Surveillance Scanning in Lymphoma
Sarah C. Rutherford, MD

Abstract: Although the role of imaging in the management of most lymphomas is well established at baseline, during treatment, and following treatment, surveillance imaging after complete response remains controversial despite the numerous studies that have investigated follow-up computed tomography, positron emission tomography, and magnetic resonance imaging over the past 20 years. Although robust data do not support an impact of this strategy on survival in Hodgkin lymphoma, diffuse large B-cell lymphoma, or follicular lymphoma, many patients continue to undergo serial imaging studies. The role of imaging following treatment in peripheral T-cell lymphoma (PTCL) and mantle cell lymphoma (MCL) is poorly investigated, although the available literature questions the utility of scanning patients with PTCL or MCL in first remission. Of clear significance in all lymphoma subtypes is the effect of such imaging on patient anxiety, secondary cancers, and health care costs. Novel monitoring strategies, such as minimal residual disease detection with circulating tumor DNA, are being examined in lymphoma and may provide a more accurate method by which to survey patients. Here I review the current literature on follow-up imaging in lymphoma patients by subtype.

Introduction

Despite the lack of evidence to support surveillance imaging in lymphomas, follow-up scans continue to be controversial and are still included as monitoring options in Hodgkin lymphoma (HL) and diffuse large B-cell lymphoma (DLBCL) by both the National Comprehensive Cancer Network (NCCN) and the European Society for Medical Oncology.\(^1,4\) The impetus for these guidelines may be related to the potential curability of these 2 lymphoma subtypes, even in the relapsed setting.\(^5,8\) In theory at least, patients may be in better condition and able to tolerate second-line therapy if the relapsed disease is detected earlier. However, studies that support such a strategy are subject to selection bias in favor of patients whose relapsed disease is discovered by planned imaging rather than on clinical grounds. These patients typically have less aggressive disease phenotypes than those presenting with symptoms, and therefore are more likely to have better outcomes regardless of the time of disease.

Keywords
CT, Hodgkin lymphoma, MRI, non-Hodgkin lymphoma, PET, surveillance imaging
Hodgkin Lymphoma

The majority of studies investigating surveillance imaging in lymphoma are retrospective, although 2 prospective trials in patients with HL have been published. Picardi and colleagues randomly assigned 300 patients with newly diagnosed HL to 1 of 2 arms: PET/CT vs ultrasound and chest radiography administered at intervals throughout the 9 years after completion of treatment. All patients underwent surveillance imaging by 1 of the 2 methods. Eligibility criteria included high-risk disease (Ann Arbor or Cotswolds stage greater than or equal to IIb with bulky disease and/or extranodal lesions, or stages III-IV). PET/CT comprised images from the midbrain to upper thigh, whereas ultrasound included evaluation of superficial, anterosuperior mediastinal, abdominal, and pelvic nodes with chest radiography using frontal and lateral views. In the PET/CT group, 55 of 150 patients had positive findings; 40 were confirmed to have active lymphoma on biopsy and 15 were deemed to have false-positive PET/CT scans because biopsies were benign (including 5 with thymic hyperplasia). Of the 20 patients who underwent biopsy of a mediastinal mass, more than half were not found to have lymphoma (n=11). No patients relapsed in the absence of a positive PET/CT scan. In the ultrasound/chest radiography group, 43 of 150 patients were found to have abnormal results that were concerning for lymphoma progression; 39 had biopsy-proven lymphoma and 4 had negative results on biopsy (all in inguinal lymph nodes). One patient in this latter group relapsed who did not have abnormal findings on ultrasound/chest radiography. The authors concluded that patients with HL who have high-risk disease can be considered for monitoring by ultrasound/chest radiography rather than PET/CT. This has not become a widely accepted strategy.

The second prospective study in HL also enrolled patients with aggressive and indolent non-Hodgkin lymphoma (NHL). A total of 421 patients in CR after first-line therapy underwent PET/CT at 6, 12, 18, and 24 months (160 HL, 183 aggressive NHL, and 78 indolent NHL). Some of the patients with HL who were included had positive PET scans after 2 cycles of frontline therapy (currently, these patients would likely be escalated or switched to a second-line therapy). Of the 160 patients with HL, relapse was detected based on PET/CT in 51 and on clinical presentation in 35. Eleven additional patients had inconclusive positive imaging findings. Although the study suggests that PET/CT is useful for relapse detection in lymphoma patients, a survival analysis was not included to support the impact of these findings.

Multiple retrospective studies have been published on follow-up imaging in HL (Table). Although one early study concluded that imaging may be useful in...
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<thead>
<tr>
<th>First Author, Year</th>
<th>Histology</th>
<th>No. of Pts</th>
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<th>Imaging Type</th>
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<th>Relapse Detected Based on Clinical Symptoms</th>
<th>OS Analysis</th>
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<tbody>
<tr>
<td>Goldschmidt, 2011&lt;sup&gt;16&lt;/sup&gt;</td>
<td>HL, Aggressive NHL, DLBCL, PTCL, Lymphoblastic</td>
<td>125</td>
<td>42</td>
<td>CT or PET/CT</td>
<td>22 (52%)</td>
<td>20 (48%)</td>
<td>HR 1.2, 95% CI 0.69-2.08</td>
</tr>
<tr>
<td>El-Galaly, 2014&lt;sup&gt;9&lt;/sup&gt;</td>
<td>HL, Aggressive NHL, DLBCL, PTCL</td>
<td>258</td>
<td>43</td>
<td>CT, PET/CT, or MRI</td>
<td>70 (27%)</td>
<td>188 (73%)</td>
<td>Median OS 90 vs 38 mo, P=0.00008</td>
</tr>
<tr>
<td>Jerusalem, 2003&lt;sup&gt;17&lt;/sup&gt;</td>
<td>HL</td>
<td>36</td>
<td>5</td>
<td>PET</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>El-Galaly, 2012&lt;sup&gt;18&lt;/sup&gt;</td>
<td>HL</td>
<td>161</td>
<td>22</td>
<td>PET/CT</td>
<td>10 (45%)</td>
<td>12 (55%)</td>
<td>—</td>
</tr>
<tr>
<td>Dann, 2014&lt;sup&gt;19&lt;/sup&gt;</td>
<td>HL</td>
<td>368</td>
<td>33</td>
<td>PET/CT</td>
<td>17 (52%)</td>
<td>16 (48%)</td>
<td>5-yr OS 94% vs 94%</td>
</tr>
<tr>
<td>Jakobsen, 2016&lt;sup&gt;20&lt;/sup&gt;</td>
<td>HL</td>
<td>771</td>
<td>—</td>
<td>CT</td>
<td>—</td>
<td>—</td>
<td>3-yr OS 96% vs 96%</td>
</tr>
<tr>
<td>Guppy, 2003&lt;sup&gt;22&lt;/sup&gt;</td>
<td>DLBCL</td>
<td>117</td>
<td>35</td>
<td>CT</td>
<td>2 (6%)</td>
<td>30 (86%)</td>
<td>—</td>
</tr>
<tr>
<td>Liedtke, 2006&lt;sup&gt;23&lt;/sup&gt;</td>
<td>DLBCL</td>
<td>108</td>
<td>108</td>
<td>Not included</td>
<td>24 (22%)</td>
<td>84 (78%)</td>
<td>5-yr OS 54% vs 43%, P=0.13</td>
</tr>
<tr>
<td>Petrusch, 2010&lt;sup&gt;24&lt;/sup&gt;</td>
<td>DLBCL</td>
<td>75</td>
<td>23</td>
<td>PET/CT</td>
<td>3 (13%)</td>
<td>20 (87%)</td>
<td>—</td>
</tr>
<tr>
<td>Lin, 2012&lt;sup&gt;25&lt;/sup&gt;</td>
<td>DLBCL</td>
<td>341</td>
<td>113</td>
<td>CT</td>
<td>25 (22%)</td>
<td>88 (78%)</td>
<td>Median OS not reached, P=0.569</td>
</tr>
<tr>
<td>Avivi, 2013&lt;sup&gt;26&lt;/sup&gt;</td>
<td>DLBCL</td>
<td>119</td>
<td>31</td>
<td>PET</td>
<td>9 (29%)</td>
<td>22 (71%)</td>
<td>—</td>
</tr>
<tr>
<td>Cheah, 2014&lt;sup&gt;27&lt;/sup&gt;</td>
<td>DLBCL</td>
<td>116</td>
<td>13</td>
<td>PET/CT</td>
<td>6 (46%)</td>
<td>7 (54%)</td>
<td>No difference, P=0.76</td>
</tr>
<tr>
<td>Hong, 2014&lt;sup&gt;28&lt;/sup&gt;</td>
<td>DLBCL</td>
<td>106</td>
<td>15</td>
<td>CT or PET/CT</td>
<td>3 (20%)</td>
<td>12 (80%)</td>
<td>—</td>
</tr>
<tr>
<td>Thompson, 2014&lt;sup&gt;29&lt;/sup&gt;</td>
<td>DLBCL</td>
<td>774</td>
<td>552 (MER) 222 (Lyon)</td>
<td>167</td>
<td>CT or PET/CT</td>
<td>78 (10%)</td>
<td>—</td>
</tr>
<tr>
<td>El-Galaly, 2015&lt;sup&gt;30&lt;/sup&gt;</td>
<td>DLBCL</td>
<td>1221</td>
<td>—</td>
<td>CT</td>
<td>—</td>
<td>—</td>
<td>3-yr OS 92% vs 91%, P=0.7</td>
</tr>
<tr>
<td>Fossard, 2017&lt;sup&gt;31&lt;/sup&gt;</td>
<td>PCNSL</td>
<td>127</td>
<td>63</td>
<td>MRI or CT</td>
<td>12 (20%)</td>
<td>49 (80%)</td>
<td>1-yr OS 41% vs 58%, P=0.21</td>
</tr>
<tr>
<td>Mylam, 2017&lt;sup&gt;33&lt;/sup&gt;</td>
<td>PCNSL</td>
<td>86</td>
<td>32</td>
<td>MRI</td>
<td>1</td>
<td>31</td>
<td>—</td>
</tr>
<tr>
<td>Guidor, 2018&lt;sup&gt;34&lt;/sup&gt;</td>
<td>MCL</td>
<td>217</td>
<td>114</td>
<td>CT or PET/CT</td>
<td>38 (33%)</td>
<td>64 (56%)</td>
<td>HR 0.74, 95% CI 0.40-1.35</td>
</tr>
<tr>
<td>Tang, 2016&lt;sup&gt;32&lt;/sup&gt;</td>
<td>PTCL</td>
<td>135</td>
<td>57</td>
<td>CT or PET/CT</td>
<td>9 (16%)</td>
<td>48 (84%)</td>
<td>—</td>
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</table>

(Table continued on following page)
follow-up of patients with HL, the majority reported no survival benefit and therefore raised questions about the utility. Of particular interest is a study of 161 patients with HL who had achieved at least a partial response (PR) to frontline therapy. The investigators assessed the positive predictive value of PET/CT scans. In this group of patients, only 21 of 76 PET/CT scans had true positive findings. Including all 211 PET/CT scans performed, the true positive rate was 5%. The positive predictive value of PET/CT results was 22% in routine scans and 37% in those done because of clinical symptoms. The authors estimated the cost of relapse diagnosed through routine PET/CT is more than $50,000.

The largest retrospective analysis of follow-up imaging in HL reviewed 368 patients at 3 centers. The majority of the 305 enrolled patients underwent routine imaging with either CT or PET/CT every 6 months for 2 years and once in the third year. The remaining 63 patients did not undergo surveillance imaging. All were followed clinically every 3 to 4 months for the first 3 years after completing first-line treatment. The number with relapsed disease and time to relapse did not differ between groups. More of the patients in the group with clinical follow-up in the absence of scans were advanced stage at relapse (5/8, 63% vs 12/25, 48%); however, no difference in progression-free survival or overall survival (OS) existed between patients followed clinically and those who underwent routine scans.

Based on these studies, planned imaging in follow-up has not reliably shown a survival difference in HL. I recommend that patients with HL should be followed closely, with scans performed only if clinical symptoms prompt a concern for relapse. Abnormal imaging tests should be followed with a biopsy to confirm findings rather than with empiric treatment, given the high rate of false positives observed in some studies.

### Diffuse Large B-Cell Lymphoma

As is the case in HL, PET/CT scans (baseline, interim, and end of treatment) are standard in the management of DLBCL (and are recommended by the Lugano Classification), although no clear data exist to guide treatment based on interim PET results. A recent study correlating circulating tumor DNA with imaging results shows a promising novel strategy that may be used as an adjunct to imaging. End-of-treatment PET/CT scans can sometimes show FDG avidity mildly greater than that of the liver in absence of persistent disease, as in HL, and these images should also be reviewed with radiology and repeated 2 to 3 months later to show resolution to less than liver SUV.

As noted above, the study by Zinzani and colleagues included 183 patients with aggressive DLBCL assessed prospectively, whereas all other studies looking at surveillance imaging in DLBCL were retrospective (Table). In the prospective study, those patients who underwent surveillance imaging were found to relapse more frequently than those followed clinically, although the impact of this finding on survival is not known. A retrospective study by Liedtke and colleagues, which looked at 108 patients with relapsed aggressive NHL, concluded that routine imaging identifies patients with more favorable outcomes based on the age-adjusted International Prognostic Index. Of the 108 patients, 24 (22%) had a relapse detected by surveillance imaging and 84 (78%) were found to have relapsed disease based on clinical presentation that prompted further assessment. Of interest, the 5-year OS was not statistically significant between the 2 groups (54% vs 43%; \( P = .13 \)). Petrausch and colleagues assessed 75 patients with DLBCL. This study pooled results for all patients with a positive PET/CT scan, including those scans

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<th>Relapse Detected Based on Clinical Symptoms</th>
<th>OS Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cederleuf, 2017</td>
<td>PTCL</td>
<td>232</td>
<td>60</td>
<td>CT</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Oh, 1999</td>
<td>FL</td>
<td>257</td>
<td>78</td>
<td>CT</td>
<td>11 (14%)</td>
<td>67 (84%)</td>
<td>—</td>
</tr>
<tr>
<td>Gerlinger, 2010</td>
<td>FL</td>
<td>71</td>
<td>34</td>
<td>CT</td>
<td>16 (47%)</td>
<td>18 (53%)</td>
<td>OS 9 vs 8 y, ( P = .16 )</td>
</tr>
</tbody>
</table>

—, unknown or not reported; CT, computed tomography; DLBCL, diffuse large B-cell lymphoma; FL, follicular lymphoma; HL, Hodgkin lymphoma; HR, hazard ratio; MCL, marginal zone lymphoma; MER, Molecular Epidemiology Resource; mo, month(s); MRI, magnetic resonance imaging; NHL, non-Hodgkin lymphoma; No., number; OS, overall survival; PCNSL, primary central nervous system lymphoma; PET, positron emission tomography; PTCL, peripheral T-cell lymphoma; Pts, patients; Rel, relapsed; y, year(s).
done because of symptoms that prompted concern for relapse. Of 27 patients with a positive PET/CT scan, 23 had a clinical presentation that prompted the scan and 4 did not. Relapse was confirmed by biopsy in 20 of 23 patients with symptoms and 3 of 4 patients without symptoms. Patients with relapsed disease were much more likely to be older than 60 years compared with those who remained in remission (16/20 with symptoms, positive PET/CT, and biopsy-proven relapse). The authors argue that patients older than 60 years should be considered for routine surveillance, whereas younger patients can be monitored in the absence of scanning.

The findings of the majority of other retrospective studies do not support routine surveillance. The study by Goldschmidt and colleagues included 81 patients with relapsed DLBCL, which occurred mostly in the first year after completion of therapy. They found that stage, B symptoms, and prognostic score did not affect the way in which the relapse was detected (clinically vs by routine imaging), but extranodal involvement and timing of diagnosis did. OS was not affected by mode of relapse detection. Avivi and colleagues assessed follow-up PET/CT scans in patients with DLBCL treated with rituximab (Rituxan, Genentech/Biogen) plus cyclophosphamide, doxorubicin, vincristine, and prednisone (R-CHOP) vs CHOP. They found that those who received rituximab were more likely to have false-positive scans, and therefore argued against surveillance with PET/CT in the modern era of DLBCL treatment. Cheah and colleagues reviewed 116 patients, 13 of whom relapsed, all within 18 months of completion of therapy (median follow-up was 53 months). Six were diagnosed by routine PET/CT and 7 by clinical symptoms prompting PET/CT. Hong and colleagues followed 106 patients; 15 relapses occurred, including 3 detected by surveillance imaging.

An analysis of 2 data sets, from the Molecular Epidemiology Resource of the University of Iowa/Mayo Clinic Lymphoma Specialized Program of Research Excellence and the Léon Bérard Cancer Center in Lyon, France, assessed a total of 902 patients with DLBCL, which occurred mostly in the first year after completion of therapy. Of these, 774 patients achieved a remission after therapy. Twenty-two percent of patients relapsed; in those with records available, 64% of these relapses occurred outside of a routine follow-up visit. Notably, there were no differences in outcome between the 2 groups. The largest published data included 525 Danish and 696 Swedish patients. The Danish patients underwent surveillance imaging (typically CT scans every 6 months for 2 years), whereas the Swedish patients had clinical follow-up in the absence of imaging. Importantly, no difference in survival was observed between the 2 cohorts. Another study by El-Galaly and colleagues investigated a total of 258 patients with NHL or HL (including 173 with DLBCL) and unexpectedly found a median OS difference between relapses detected by imaging vs non-imaging (90 vs 38 months; \( P = 0.00008 \)). Multivariate analysis indicated that patients with DLBCL whose relapse was diagnosed after imaging had a reduced risk of death, although this reduction was not statistically significant when relapses with indolent histologies were excluded. Notably, transplant-eligible patients younger than 70 years whose relapses were detected on imaging were not more likely to complete stem cell transplant than their counterparts whose symptoms triggered the diagnosis of relapse. The authors cited a length of time bias in patients with aggressive DLBCL as a potential explanation for these findings and emphasized the need for prospective studies prior to making broad conclusions based on this report.

A systematic review of surveillance imaging in patients with DLBCL or HL pooled 3099 patients across 15 studies. Twenty percent of these patients experienced relapse; 60% were identified by means other than surveillance imaging. No reports showed a survival advantage for those whose relapses were detected by imaging. These data, along with multiple studies cited above, indicate that there is insufficient support for routine surveillance scanning in patients with DLBCL.

### Primary CNS Lymphoma

Follow-up imaging in primary central nervous system lymphoma (PCNSL), most often an aggressive lymphoma of DLBCL histology, has been minimally investigated. The largest study was conducted in 209 patients who were treated in Lyon, France, between 1985 and 2011. The majority of patients received chemotherapy; about half underwent consolidation radiation. Of the 209, 127 had a CR and 63/127 (50%) eventually relapsed. Although 819 imaging studies were conducted (either MRI or CT) in patients undergoing surveillance, most of the relapses were found outside of the planned follow-up period. OS at 1 year was not significantly different between patients who were symptomatic vs asymptomatic at the time of relapse (41% vs 58%; \( P = .21 \)). A second retrospective study reported on surveillance scanning in 86 patients with PCNSL (most of whom had DLBCL) in CR at the end of treatment. Relapse was detected in 32 of 86 patients, the majority of whom had corresponding clinical symptoms (n=31). Thirty of 31 patients underwent MRI scans because of symptoms that developed outside of the planned visit times. Only 1 of 189 MRI scans done for surveillance purposes detected relapse. Both groups questioned the clinical utility of routine follow-up imaging in the diagnosis of relapse in PCNSL.
Mantle Cell Lymphoma

Mantle cell lymphoma (MCL) is a heterogeneously managed disease. Some newly diagnosed patients can be monitored closely without initiation of treatment, whereas others should be treated with chemotherapy followed by maintenance rituximab or high-dose chemotherapy followed by autologous, or in some cases allogeneic, stem cell transplant. Surveillance imaging of those in CR after first-line therapy is not well studied. A recent publication reported on 217 patients with MCL who had achieved a response or stable disease after first-line therapy (166 CR, 41 PR, 10 stable disease). Of the 114 patients who relapsed, 38 were diagnosed by routine imaging (25 by CT, 7 by PET/CT, 6 by other imaging), 61 were diagnosed based on clinical symptoms, and 3 were incidentally found to have relapsed disease. The median time to relapse was similar in both groups: 2.5 vs 2.8 years. There was no difference in OS based on method of relapse detection. These data support a strategy for clinical follow-up of patients with MCL after first-line therapy without surveillance imaging.

Peripheral T-Cell Lymphoma

Few studies have investigated follow-up scanning in peripheral T-cell lymphoma (PTCL), in part because additional therapy is frequently given after frontline treatment. For those in first CR, the NCCN recommends enrollment in a clinical trial, consideration of high-dose therapy with stem cell rescue, or observation. Of the studies mentioned previously in this article that included patients with multiple lymphoma subtypes, only 2 enrolled patients with PTCL in addition to HL and DLBCL. Conclusions were limited owing to the small numbers of patients with PTCL. Two studies specifically addressed surveillance scanning in PTCL. Tang and colleagues reported on 338 patients with PTCL. One hundred thirty-five experienced a CR after first-line therapy, 61 of whom subsequently relapsed. Relapse was detected in the majority of patients based on clinical presentation (48 patients, 84.2%), whereas relapse was found on surveillance scans in only 9 (15.8%). The information was not available for 4 patients. Most patients with relapsed disease were symptomatic (55 patients, 93.2%). A study by Cederleuf and colleagues included 109 Danish and 123 Swedish patients with nodal PTCL in CR following CHOP or therapy with cyclophosphamide, doxorubicin, vincristine, etoposide, and prednisone (CHOEP). The Swedish patients underwent clinical follow-up and the Danish group was also followed with serial imaging, typically CT scans every 6 months for 2 years. Incidence of relapse was similar between the 2 groups (24% vs 28% in

Follicular Lymphoma and Marginal Zone Lymphoma

Given its often indolent nature, follicular lymphoma (FL) is an incurable disease that can be characterized by long periods without therapy. Frequent imaging in this subtype is particularly controversial given the amount of radiation that could be incurred over the course of the disease in a given patient. As a result, it has been more widely accepted to limit imaging in patients with FL compared with other lymphoma subtypes, and therefore few studies have been performed in this histology. A study of patients with stage I to III FL conducted between 1978 and 1994 followed 328 patients for a median of 101 months after first-line therapy. Of these patients, 257 achieved a CR. In addition to clinical follow-up, patients underwent chest, abdominal, and pelvic radiography, and CT of the abdomen/pelvis. Imaging was typically done every 3 months for the first 5 years and then yearly. Relapse was detected in 78 of 328 patients in the follow-up period (based on clinical presentation in 55 patients, radiography in 19, and CT in 48). Only 11 of 78 relapses were found on CT in the absence of symptoms. Although a survival analysis was not conducted, the authors concluded that the yield of CT imaging was low in patients with stage I to III FL.

A second study was performed in 99 patients with FL who had undergone high-dose therapy and autologous stem cell transplant (ASCT) for recurrent disease. Seventy-one of the 99 had sufficient clinical responses to this treatment and underwent surveillance after transplant. Of these, 34 were found to have relapsed disease. Eighteen (53%) of the relapses were found by clinical symptoms and 16 (47%) on monitoring studies, including CT-based imaging and/or bone marrow biopsy. OS was not statistically significant between the 2 groups (8 vs 9 years).

No study to my knowledge has investigated surveillance scanning specifically in marginal zone lymphoma. I advocate for a similar management strategy as in FL, particularly given the often-indolent course of disease: regular clinical follow-up and imaging tests based on symptoms.

Negative Impact of Surveillance Imaging

As outlined above, frequent scanning in the follow-up period is not well supported as clinically beneficial in
the majority of patients with lymphoma. A number of studies have investigated the negative impacts of this strategy. Thompson and colleagues assessed the psychological effects of routine scans in 70 patients with curable aggressive lymphomas.46 They reported that 57% of patients met the criteria for clinically significant anxiety, typically related to a concern for relapse. The anxiety was not present at baseline and worsened around the time of planned imaging studies. These findings suggest that removing surveillance scans would lessen anxiety in lymphoma survivors. Secondary cancers as a result of radiation exposure are also of concern. A study using a risk model estimated that 29,000 future cancers could occur as a result of CT scans performed in the United States in 2007.47 A second study investigating radiation exposure in whole-body PET/CT showed substantial increased lifetime attributable risk of secondary cancers.48 An investigation of patients with NHL undergoing CT scans from 1997 to 2010 found that those patients who had more than 8 CT scans had a much higher risk of second primary malignancy compared with those who had 8 or fewer scans (hazard ratio, 2.25; 95% CI, 1.61-1.31; P<.001).49 The researchers estimated that the risk of second primary malignancy in the more-frequently scanned group increased by 3% per CT scan performed. Finally, routine scanning is not a cost-effective strategy. In a 2015 publication, Huntington and colleagues assessed patients with DLBCL in first remission and concluded that surveillance imaging offers limited clinical utility and significant costs.50 A study in 2014 reported that cost in US dollars for CT-detected relapse in patients with HL or NHL ranged from $21,725 to $157,605.51 In an era of increased attention to cost savings in health care, as well as initiatives such as Choosing Wisely from the American Board of Internal Medicine’s ABIM Foundation, these amounts are not well justified, particularly given the questionable lack of benefit of frequent scanning.

Conclusion

Increasing evidence supports monitoring without surveillance imaging in the majority of lymphoma patients following completion of treatment. Although frequent scanning may identify relapses earlier than close clinical follow-up of patients, no OS benefit has been reported in most studies. Novel methods of disease detection may prove to be useful in the surveillance setting and eventually spare patients from the negative aspects of frequent imaging tests, including psychological impact, secondary cancers, and added financial burden.

Disclosure

Dr Rutherford has served as a consultant for AstraZeneca.
first remission has a low positive predictive value and high costs. *Haematologica.* 2012;97(6):931-936.