95,96</sup> The treatment options for patients with a Deauville score of 4 include 2 additional cycles of ABVD (total of 4), or 2 to 3 cycles of escalated BEACOPP. PET restaging may be considered at this point and patients are followed up with ISRT (30 Gy) or an additional cycle of escalated BEACOPP, if they were previously treated with 3 cycles of escalated BEACOPP. Biopsy is recommended for all patients with a Deauville score of 5 after initial treatment with 2 cycles of ABVD. If the biopsy is negative, patients should be managed as described for patients with a Deauville score of 4. Patients with a positive biopsy should be managed as described for refractory disease. Alternatively, patients with a Deauville score of 5 can be initially managed as described for refractory disease, or treated with 2 cycles of escalated BEACOPP, followed by a consideration of PET and ISRT (30 Gy).<sup>95</sup>

Another recommended regimen for patients with stage I–II bulky mediastinal disease or adenopathy >10 cm is the Stanford V regimen, which is administered for 12 weeks (3 cycles) followed by ISRT (30–36

Gy).<sup>100,102</sup> Patients are restaged with PET at the completion of chemotherapy. ISRT to initial sites >5 cm is recommended for all patients with a Deauville score of 1 to 4. ISRT should be instituted within 2 to 3 weeks of completion of chemotherapy. Biopsy is recommended for all patients with a Deauville score of 5 after completion of therapy. ISRT should be given if the biopsy is negative. Patients with a positive biopsy should be managed as described for refractory disease.

Alternatively, patients may receive escalated BEACOPP (2 cycles) and ABVD (2 cycles) and are restaged after completion of chemotherapy. ISRT is recommended for those with a Deauville score of 1 to 4 and biopsy is recommended for patients with a Deauville score of 5. ISRT should be given if the biopsy is negative. Patients with a positive biopsy should be managed as described for refractory disease.

### **Stage III–IV Disease**

While chemotherapy is always used for patients with advanced-stage disease, combined modality therapy is the management approach for some treatment regimens, especially for patients with bulky disease, and is used for poor responders to chemotherapy in other treatment regimens.<sup>31,100,102</sup>

ABVD has been the standard treatment for patients with stage III–IV disease since publication of the landmark randomized trial by the CALGB, which showed that ABVD alone or alternating with MOPP was superior to MOPP alone in patients with newly diagnosed advanced HL (stage III–IV).<sup>104</sup> ABVD also was less myelotoxic than MOPP, or ABVD alternating with MOPP. Stanford V and BEACOPP are the other two regimens developed to improve the outcome of patients with advanced disease.

The results from prospective studies conducted by the Stanford group and other investigators have demonstrated the efficacy of Stanford V and IFRT in patients with advanced-stage disease.<sup>100,105-107</sup> The recently completed

phase III intergroup trial (E2496) also showed that there was no significant difference between ABVD and Stanford V (with RT, when indicated, according to Stanford V protocol guidelines) in ORR, FFS, OS, and toxicity in patients with stage III–IV disease.<sup>102</sup> However, among patients with high-risk disease (IPS ≥3), the 5-year FFS rate was significantly better for ABVD than Stanford V (67% vs. 57%;  $P = .02$ ), but there was no significant difference in 5-year OS rate (84% vs. 77%;  $P = .15$ ).

The efficacy of BEACOPP in patients with advanced disease was demonstrated in two phase III randomized trials conducted by the GHSG.<sup>108,109</sup> In the HD9 study, 1196 patients with stage IIB and IIIA disease with risk factors or stage IIIB and IV disease were randomized to undergo 8 cycles of COPP-ABVD, 8 cycles of standard-dose BEACOPP, or 8 cycles of escalated-dose BEACOPP.<sup>108</sup> Each regimen was followed by RT to initial sites of disease greater than 5 cm. The majority of patients in each treatment arm had stage III–IV disease. At 5-year analysis, escalated-dose BEACOPP showed better tumor control and OS than COPP-ABVD and significantly lower rates of early progression than COPP-ABVD or standard-dose BEACOPP. The 10-year analysis confirmed that escalated-dose BEACOPP was significantly better than standard-dose BEACOPP or COPP-ABVD in terms of FFTF (82%, 70%, and 64%, respectively) and OS rates (86%, 80%, and 75%, respectively). Escalated-dose BEACOPP was significantly better than standard-dose BEACOPP in terms of FFTF ( $P < .0001$ ) and OS ( $P = .0053$ ).<sup>109</sup>

The final results of the HD12 study ( $n = 1670$ ) that compared 8 cycles of escalated-dose BEACOPP with 4 cycles of escalated-dose BEACOPP followed by 4 cycles of standard-dose BEACOPP, with or without RT, also confirmed the efficiency of escalated-dose BEACOPP for patients with advanced-stage HL who have risk factors, as reported in the HD9 trial.<sup>110</sup> In this study, at 5 years, the FFTF (86.4% and 84.8%, respectively) and PFS (87.5% and 85%, respectively) were better (although the difference

was not significant) for 8 cycles of escalated-dose BEACOPP compared to 4 cycles of escalated-dose BEACOPP followed by 4 cycles of standard-dose BEACOPP. The 5-year OS rate, however, was not different (92% and 90.3%, respectively).<sup>110</sup>

The final analysis of the HD15 trial reported by Engert et al showed that 6 cycles of escalated-dose BEACOPP followed by PET-guided RT resulted in significantly superior OS and tumor control than 8 cycles of escalated-dose BEACOPP in patients with advanced-stage disease (stage IIB with large mediastinal mass or stage III–IV).<sup>31</sup> In this study, 2182 patients were randomly assigned to one of the 3 treatment groups: 8 cycles of escalated-dose BEACOPP (n = 728), 6 cycles of escalated-dose BEACOPP (n = 726), or 8 cycles of a time-intensified standard-dose BEACOPP (n = 728). RT (30 Gy) was restricted to patients with PET-positive residual sites (2.5 cm or more) after chemotherapy. The 5-year FTF rates were 84.4%, 89.3%, and 85.4%, respectively, for the 3 groups. The corresponding OS rates were 91.9%, 95.3%, and 94.5%, respectively, and were significantly better with 6 cycles of escalated-dose BEACOPP than with 8 cycles of escalated-dose BEACOPP ( $P = .019$ ). Escalated-dose BEACOPP was also associated with less treatment-related mortality (TRM) (4.6% vs. 7.5% for 8 cycles of escalated-dose BEACOPP and 5.2% for 8 cycles of time-intensified standard-dose BEACOPP) and fewer secondary cancers (2.4% compared to 4.7% and 3.1%, respectively, for 8 cycles of escalated-dose BEACOPP and 8 cycles of time-intensified standard-dose BEACOPP). These results confirm that 6 cycles of escalated-dose BEACOPP followed by PET-guided RT is an acceptable treatment for patients with advanced-stage disease.

The HD18 trial investigated whether PET response after 2 cycles of escalated BEACOPP would sufficiently guide treatment adaptation in adult patients with newly diagnosed, advanced-stage HL (n = 2101).<sup>111</sup> After 2

cycles of escalated BEACOPP, PET-negative patients were randomized to receive an additional 2 or 6 cycles of escalated BEACOPP, and PET-positive patients were randomized to receive an additional 6 cycles of escalated BEACOPP alone or with rituximab. The final results of the phase III trial showed that patients with a negative PET-2 who received 6 to 8 cycles of BEACOPP (n = 504) or 4 cycles of escalated BEACOPP (n = 501) had a 5-year PFS of 90.8% and 92.2%, respectively. Patients with a positive PET-2 who received 8 cycles of escalated BEACOPP alone or combined with rituximab (n = 217 per arm) had a 5-year PFS of 89.7% and 88.1%, respectively.<sup>111</sup> These results suggest that 4 cycles on escalated BEACOPP is adequate therapy in patients with a negative interim PET.

Results from studies that have compared escalated-dose BEACOPP with standard-dose BEACOPP or ABVD failed to show an OS advantage for escalated-dose BEACOPP, although it resulted in better tumor control in patients with advanced disease.<sup>112–115</sup> However, some of these studies were not sufficiently powered to determine differences in OS due to small patient numbers. The EORTC 2012 trial evaluated BEACOPP (4 cycles of escalated-dose and 4 cycles of standard-dose) and ABVD (8 cycles) in high-risk patients with stage III–IV disease and IPS  $\geq 3$  (274 patients in the BEACOPP arm and 275 patients in the ABVD arm).<sup>112</sup> The results showed that there was no improvement in OS (86.7% and 90.3, respectively, at 4 years;  $P = .208$ ) or EFS (63.7% and 69.3%, respectively, at 4 years;  $P = .312$ ), although the PFS was significantly better with BEACOPP (83.4% vs. 72.8% for ABVD;  $P = .005$ ). Early discontinuations were also more frequent with BEACOPP. The median follow-up was 3.6 years.<sup>112</sup> The long-term follow-up analysis of the HD2000 trial also showed that the risk of secondary malignancy at 10 years was significantly higher with BEACOPP than with ABVD (6.6 vs. 0.9;  $P = .027$ ).<sup>116</sup>

Several trials have addressed the role of consolidative RT after completion of chemotherapy in patients with stage III–IV disease.

In the randomized trial (EORTC 20884 trial) that assessed the role of consolidation RT following MOPP-ABV chemotherapy in patients with advanced disease, 739 patients with untreated stage III–IV disease received 6 to 8 cycles of MOPP-ABV. Patients in complete remission on CT imaging after chemotherapy were randomized to no further treatment or IFRT, and those with a partial remission received IFRT to involved nodal areas and extranodal sites.<sup>117</sup> The 8-year OS and EFS rates in the partial remission group were 76% and 84%, respectively. These outcomes were not significantly different in patients with complete remission (with or without IFRT), suggesting that consolidative IFRT is beneficial for patients experiencing partial remission after chemotherapy.

In the randomized controlled trial from the United Kingdom Lymphoma Group (LY09 trial) that compared ABVD with two other multidrug regimens, IFRT was recommended for incomplete response to chemotherapy or bulk disease at presentation.<sup>118</sup> PFS was superior for patients who received RT (5-year PFS was 71% without RT and 86% with RT) and a similar advantage was seen for OS. The final results of the HD12 trial also showed that consolidation RT was beneficial for patients with residual disease after escalated-dose BEACOPP (FFTF was 90.4% and 87%, respectively), whereas this effect was not seen in patients with initial bulk disease who were in CR after chemotherapy.<sup>110</sup> In contrast, Laskar and colleagues reported a survival advantage for consolidative RT in patients experiencing CR after initial chemotherapy, particularly in patients younger than 15 years and in patients with B symptoms and bulky and advanced disease.<sup>119</sup> However, this study included patients with a different distribution of histologic subtypes of HL than those included in Western studies, and most patients had early-stage HL. Of note, none of these studies incorporated PET scan for the evaluation of response.

In the HD15 trial, RT (30 Gy) after BEACOPP chemotherapy was restricted to those patients in PR with PET-positive residual disease (2.5 cm or more). PET-negative patients received no additional RT.<sup>31</sup> Of the 739 qualified patients with residual disease (2.5 cm or more) after 6 to 8 cycles of BEACOPP, 548 patients (74%) were PET-negative; 191 patients (26%) were PET-positive and received consolidative RT. The final analysis showed that the prognosis of patients in PR with PET-negative persistent residual disease after chemotherapy was similar to those who were in CR as measured by conventional CT (4-year PFS was 92.1%), suggesting that consolidative RT could be omitted in patients with a PET-negative PR.<sup>31</sup> However, the use of consolidative RT was effective for patients with PET-positive PR, since the 4-year PFS in this group was 86.2%. In relapse analysis of the HD15 trial, of 225 patients with PET-positive disease after BEACOPP chemotherapy and RT, 197 (89%) were relapse-free for the duration of their follow-up (median 42 months).<sup>120</sup>

A recent randomized phase III trial, ECHELON-1, compared the efficacy of ABVD (n = 670) versus brentuximab vedotin plus AVD (n = 664) in previously untreated stage III or IV CHL.<sup>121</sup> At a median follow-up of 24.9 months, the 2-year modified PFS rates in the brentuximab vedotin + AVD and ABVD groups were 82.1% and 77.2%, respectively (*P* = .03). The study demonstrated that removing bleomycin from frontline therapy lowered the incidence of pulmonary toxicity, but it was noted that peripheral neuropathy occurred more frequently in the brentuximab vedotin + AVD group.<sup>121</sup> Based on the results of this study, the FDA approved the use of brentuximab vedotin combined with chemotherapy for first-line treatment of stage III or IV CHL.

Two European trials evaluated the role of HDT/ASCR as a consolidative therapy for patients with advanced-stage and unfavorable HL that responded to initial chemotherapy.<sup>122,123</sup> Neither trial showed an advantage for HDT/ASCR over conventional chemotherapy for patients

with unfavorable and advanced HL experiencing CR or PR after an initial course of doxorubicin-based chemotherapy. Instead, additional courses of the same conventional chemotherapy used as initial treatment produced equivalent or better outcomes than HDT/ASCR.

### ***NCCN Recommendations for Stage III–IV Disease***

ABVD, escalated-dose BEACOPP (in selected patients <60 years with an IPS of  $\geq 4$ ), or brentuximab vedotin plus AVD are included as options for primary treatment for patients with stage III–IV disease.<sup>31,95,96,111,121</sup> In this setting, the ABVD regimen is preferred. Brentuximab vedotin plus AVD is a category 2B option, but is a category 2A option in select patients with no known neuropathy, if IPS  $\geq 4$ , or bleomycin is contraindicated.

ABVD is initially administered for 2 cycles followed by restaging with PET. Patients with a Deauville score of 1 to 3 are treated with 4 cycles of AVD based on results from the RATHL trial.<sup>96</sup> Consistent with the results of the E2496 study, observation or ISRT to initially bulky or selected PET-positive sites are included as options for patients with a Deauville score of 1 to 3 after 2 cycles of ABVD and 4 cycles of AVD.<sup>102</sup>

Several studies have reported that early intensification to escalated BEACOPP in patients with a positive interim PET scan (based on the 5-PS) after 2 cycles of ABVD is associated with favorable outcomes.<sup>96,124,125</sup> Based on these findings, for patients with a Deauville score of 4 or 5, the guidelines recommend 2 cycles of escalated BEACOPP. Alternatively, patients with a Deauville score of 4 may receive an additional 2 cycles of ABVD (total of 4). Patients are then restaged with PET and for patients with a Deauville score of 1 to 3, the recommended options are to continue on therapy with 2 additional cycles of either escalated BEACOPP (total of 4) or ABVD (total of 6), alone or combined with ISRT to initially bulky or selected PET-positive sites. A biopsy is recommended for patients with a Deauville score of 4 or 5. If the biopsy is negative, treatment is as described for patients with a Deauville score of 1

to 3. Patients with a positive biopsy should be managed as described for refractory disease.

In selected patients less than 60 years of age with IPS  $\geq 4$ , escalated BEACOPP is initially administered for 2 cycles followed by restaging with PET. For patients with a Deauville score of 1 to 3, treatment options include an additional 2 cycles of escalated BEACOPP or 2 cycles of ABVD or AVD, with ISRT to initially bulky or PET-positive sites. Based on the final results of the HD15 and HD18 trials,<sup>31,111</sup> for patients with a Deauville score of 4, an additional 2 cycles of escalated BEACOPP (4 cycles) is recommended followed by restaging with PET. If the resulting Deauville score is 1 to 3, or 4 to 5 with a negative biopsy, an additional 2 cycles of escalated BEACOPP with ISRT to initially bulky or PET-positive sites is recommended. Patients with a Deauville score of 4 to 5 with a positive biopsy should be managed as described for refractory disease. For patients with a Deauville score of 5, a biopsy is recommended. If the biopsy is negative, an additional 4 cycles of escalated BEACOPP (total of 6) with ISRT to the initially bulky or PET-positive sites is a recommended option. Patients with a positive biopsy should be managed as described for refractory disease.

The feasibility of de-escalation of therapy to ABVD in patients with advanced-stage disease (IPS  $\geq 3$ ) who achieved CR after 2 cycles of escalated BEACOPP has been demonstrated in studies conducted by the Israeli Study Group.<sup>52</sup> Interim restaging with PET after 2 cycles of escalated BEACOPP with a possible de-escalation of therapy (4 cycles of ABVD) may be considered in patients with a negative interim PET.

Brentuximab vedotin plus AVD is initially administered for 2 cycles followed by restaging with PET. Patients with a Deauville score of 1 to 5 are treated with 4 additional cycles of brentuximab vedotin plus AVD. If patients have a Deauville score of 5, alternative frontline therapy should be considered, including escalated BEACOPP (category 2B) or therapy for

refractory disease. If the subsequent restaging with PET results in a Deauville score of 3 or 4, patients may be observed or administered ISRT to PET-positive sites. However, for patients with a Deauville score of 5, management recommendations are as described for refractory disease.

### **Management of Classic Hodgkin Lymphoma in Older Adults (>60 years)**

CHL in older adult patients (>60 years of age) is associated with worse disease outcomes.<sup>126</sup> B symptoms, poor performance status, mixed cellularity, histologic subtype, Epstein-Barr virus-positive (EBV+) disease, and medical comorbidities are more frequent in this population.<sup>127</sup> Standard chemotherapy regimens are associated with dose reductions, treatment toxicity, and TRM in older patients.<sup>128-131</sup> However, there are limited prospective data evaluating alternatives to standard therapies for older patients. Selection of standard versus alternate first-line regimens should be based on clinical judgment, with the goal of minimizing toxicity while maximizing efficacy.

In the HD10 and HD13 trials led by the GHSG, the impact of bleomycin in the ABVD regimen in older (≥60 years) patients with stage I–II favorable HL was evaluated. Two hundred eighty-seven patients were randomized to receive: 2 cycles of ABVD or 2 cycles of AVD followed by 20 or 30 Gy IFRT (HD13 study) and 2 cycles of ABVD or 4 cycles of ABVD followed by 20 or 30 Gy IFRT (HD10 study).<sup>132</sup> Overall grade III–IV toxicity and grade III–IV leukopenia and infection rates were higher in patients receiving 4 cycles of ABVD. The results of the study suggested limited benefit in older patients receiving more than 2 cycles of bleomycin.<sup>132</sup>

Due to pulmonary toxicity, bleomycin should be used with caution, as it may not be tolerated in elderly patients. In a retrospective analysis, 147 patients with stage I–IV HL aged at least 60 years were treated with ABVD and evaluated for toxicity and survival.<sup>133</sup> All patients received at least 1 full course of ABVD and 50 patients received additional RT (30–40 Gy). Bleomycin was removed or reduced in 53 patients due to pulmonary

toxicity. Complete remission was observed in 117 patients (80%) with a 5-year OS rate estimated at 67% (95% CI, 58–74).<sup>133</sup>

Other regimens have been used as front-line chemotherapy in elderly patients with HL, including CHOP (cyclophosphamide, doxorubicin, vincristine, and prednisolone);<sup>134</sup> brentuximab vedotin plus dacarbazine (DTIC);<sup>135,136</sup> VEPEMB (vinblastine, cyclophosphamide, prednisolone, procarbazine, etoposide, mitoxantrone, and bleomycin);<sup>137,138</sup> BACOPP (bleomycin, doxorubicin, cyclophosphamide, vincristine, procarbazine, and prednisone);<sup>131</sup> and PVAG (prednisone, vinblastine, doxorubicin, and gemcitabine).<sup>139</sup>

### **NCCN Recommendations for Older Adults (Age >60 years) with CHL**

The regimens listed below should be considered in older patients to lessen or minimize toxicity. These regimens have not been proven to overcome the poorer disease outcomes observed in older patients. Clinical trial is recommended when available.

#### *Stage I–II Favorable Disease*

ABVD, CHOP, and VEPEMB are included as primary treatment options for elderly patients (>60 years of age) with stage I–II favorable disease.<sup>72,132-134,138</sup> In this setting, ABVD is the preferred option and 2 cycles of ABVD are administered with or without 2 cycles of AVD and ISRT (20–30 Gy). Bleomycin may be omitted from ABVD. The other treatment regimens include 4 cycles of CHOP with ISRT (30 Gy) and 3 cycles of VEPEMB with or without ISRT (30 Gy).

#### *Stage I–II Unfavorable or Stage III–IV Disease*

ABVD, brentuximab vedotin plus DTIC, CHOP, PVAG, and VEPEMB are included as primary treatment options for elderly patients with stage I–II unfavorable or stage III–IV disease.<sup>96,134-139</sup> For all stages, a PET scan follows treatment with 2 cycles of ABVD. Bleomycin may be omitted from ABVD. If the PET scan is negative, patients can be treated with 4 cycles

of AVD (total of 6 cycles), although 2 cycles of AVD (total of 4 cycles) may be considered for stage I–II unfavorable disease. If the PET scan is positive after 2 cycles of ABVD, an individualized treatment plan should be developed. Other treatment regimens include 6 cycles of CHOP, PVAG, and VEPEMB with or without ISRT.

### Nodular Lymphocyte-Predominant Hodgkin Lymphoma

NLPHL is characterized by an indolent course and occasional late relapse. It has a different natural history and response to therapy compared with CHL.<sup>140</sup> The majority of patients present with early-stage disease and rarely with B symptoms, mediastinal or extranodal involvement, or bulky disease.<sup>141-143</sup> Patients who present with bulky disease, subdiaphragmatic disease, or splenic involvement have a high risk for initial or later transformation to large cell lymphoma.<sup>144</sup> Data suggest outcomes differ for typical immunoarchitectural patterns (A/B) versus variant patterns (C/D/E/F), with the variant patterns being associated with advanced-stage disease and a higher risk of relapse.<sup>145-147</sup> In the retrospective analysis from the GHSG that included 394 patients with NLPHL, 63% had early-stage favorable, 16% had early-stage unfavorable, and 21% had advanced-stage disease. At a median follow-up of 50 months, FFTF (88% vs. 82%) and OS (96% vs. 92%) were better for NLPHL compared with CHL.<sup>142</sup> Among patients with NLPHL, FFTF was better for early-stage favorable disease (93%) compared with early-stage unfavorable (87%) and advanced-stage disease (77%). The European Task Force on Lymphoma also reported favorable FFTF for early-stage disease (85% for stage I; 71% for stage II) compared with those with stage III (62%) or stage IV (24%) disease.<sup>141</sup> Advanced stage at presentation, age ( $\geq 45$  years), low hemoglobin, and the presence of B symptoms are associated with worse OS.<sup>142,143</sup>

Several retrospective studies have reported favorable clinical outcomes for patients with stage I to II disease treated with RT alone<sup>148-152</sup> or in

combination with chemotherapy.<sup>143,153,154</sup> RT alone is an effective treatment option for patients with stage IA–IIA disease.<sup>148,150,155</sup> In a retrospective analysis, Schlembach and colleagues reported favorable 5-year relapse-free survival (RFS; 95%) and OS (100%) for patients with stage IA disease treated with IFRT and regional RT alone.<sup>148</sup> There was no evidence of secondary solid tumors even after long-term follow-up (11.6 years for IFRT and 5.5 years for regional RT). Longer follow-up is needed to define the risks for cardiac toxicity; however, mediastinal treatment is infrequently required for patients with NLPHL. Another retrospective study from the Australasian Radiation Oncology Lymphoma Group reported longer follow-up of 202 patients with stage I–II NLPHL treated with RT alone, including mantle and total lymphoid irradiation (TLI).<sup>150</sup> At 15 years, FFP was 84% for patients with stage I disease and 73% for those with stage II disease. An additional retrospective analysis from the GHSG clinical trials reported favorable PFS and OS rates (91.9% and 99.0%, respectively) at 8 years in patients with stage IA disease treated with IFRT.<sup>155</sup>

Among the studies that have evaluated the outcomes of patients treated with RT alone or combined modality treatment, the subgroup analysis of 64 patients with NLPHL included in the GHSG HD7 trial showed a non-significant trend toward better 7-year FFTF for the combined modality group (96%) compared with the EFRT group (83%;  $P = .07$ ).<sup>154</sup> However, other retrospective studies have shown no difference in outcome between patients treated with RT alone or in combination with chemotherapy.<sup>149,151,152</sup> The MD Anderson study that evaluated RFS, OS, and patterns of first recurrence in patients with stage I–II NLPHL treated with RT alone or with chemotherapy followed by RT showed that the RFS (77% and 68%, respectively) and OS (90% and 100%, respectively) were similar in the 2 treatment groups at 9.3 years and that chemotherapy did not reduce the recurrence outside the RT field.<sup>149</sup> The GHSG retrospectively compared 3 treatment options, including EFRT, IFRT, and

combined modality treatment in patients with stage IA NLPHL.<sup>151</sup> Median follow-up was 78 months for EFRT, 40 months for combined modality, and 17 months for IFRT. Complete remissions were observed in 98% after EFRT, 95% after combined modality, and 100% after IFRT, and no significant differences were seen in FTF, suggesting that IFRT is equally as effective as EFRT and combined modality treatment. Chen and colleagues reported the long-term outcome of 113 patients with NLPHL treated at the author's institution with a median follow-up of 136 months.<sup>152</sup> Ninety-three patients received RT alone, 13 received RT with chemotherapy, and 7 received chemotherapy alone. The 10-year PFS rates were 85% (stage I) and 61% (stage II); OS rates were 94% and 97% for stages I and II, respectively. The addition of chemotherapy to RT did not improve PFS or OS compared with RT alone and six of seven patients who received chemotherapy alone developed early disease progression.

A report from the French Adult Lymphoma Study Group that analyzed the long-term outcomes of 164 patients with NLPHL (82% of patients had stage IA–IIA disease) included 58 patients who were observed following diagnosis and lymph node biopsy.<sup>156</sup> The 10-year PFS rate for this group of patients was 41% compared to 66% for patients who received specific treatment. However, the 10-year OS rate was not different between the two groups (91% and 93%, respectively) and 50% of patients treated with a watch-and-wait approach were in complete remission at a median follow-up of 3 years. Watchful waiting has also been shown to be an appropriate treatment option in pediatric patients with early-stage NLPHL who are in complete remission following lymph node excision.<sup>157,158</sup>

Patients with advanced-stage NLPHL have a worse prognosis than those with early-stage favorable disease, and can be treated with chemotherapy. In the European Task Force on Lymphoma study, the 8-year disease-specific survival and FTF were 94% and 62%, respectively, for stage III disease and 41% and 24%, respectively, for stage IV disease.<sup>141</sup>

Most of these patients (80%–95%) were treated with chemotherapy (MOPP- or ABVD-like regimens) with or without RT.

In the absence of randomized trials comparing different chemotherapy regimens, no preferred chemotherapy regimen exists for NLPHL, although ABVD is often used based on the data for patients with CHL. Savage et al have reported that ABVD chemotherapy with (n = 89) or without (n = 11) RT was associated with superior outcomes compared to a historical cohort of patients treated with RT alone for stage IA, IB, or IIA NLPHL.<sup>159</sup> With a median follow-up of 6.4 years, patients treated with ABVD-like chemotherapy with or without RT had a superior 10-year time to progression (TTP) (98% vs. 76%), PFS (91% vs. 65%), and OS (93% vs. 84%) compared to those treated with RT alone. On the other hand, an analysis of the combined data from the CALGB trials and Dana-Farber Cancer Institute trials that included patients with stage III–IV NLPHL treated with chemotherapy alone, showed that the failure rate was 75% for the 12 patients treated with ABVD or EVA (etoposide, vinblastine, and doxorubicin) and 32% for the 25 patients treated with alkylating agent-containing regimens (MOPP or MOPP/ABVD).<sup>160</sup> Some investigators have also reported good response rates with CHOP plus rituximab<sup>161–163</sup> or CVP (cyclophosphamide, vincristine, and prednisone) in patients with early-stage or advanced disease.<sup>164</sup>

Because NLPHL cells consistently express CD20 antigen, several clinical studies have explored the efficacy of rituximab, an anti-CD20 antibody for patients with newly diagnosed and relapsed or refractory NLPHL.<sup>165–169</sup>

In a prospective phase II trial conducted by the Stanford group, previously treated (n = 10) and untreated (n = 12) patients with stage I–IV NLPHL received 4 weekly doses of rituximab at 375 mg/m<sup>2</sup>. The ORR was 100% (41% CR, 54% PR, and 5% CRu). At a median follow-up of 13 months, 9 patients had relapsed and the estimated median FFP was 10.2 months.<sup>165</sup>

The estimated probability of disease progression at 10.2 months was 52%. Rituximab was well tolerated, with few adverse side effects.

In a GHSG phase II study that investigated rituximab in patients with newly diagnosed stage IA NLPHL (n = 28), the ORR was 100% (complete and partial remission were achieved in 86% and 14% of patients, respectively). At a median follow-up of 43 months, the OS rate was 100%; the PFS rate at 12, 24, and 36 months was 96%, 85%, and 81%, respectively.<sup>167</sup> However, the relapse rate was 25%. In the GHSG phase II study that evaluated rituximab in patients with relapsed or refractory CD20-positive NLPHL (n = 15), the ORR was 94% (8 patients with complete remission and 6 patients with partial remission). At a median follow-up of 63 months, median TTP was 33 months and the median OS was not reached.<sup>166</sup>

Rituximab followed by rituximab maintenance has also been evaluated in patients with newly diagnosed and relapsed or refractory NLPHL. In a study conducted by the Stanford group, newly diagnosed or previously treated patients with NLPHL (n = 39) were treated with rituximab (4 weekly doses of rituximab at 375 mg/m<sup>2</sup>) or rituximab followed by rituximab maintenance (once every 6 months for 2 years).<sup>169</sup> The ORR was 100% (67% CR and 33% PR) at the end of initial therapy with rituximab alone. The median follow-up was 9.8 years for rituximab and 5 years for rituximab plus maintenance rituximab. The estimated 5-year PFS rate was 39.1% and 58.9%, respectively, for patients treated with rituximab and rituximab followed by maintenance rituximab. The corresponding 5-year OS rates were 95.7% and 85.7%, respectively. Rituximab as initial treatment was also associated with a pattern of relapse with evidence of transformation to aggressive B-cell lymphoma, primarily in patients with intra-abdominal disease. This underscores the importance of biopsy of intra-abdominal sites of disease at initial presentation or relapse. Rituximab maintenance for 2 years was associated with a non-significant

increase in median PFS compared to rituximab alone (5.6 years and 3 years, respectively;  $P = .26$ ).

Collectively, the above data suggest that rituximab alone or in combination with chemotherapy has activity in the management of patients with newly diagnosed and relapsed NLPHL.<sup>165,167,169</sup>

### ***NCCN Recommendations for NLPHL***

Available evidence from retrospective studies supports the use of ISRT alone as a treatment option for patients with early-stage disease.<sup>148-152</sup>

The panel recommends that ISRT (30–36 Gy) be the preferred treatment for all patients with stage IA or contiguous stage IIA non-bulky disease. Observation may be an option for highly selected patients with stage IA disease with a completely excised solitary node. A brief course of chemotherapy plus ISRT with rituximab is recommended for patients with stage IB or IIB disease and for very rare patients presenting with stage IA or IIA bulky or non-contiguous disease. For select patients with stage IB or stage IIA non-contiguous disease, ISRT alone may be considered.

Chemotherapy and rituximab with or without ISRT is recommended for all patients with stage III–IV disease. Alternatively, patients can be observed if asymptomatic, or treated with local RT for palliation of locally symptomatic disease or rituximab. Abdominal involvement has been associated with the risk of transformation to an aggressive B-cell lymphoma.<sup>169</sup> Biopsy of persistent or new subdiaphragmatic sites should be considered to rule out transformation for patients with stage III or IV disease.

Reevaluation with PET should be done for all patients after completion of initial therapy. Observation is recommended for all asymptomatic patients with a clinical response. ISRT is recommended if not received previously. Biopsy is recommended for patients with stable or progressive disease.

Asymptomatic patients with a negative biopsy can be observed and those with a positive biopsy should be managed as described for relapsed or refractory disease.

Rituximab may be used in combination with chemotherapy regimens (ABVD, CHOP, or CVP) that are most commonly used at NCCN Member Institutions. Ongoing clinical trials may clarify the role of observation, rituximab, or combination chemotherapy options for patients with NLPHL.

### Follow-up after Completion of Treatment

Recommendations included in the guidelines are based largely on the clinical practices at NCCN Member Institutions and are not supported by high-level evidence, since there are very few data available on the follow-up and monitoring of late effects in patients with HL, after completion of treatment.<sup>170</sup>

The panel overwhelmingly agrees that, given the long-term risks of the therapies for HL, patients should be followed up with an oncologist who is aware of these risks and complications, and coordinated with the primary care provider, especially during the first 5 years after treatment to detect recurrence and then annually because of the risk for late complications, including secondary cancers and cardiovascular disease.<sup>170</sup> The follow-up schedule should be individualized, depending on clinical circumstances such as patient's age, stage of disease, and initial treatment modality. Patients should be encouraged to undergo counseling on issues regarding survivorship, long-term treatment effects (secondary cancers, cardiac disease, and reproduction), health habits, and psychosocial issues. It is recommended that the patient be provided with a treatment summary at the completion of therapy, including details of RT, OARs, and cumulative anthracycline dosage given.

Interim physical examinations and blood tests (CBC, platelets, and ESR if elevated at initial diagnosis and chemistry profile) are performed every 3 to

6 months for 1 to 2 years and then every 6 to 12 months for the next 3 years and then annually. Annual fasting glucose levels may also be monitored. An annual influenza vaccination and other vaccines as clinically indicated is recommended for all patients (see the [NCCN Guidelines for Survivorship](#)). In addition, patients treated with splenic RT or splenectomy should receive pneumococcal, meningococcal, and Haemophilus influenzae type b revaccination after 5 to 7 years (according to the current CDC recommendations).

Repeat imaging studies of initially involved sites are important, as are surveillance studies of the chest and abdomen.<sup>171</sup> In a randomized trial that compared the use of PET/CT with the combination of US and chest radiography for systematic follow-up of 300 patients with advanced-stage disease, the sensitivity for the detection of relapse was similar for both procedures.<sup>172</sup> The specificity (96% vs. 86%, respectively;  $P = .02$ ) and positive predictive value (91% vs. 73%, respectively;  $P = .01$ ) were significantly higher for the combination of US and chest radiography. It is acceptable to obtain a neck/chest/abdominal/pelvis CT scan with contrast at 6, 12, and 24 months following completion of therapy, or as clinically indicated. However, PET scans are not recommended for routine surveillance due to the risk of false positives.<sup>33,34,36</sup>

### Monitoring for Late Effects

Secondary cancers, cardiovascular disease, hypothyroidism, and fertility issues are the most serious late effects in long-term survivors of HL. The incidence of these late effects increases with longer follow-up time. The risk may be less with current treatment programs compared to those used more than 10 years ago.

#### Secondary Cancers

Solid tumors are the most common secondary cancers and most develop more than 10 years after the completion of treatment. The risk of

developing secondary cancers is highest when RT is used as a component of first-line treatment. Meta-analysis by Franklin and colleagues showed that the risk of developing secondary cancers was lower with combined modality treatment than with RT alone as the initial treatment.<sup>173</sup> The risk was marginally higher with combined modality treatment when compared with chemotherapy alone as initial treatment. No significant differences in the risk of developing secondary cancers were seen with IFRT versus EFRT, although the risk of developing breast cancer was substantially higher for EFRT. Risks for secondary lung cancer, non-Hodgkin's lymphoma (NHL), and leukemia were significantly higher after treatment with chemotherapy alone, whereas combined modality therapy was associated with a higher risk for these and several other cancers.<sup>174</sup> Lung cancer and breast cancer are the most common secondary cancers in patients with HL.

Annual breast screening [mammography and MRI] beginning no later than 8 to 10 years after completion of therapy or at age 40 (whichever occurs earlier) is recommended for women who have received chest or axillary irradiation.<sup>171</sup> They should also be encouraged to perform monthly breast self-examination and undergo yearly breast examination by a health care professional. In a prospective study that evaluated the sensitivity and specificity of breast MRI with that of mammography in women who received chest irradiation for HL, the sensitivity of the combined MRI and mammography as a combined screening modality was higher than that of MRI or mammography alone (94% for combined MRI and mammography; 67% and 68%, respectively, for MRI and mammography).<sup>175</sup> The guidelines recommend breast MRI in addition to mammography for women who received irradiation to the chest between 10 and 30 years of age, which is consistent with the recommendation of the American Cancer Society Guidelines<sup>176</sup> and the NCCN Guidelines for Detection, Prevention, and Risk Reduction.

The guidelines recommend that routine surveillance tests for cervical, colorectal, endometrial, lung, and prostate cancer be performed as per the American Cancer Society Guidelines.

### **Cardiovascular Disease**

Mediastinal irradiation and anthracycline-based chemotherapy are the highest risk factors for developing cardiac disease, which may be asymptomatic.<sup>177-179</sup> RT-induced cardiotoxicity is usually observed more than 5 to 10 years after completion of treatment. However, cardiovascular symptoms may emerge at any age. Coronary CT angiography abnormalities have been detected in nearly 15% of the patients within the first 5 years after treatment and their incidence significantly increases 10 years after treatment.<sup>180</sup> In a multivariate analysis patient's age at treatment, hypercholesterolemia, hypertension, and RT dose to the coronary artery origins were identified as independent prognostic factors.

Based on data regarding increased long-term risk of cardiac disease, annual blood pressure monitoring (even in asymptomatic individuals) and aggressive management of cardiovascular risk factors is recommended.<sup>171</sup> A baseline stress test or echocardiogram and carotid US (for patients treated with neck RT) should be considered at 10-year intervals after completion of treatment.

### **Hypothyroidism**

Abnormal thyroid function, mostly hypothyroidism, is reported in about 50% of long-term survivors who received neck or upper mediastinal irradiation.<sup>170</sup> A careful thyroid examination should be a part of the physical exam. Thyroid function tests should be done at least annually to rule out hypothyroidism, especially in patients treated with RT to the neck.

### **Myelosuppression**

Myelosuppression is the most common side effect of chemotherapy and is associated with increased risk of infections. It is uncommon for



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## Hodgkin Lymphoma

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myelosuppression to continue for very long beyond completion of the primary treatment program. However, patients who undergo HDT/ASCR or allogeneic hematopoietic stem cell transplant (HSCT) may be at continued risk for infection. Pneumococcal, meningococcal, and H-flu revaccinations are recommended every 5 years for patients treated with splenic RT or splenectomy.

### **Infertility**

Certain chemotherapy combinations (eg, BEACOPP) may cause immediate and permanent infertility in both men and women.<sup>181,182</sup> Other combinations (eg, ABVD) are only rarely associated with infertility.<sup>86,183</sup> Since women who have received chemotherapy with alkylating agents and who maintain short-term fertility may experience premature menopause,<sup>84</sup> this should be taken into consideration with respect to family planning.

### **Pulmonary Toxicity**

Bleomycin-induced pulmonary toxicity (BPT) is well documented in patients with HL treated with bleomycin-containing chemotherapy regimens. Risk factors include older age, cumulative bleomycin dose, pulmonary irradiation, and prior history of lung disease. Some reports have suggested that the use of growth factors increases the incidence of pulmonary toxicity. Martin and colleagues reported that BPT significantly decreases the 5-year OS rate, especially in patients 40 years or older.<sup>184</sup> They also showed that the use of growth factors with chemotherapy significantly increases the incidence of BPT (26% vs. 9%). Recently, two separate studies confirmed that ABVD chemotherapy can be safely administered at the full-dose intensity without any growth factor support.<sup>185,186</sup> Five-year EFS (87.4% vs. 80%, respectively) and OS (94.1% vs. 91.3%, respectively) rates in patients who received ABVD with no growth factors were comparable to those in patients who received prophylactic growth factor support with the ABVD regimen.<sup>186</sup>

Leukopenia is not a risk factor for reduction of dose intensity. The NCCN Guidelines do not recommend the routine use of growth factors with ABVD regimens.

### **Refractory or Relapsed Disease**

#### ***Relapsed or Refractory Classic Hodgkin Lymphoma***

Two randomized phase III studies performed by the British National Lymphoma Investigation<sup>187</sup> and the GHSG/European Group for Blood and Marrow Transplantation<sup>188</sup> have compared HDT/ASCR with conventional chemotherapy in patients with relapsed or refractory HL. Both studies showed significant improvement in EFS and PFS and FFTF (with no difference in OS) for patients with relapsed or refractory HL who underwent HDT/ASCR compared with conventional chemotherapy alone. HDT/ASCR is the best option for patients with HL that is not cured with primary treatment, even though it does not improve OS.

Some studies have suggested that patients with CR to second-line therapy prior to HDT/ASCR or those with chemosensitive disease to second-line chemotherapy have improved outcomes following HDT/ASCR compared to those with resistant disease.<sup>189,190</sup> Moskowitz et al reported that the EFS, PFS, and OS were significantly better for patients with disease responding to second-line chemotherapy (60%, 62%, and 66%, respectively) compared to those who had a poor response (19%, 23%, and 17%, respectively) ( $P < .001$ ).<sup>189</sup> Sirohi et al also reported similar findings; the 5-year OS rate was 79%, 59%, and 17%, respectively, for patients who were in CR, PR, or those with resistant disease at the time of HDT/ASCR ( $P < .0001$ ), and the 5-year PFS rates were 69%, 44%, and 14%, respectively ( $P < .001$ ).<sup>190</sup>

Several investigators have developed prognostic models to predict the outcome in patients with relapsed or refractory disease undergoing HDT/ASCR. Brice and colleagues used end-of-treatment to relapse

interval (12 months or less) and extranodal disease at relapse as adverse prognostic factors to predict outcome of 280 patients undergoing HDT/ASCR.<sup>191</sup> The PFS rates were 93%, 59%, and 43%, respectively, for patients with 0, 1, or 2 of these risk factors. In a prospective study, Moskowitz and colleagues identified extranodal sites, CR duration of less than 1 year, primary refractory disease, and B symptoms as adverse prognostic factors associated with poor survival after HDT/ASCR.<sup>192</sup> In patients with none or one risk factor, 5-year EFS and OS were 83% and 90%, respectively, which decreased to 10% and 25% if all factors were present. This prognostic model has been used for the risk-adapted augmentation of treatment for relapsed or refractory disease to improve EFS in poorer-risk patients.<sup>193</sup> In a retrospective analysis of 422 patients with relapsed disease, Josting and colleagues from the GHSG identified time to relapse, clinical stage at relapse, and anemia at relapse as independent risk factors to develop a prognostic score that classified patients into four subgroups with significantly different freedom from second failure and OS.<sup>194</sup> Investigators of the GEL/TAMO group identified bulky disease at diagnosis, a short duration of first CR (<1 year), detectable disease at transplant, and the presence of >1 extranodal site as adverse factors for OS.<sup>195</sup> Other groups have identified extent of prior chemotherapy,<sup>196</sup> short time from diagnosis to transplant,<sup>197</sup> and disease status at transplantation<sup>198</sup> as significant prognostic factors for OS and PFS. Pretransplant functional imaging status has also been identified as an independent predictor of outcome in patients with recurrent/refractory HL.<sup>199-202</sup> The main potential of these prognostic factor studies is to facilitate comparison of outcomes at different centers, where the preparatory regimens may vary.

Several studies have shown the importance of cytoreduction with second-line chemotherapy before HDT/ASCR.<sup>192,203-211</sup> Newer regimens, such as GVD (gemcitabine, vinorelbine, and pegylated liposomal doxorubicin),<sup>212</sup> IGEV (ifosfamide, gemcitabine, and vinorelbine),<sup>213</sup> and

GCD (gemcitabine, carboplatin, and dexamethasone)<sup>214,215</sup> have also been effective for relapsed or refractory HL. However, none of these regimens has been studied in randomized trials.

Bendamustine, lenalidomide, and everolimus have also shown activity in patients with relapsed or refractory HL.<sup>216-218</sup> In a phase II trial, bendamustine was well tolerated and highly active in heavily pretreated patients with relapsed or refractory disease (including those with HL disease that failed to respond to HDT/ASCR treatment), resulting in an ORR of 56% among evaluable patients (34 out of 36 patients enrolled).<sup>216</sup> The ORR by intent-to-treat analysis was 53% (33% CR and 19% PR). The median response duration was 5 months. Lenalidomide and everolimus have also shown single-agent activity in a small cohort of patients with relapsed or refractory HL, resulting in ORRs of 19% and 47%, respectively.<sup>217,218</sup> In a phase II study, bendamustine in combination with gemcitabine and vinorelbine (BeGEV) was used as induction therapy before ASCT in patients with relapsed or refractory HL, resulting in an ORR of 83% (73% CR and 10% PR).<sup>219</sup>

Brentuximab vedotin, a CD30-directed antibody-drug conjugate, has demonstrated activity in patients with relapsed or refractory CD30-positive lymphomas.<sup>220</sup> In a pivotal phase II multicenter study of 102 patients with relapsed or refractory HL after HDT/ASCR, brentuximab vedotin induced objective responses and complete remissions in 75% and 34% of patients, respectively, with a median follow-up of more than 1.5 years. The median PFS for all patients and the median duration of response for those in CR were 5.6 months and 20.5 months, respectively.<sup>221</sup> Based on the results of this study, the FDA approved brentuximab vedotin for the treatment of patients with HL after failure of HDT/ASCR or at least two prior chemotherapy regimens in patients who are not candidates for HDT/ASCR. The 3-year follow-up data confirmed durable remissions in patients with disease responding to brentuximab vedotin.<sup>222</sup> After a median

follow-up of approximately 3 years, the estimated median OS and PFS were 40.5 months and 9.3 months, respectively. In patients who achieved a complete remission on brentuximab vedotin, the estimated 3-year OS and PFS rates were 73% and 58%, respectively.<sup>222</sup>

Several studies are investigating the utility of brentuximab vedotin as a second-line therapy for relapsed or refractory HL, either sequentially or in combination with other regimens, prior to HDT/ASCR. A multicenter prospective phase II study examined the efficacy of brentuximab vedotin in patients (n = 37) with relapsed or refractory HL (prior to HDT/ASCR), which resulted in an ORR of 68% (35% CR).<sup>223</sup> The ORR was 67% for primary refractory disease and 69% for relapsed disease, and 33 patients (89%) successfully proceeded to HDT/ASCR. Other studies have combined brentuximab vedotin with bendamustine, ICE (ifosfamide, carboplatin, and etoposide), or ESHAP (etoposide, methylprednisolone, and high-dose cytarabine or cisplatin), with preliminary data demonstrating PET-negative responses ranging from approximately 75% to 90%.<sup>224-227</sup>

The use of brentuximab vedotin as consolidation therapy following HDT/ASCR was evaluated in the AETHERA trial.<sup>228</sup> In this trial, 329 patients who were at high risk of progression (patients with disease refractory to front-line therapy, relapsed disease <12 months after frontline therapy, and relapsed disease ≥12 months after frontline therapy with extranodal disease) were randomized (following HDT/ASCR) to brentuximab vedotin (n = 165) or placebo (n = 164).<sup>228</sup> Patients were required to have obtained a CR, PR, or stable disease to second-line therapy prior to ASCT. After a median follow-up of 30 months (range 0–50 months), the primary analysis showed that early consolidation with brentuximab vedotin following HDT/ASCR was associated with improved PFS and the survival benefit was demonstrated across all risk groups. The median PFS was 42.9 months in the brentuximab vedotin group and 24.1 months in the placebo group. The estimated 2-year PFS rates by

independent review were 63% and 51%, respectively, for the brentuximab vedotin and placebo arms ( $P = .0013$ ). There was no statistically significant difference in OS between the two groups (HR, 1.15;  $P = .6204$ ) and the benefit of brentuximab vedotin on PFS appeared to decrease in patients who were PET-negative before HDT/ASCR.<sup>229</sup> Brentuximab vedotin was also well tolerated. Peripheral sensory neuropathy (56%), upper respiratory tract infection (26%), neutropenia (35%), and fatigue (24%) were the most common adverse events.

Programmed death 1 (PD-1)-blocking monoclonal antibodies have also demonstrated activity in patients with relapsed or refractory PD-1–positive lymphomas.<sup>230-234</sup> In a phase I study of 23 patients with relapsed or refractory HL and pretreated with both HDT/ASCR and brentuximab vedotin, treatment with nivolumab, a human monoclonal PD-1–directed antibody, induced an ORR of 87% with a PFS rate of 86% at 24 weeks.<sup>230</sup> In a phase II study (CheckMate 205 trial) of 80 patients with relapsed or refractory HL and pretreated with both HDT/ASCR and brentuximab vedotin, treatment with nivolumab induced an objective response in 53 of 80 patients (66.3%; 95% CI, 54.8–76.4) as determined by an independent radiologic review committee and at a median follow-up of 8.9 months.<sup>234</sup> Extended follow-up of the CheckMate 205 trial analyzed the safety and efficacy of nivolumab in patients with relapsed or refractory HL according to treatment history: brentuximab vedotin-naïve, brentuximab vedotin after HDT/ASCR, or brentuximab vedotin received before and/or after HDT/ASCR.<sup>231</sup> The overall ORR was 69% (95% CI, 63%–75%) and 65% to 73% in each cohort, with a median duration of response of 16.6 months (95% CI, 13.2–20 months).<sup>231</sup> Armand and colleagues reported that pembrolizumab, another human monoclonal PD-1–directed antibody, may also be an option for patients with relapsed or refractory HL and pretreated with brentuximab vedotin.<sup>232</sup> In a phase I study of 31 patients with relapsed or refractory HL and pretreated with brentuximab vedotin, pembrolizumab treatment induced a CR rate of 16% (90% CI, 7%–31%) and a PR rate of

48% resulting in an ORR of 65% (90% CI, 48%–79%).<sup>232</sup> In a phase II study of 210 patients with relapsed or refractory HL, the efficacy of pembrolizumab was examined in 3 cohorts of patients with disease progression after: 1) ASCT and subsequent brentuximab vedotin; 2) salvage chemotherapy and brentuximab vedotin (ineligible for ASCT due to chemoresistant disease); and 3) ASCT without brentuximab vedotin.<sup>233</sup> The corresponding ORRs were 73.9%, 64.2%, and 70%, respectively.<sup>233</sup> Emerging data are investigating the combination of brentuximab vedotin and PD-1 or checkpoint inhibitors as an option for relapsed or refractory HL prior to transplant.<sup>235</sup>

Josting and colleagues from the GHSG reported that second-line RT may be effective in a select subset of patients with relapsed or refractory disease.<sup>236</sup> The 5-year FFTF and OS rates were 28% and 51%, respectively. B symptoms and stage at the time of disease progression or relapse were identified as significant prognostic factors for OS. Moskowitz and colleagues have demonstrated the efficacy and feasibility of second-line RT with chemotherapy in patients with relapsed and refractory disease.<sup>192</sup> At a median follow-up of 43 months, the response rate to ICE and IFRT was 88% and the EFS rate for patients who underwent HDT/ASCR was 68%. Thus, RT may improve the chance of transitioning to HDT/ASCR in relapsed or refractory disease. Alternately, second-line RT may be effective in patients who are in good performance status with limited-stage late relapses and without B symptoms. It may be a very effective treatment for patients with initial favorable stage I–II disease who are treated with chemotherapy alone and relapse in initially involved sites. A comprehensive review and recommendations for incorporation of RT in salvage treatment programs is provided by the International Lymphoma Radiation Oncology Group consensus guidelines.<sup>237</sup>

### ***NCCN Recommendations for Relapsed or Refractory CHL***

Individualized treatment is recommended since there are no data to support a superior outcome with any of the treatment modalities.

Histologic confirmation with biopsy is recommended before initiating treatment for refractory disease. Although further cytoreduction and HDT/ASCR (with RT if not previously given) are often appropriate, occasional clinical circumstances may warrant the use of RT or systemic therapy with or without RT. Conventional-dose second-line systemic therapy may precede HDT/ASCR. RT should be strongly considered for selected sites of relapse that have not been previously irradiated. In radiation-naïve patients, TLI may be an appropriate component of HDT/ASCR.<sup>238</sup>

Second-line systemic therapy followed by response assessment with PET is recommended for all patients. Patients with a Deauville score of 1 to 3 should be treated with HDT/ASCR with or without RT or observation with or without RT (category 1 recommendation), followed by observation or 1 year of brentuximab vedotin maintenance therapy for patients with a high risk of relapse as defined by the AETHERA trial.<sup>228</sup> If HDT/ASCR is contraindicated, observation with or without RT is recommended. For patients with a Deauville score of 4 or 5 after second-line systemic therapy, subsequent systemic therapy with or without RT or RT alone is recommended, followed by repeat response assessment. Alternatively, those with a Deauville score of 4 can be treated with HDT/ASCR with or without RT, followed by 1 year of brentuximab vedotin maintenance therapy for patients with a high risk of relapse. Among patients with relapsed or refractory disease, those with a CR to second-line therapy prior to HDT/ASCR have better outcomes following HDT/ASCR compared to those with resistant disease.<sup>189,190</sup> In selected patients with long disease-free intervals and other favorable features, the selection of second-line therapy should be individualized.

Brentuximab vedotin alone or in combination with bendamustine<sup>227</sup>; nivolumab (category 2B)<sup>235</sup>; DHAP (dexamethasone, cisplatin, and high-dose cytarabine)<sup>204,207</sup>; ESHAP<sup>205,208,239</sup>; GVD<sup>212</sup>; ICE<sup>192,204</sup>; IGEV<sup>213</sup>; and BeGEV<sup>219</sup> regimens are included as options for second-line systemic therapy for patients with relapsed or refractory CHL. Bendamustine, everolimus, and lenalidomide are included as subsequent therapy options for patients with relapsed or refractory CHL.<sup>216-218</sup> Nivolumab and pembrolizumab are included as subsequent therapy options for CHL patients that have relapsed or progressed following HDT/ASCR and post-transplant brentuximab vedotin, or after 3 or more lines of systemic therapy including autologous HSCT.<sup>230-234</sup>

Allogeneic HSCT with myeloablative conditioning has been associated with lower relapse rate in patients with relapsed or refractory disease; however, TRM was >50%. Allogeneic HSCT with reduced-intensity conditioning has been reported to have decreased rates of TRM.<sup>240,241</sup> However, this approach remains investigational. Nonmyeloablative allogeneic transplant using posttransplant cyclophosphamide has excellent outcomes even in haploidentical patients with estimated OS and PFS rates of 63% and 59%, respectively, at 3 years.<sup>242</sup> The panel has included allogeneic HSCT with a category 3 recommendation for select patients with refractory or relapsed disease. For patients with PET-positive refractory HL (Deauville 5) that is responsive to RT alone or to subsequent systemic therapy, with or without RT, use of ASCT or allogeneic SCT is an option.

### ***NCCN Recommendations for Relapsed CHL***

Suspected relapse at any point should be confirmed with biopsy. Observation (with short-interval follow-up with PET/CT) is appropriate if biopsy is negative. Restaging is recommended for patients with positive biopsy. Second-line systemic therapy with RT or HDT/ASCR with or without RT are treatment options for patients with stage IA–IIA disease

who were initially treated with chemotherapy alone and experienced failure at the initial sites. RT alone may be appropriate for highly selected patients who received abbreviated chemotherapy (3–4 cycles) without RT. All other patients experiencing disease relapse after initial treatment with chemotherapy or combined modality therapy should be treated with second-line systemic therapy.

Restaging after completion of treatment is recommended for all patients. Subsequent treatment options (based on the score on interim PET scan) are as described for patients with refractory disease.

### ***NCCN Recommendations for the Management of Relapsed or Refractory CHL in Older Adults (Age >60 years)***

Outcomes are uniformly poor for elderly patients with relapsed or refractory disease.<sup>243</sup> No uniform recommendation can be made, although clinical trials or possibly single-agent therapy with a palliative approach is recommended. Palliative therapy options include bendamustine,<sup>216</sup> brentuximab vedotin,<sup>216,244</sup> everolimus,<sup>218</sup> lenalidomide,<sup>217</sup> nivolumab,<sup>230,234</sup> and pembrolizumab.<sup>232</sup> Nivolumab and pembrolizumab may be considered when patients have been previously treated with brentuximab vedotin or after 3 or more lines of systemic therapy including autologous HSCT. ISRT alone is an option when systemic therapy is not considered feasible or safe.

### ***Relapsed or Refractory Nodular Lymphocyte-Predominant Hodgkin Lymphoma***

Patients with refractory or relapsed NLPHL can be managed with second-line therapy as described below. However, some patients have a chronic indolent disease and may not require aggressive treatment. Individualized treatment is recommended since there are no data available to support a superior outcome with any of the treatment modalities. Rituximab should be considered with all second-line chemotherapy regimens for patients with relapsed or refractory NLPHL.



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### ***NCCN Recommendations for Refractory or Suspected Relapsed NLPHL***

Late relapse or transformation to DLBCL has been reported in patients with NLPHL.<sup>245-247</sup> In a study of 95 patients diagnosed with NLPHL, with a median follow-up of 6.5 years, transformation to aggressive lymphoma was seen in 13 (14%) patients and the actuarial risk at 10 and 20 years was 7% and 30%, respectively.<sup>247</sup>

Re-biopsy should be considered to rule out transformation to aggressive lymphoma prior to initiation of treatment for refractory disease or suspected disease relapse. Patients with a negative biopsy can be observed. All patients with biopsy-proven relapsed NLPHL should be observed or treated with second-line therapy (rituximab and/or chemotherapy and/or ISRT) followed by reevaluation with PET. No further treatment is necessary for patients with clinical response. Biopsy is recommended for patients with progressive disease to rule out transformation. At this stage, patients should be managed as described for refractory disease or treated with any second-line therapy that was not previously used (rituximab and/or chemotherapy and/or ISRT) followed by reevaluation with PET. Maintenance rituximab for 2 years may be considered for patients treated with rituximab alone.<sup>169</sup> Patients with disease transformation to DLBCL should be managed as discussed in the NCCN Guidelines for Non-Hodgkin's Lymphomas.

### **Summary**

HL is an uncommon malignancy involving lymph nodes and the lymphatic system. CHL and NLPHL are the two main types of HL. CHL is characterized by the presence of Reed-Sternberg cells in an inflammatory background, whereas NLPHL is characterized by the presence of lymphocytic and histiocytic cells.

Current management of CHL involves initial treatment with chemotherapy or combined modality therapy, followed by restaging with PET/CT to

assess treatment response using the Deauville criteria (5-PS). Combined modality therapy (ABVD, ABVD followed by escalated BEACOPP, or Stanford V plus ISRT) or ABVD alone are included as treatment options for patients with stage I or II favorable CHL. Chemotherapy (ABVD or Stanford V or BEACOPP plus ABVD) followed by consolidative ISRT is recommended for patients with stage I–II unfavorable disease. Chemotherapy with ABVD or escalated-dose BEACOPP or brentuximab vedotin plus AVD is recommended for patients with stage III–IV disease.

HDT/ASCR is the best treatment option for patients with refractory or relapsed CHL, although it does not improve OS. Second-line therapy (RT or second-line systemic therapy with or without RT) may be given prior to HDT/ASCR. Maintenance therapy with brentuximab vedotin (for one year) following HDT/ASCR is included as an option for patients with primary refractory disease.

ISRT is the preferred treatment for patients with stage IA or IIA non-bulky NLPHL. Observation may be an option for highly selected patients with stage IA disease with a completely excised solitary node. A brief course of chemotherapy plus ISRT with rituximab is recommended for patients with stage IB or IIB disease and for very rare patients presenting with stage IA or IIA bulky or non-contiguous disease. Chemotherapy with rituximab and with or without ISRT is recommended for all patients with stage III–IV disease. Alternatively, selected patients with stage III–IV disease can either be observed (if asymptomatic) or treated with local palliative RT or rituximab.

Late relapse or transformation to diffuse large B-cell lymphoma (DLBCL) has been reported in patients with NLPHL. In patients with suspected relapse, re-biopsy should be considered to rule out transformation to DLBCL. Patients with refractory or relapsed NLPHL can be managed with second-line therapy. However, some patients have a chronic indolent



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disease and may not require aggressive treatment, unless they are symptomatic.

HL is now curable in most patients because of the introduction of more effective and less toxic regimens. However, survivors may experience late treatment-related side effects. For this reason, long-term follow-up by an oncologist is essential after completion of treatment. Counseling about issues of survivorship and careful monitoring for late treatment-related side effects should be an integral part of follow-up. Consistent with NCCN philosophy, participation in clinical trials is always encouraged.

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