Core needle biopsy (CNB) for the diagnosis of lymphoproliferative disorders: an audit and re-audit

The College's Professional Standards Unit wishes to encourage high-quality clinical audit. We therefore periodically publish interesting examples of audits that have been successfully evaluated through our clinical audit certification scheme.

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Background

Tissue diagnosis is a prerequisite for the treatment of lymphoproliferative disorders. Fine-needle aspiration (FNA) cytology assessment of lymphadenopathy has >90% diagnostic accuracy in identification of lymphoma, but whether FNA provides sufficient information for WHO classification and management of lymphoma is controversial.[1,2]

The CNB permits routine histology, immunohistochemistry (IHC), flow cytometry (FC) and FISH (fluorescence *in situ* hybridisation) for morphological, immunophenotypic and genetic characterisation of lymphoid proliferations.[3] Compared to the FNA, pathologists find the CNB easier to interpret and it is popular with interventional radiologists and surgeons, endorsed by the British Committee for Standards in Haematology (BCSH) and The Royal College of Pathologists (RCPath) for lymphoma diagnosis.[4] The principal disadvantages of CNB include sampling errors and the requirement for careful laboratory processing to maximise diagnostic, prognostic and predictive information.[5] The whole lymph node excision biopsy (WNE) remains the diagnostic standard of reference, as it allows the full range of laboratory investigations to be performed. However, this is an invasive diagnostic procedure and may not be integral to the patient's treatment.

As CNB replaces WNE as the diagnostic procedure of choice for assessment of peripheral and deep lymphadenopathy, it is essential to audit and optimise its use in the lymphoma diagnostic pathway. An initial audit of CNB for the period 2004–2008 showed a diagnostic adequacy of 57.4%. Obtaining multiple needle cores, processing these in separate tissue blocks and good record keeping were recommended. A re-audit was carried out to study the effect of these recommendations.

Aims and objectives

The aim of this project was to evaluate:

1. extent of use of the CNB
2. adequacy of prognostic and diagnostic information available from CNB
3. the clinical acceptance of CNB for management of lymphoma and circumstances in which follow-up excisions are performed.

Standards

There are no established standards for the use of CNB in lymphoma diagnosis. The UK guidelines from the RCPath and the BCSH state that lymphoma diagnosis may be achieved using CNB or excisions and recommend that each needle core fragment should be processed in a separate block.[6] The optimum size and number of needle cores needed for diagnosis are unspecified. If CNB is to replace WNE, it is intuitive that 100% of the CNB should be diagnostic and sufficiently informative for patient management.

Method

An initial audit of CNB in the diagnosis of lymphoma done in 2009 covered the years 2004–2008. Majority of the CNB were from deep sites in the body and diagnostic accuracy for different WHO lymphoma subtypes was <60%. Recommendations following this audit stated more than one core should be taken from a node and each of these cores should be carefully processed in separate cassettes to avoid tissue damage. The re-audit was performed in 2012, evaluating the years 2008–2012. Using SNOMED codes for needle biopsies, malignant lymphoma of different types and atypical lymphoproliferative disorder, 73 consecutive core needle biopsies in 71 patients in the first audit and 133 consecutive biopsies of the same number of patients in the re-audit were identified from the laboratory information system. CNB were identified by verification of each lymphoma report in this period, cross referenced with follow-up or previous biopsy reports and haematopathology multidisciplinary team (MDT) discussions. The biopsies in the first audit were submitted by seven hospitals from February 2004 to November 2008. In the re-audit (period December 2008–June 2012), the biopsies were performed in ten hospitals. The CNB were processed in two histopathology laboratories in the Belfast Health and Social Care Trust and reported by three pathologists. CNB for non-lymphoid pathologies were excluded. There was no attempt to audit the entire process from specimen receipt to the issue of the diagnostic reports, and no histological slides were reviewed.

For each project, histopathology accession number, age and sex of patients, past history of

malignancy, hospital source of CNB, biopsy site, the size of the biopsy needle, number and size of tissue cores, adequacy of specimen and reporting pathologist were collected. In addition, the CNB diagnosis including WHO subtype if given, reason for incomplete lymphoma diagnosis, number of antibodies used for immunohistochemistry (IHC), any molecular studies requested and pathology follow up, including a surgical excision biopsy performed, were also documented.

Definitions

'Adequate sample' was one in which the lesion was correctly sampled and a complete diagnosis of lymphoma including WHO sub-classification was provided.

'Inadequate sample' was one in which the specimen was insufficient for histological diagnosis of lymphoma and/or WHO sub-classification.

WHO classification of haematopoietic tumours and lymphoid tissues 2001 was the basis of diagnosis in the period 2004–2008, while the 2008 WHO classification was the reference for the period 2008–2012.[7]

Results

The results of the audit (Table 1) over the two time periods are presented together for comparison and analysis of trends. The period 2004–2008 is referred to as the 1st project and the period 2008–2012 as the 2nd project.

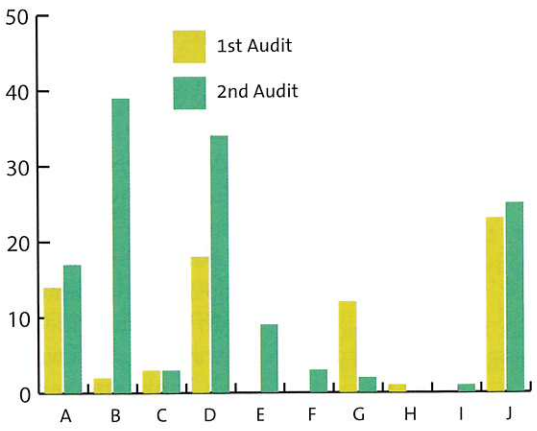

Figure1: Showing numbers of biopsies performed at the different hospitals over the time periods 2004–2008 (1st project) and 2008–2012 (2nd project)

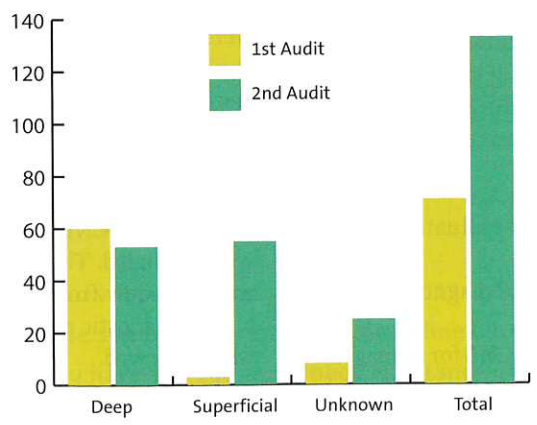

Figure 2: Site of CNB grouped as superficial, deep or unknown

Patient information

The first project included 71 patients (39 males and 32 females), with an age range of 19–83 years (mean 60.74 y). The second project included 133 patients (75 males and 58 females), ranging from 20–93 years (mean of 61.32 y).

The 73 CNB of the 1st project were performed at seven hospitals. In the second project, the 133 patients had CNB done in ten hospitals (Figure 1) including seven hospitals from the 1st project. (In the graphs, the letters correspond to the same hospitals in each.)

Site, size and number of CNB

In the first project, 53/71 biopsies were from lymph nodes (deep 42, superficial 3 and unknown site 8) and 18 from extranodal sites (deep soft tissue 7 [pelvis, rib, humerus and abdomen], lung 4, liver 2, spleen 2, kidney 1, parotid 1 and anus 1) (Figure 2). In the second project, 124 biopsies were from lymph nodes (44 deep, 55 superficial, and site not mentioned 25) and 9 biopsies were extranodal (deep soft tissue 9 [pre tibial, pelvis, iliac ring, groin, paraspinal muscle, retroperitoneum, omentum 1 and mesentery 2]) (Figure 2).

The size of the biopsy needle was mentioned in only one case in the first project. It was recorded in 26/133 (19.5%) cases in the second project (one 14G, two 16G, 19 18G, and four 20G).

The number of needle cores were grouped as '1', 'many' or 'not mentioned'. The 'many' category includes biopsies with two or more cores. In the first project, there were 27 cases with one core and 44 with multiple cores (mode 1 core – 22 cases). In two cases, this data was unavailable. Where recorded, the length of the cores varied from 6 mm to 26 mm. The second project contained 32 cases having one core, 95 having multiple cores and in six cases, this data was unavailable (mode 2 cores – 41 biopsies). The length of the cores in the second project varied from 2 to 27 mm, size unknown in 15 cases.

The re-audit showed that number of CNB per procedure for lymphoma diagnosis varies considerably and 2–4 needle cores/procedure are submitted to the laboratory. However 4/10 hospitals submit one CNB in a significant number of cases.

History of malignancy and tests done

A prior history of malignancy was present in 19/71 cases in the first project (16 lymphoma (22.53%), 1 MDS/MPD (4.23%) and 2 carcinomas). In the second project, 58/133 cases had a history of malignancy (47 lymphoma (35.34%) and 11 including diagnoses of carcinoma, melanoma and leukaemia(8.27%)).

In both audit periods, most CNB were processed in single tissue blocks.

The number of antibodies used for IHC varied from 6 to 22 (not requested in one case) in the first project (mean 10.76/case). The second project had similar numbers with a range of 2–19

Table 1: Summary of the results of the audit

Results	Audit 1: 2004-2008	Audit 2: 2008-2012
Number of patients	71	133
Male:female ratio	39:22	75:58
Number of hospitals	7	10
Site of biopsy		
Lymph nodes	53/71 (37.6%)	124/133 (93%)
Extra-nodal	18/71 (25.3%)	9/133 (6.7%)
Deep sites	60/71 (84.5%)	53/133 (39.8%)
Superficial sites	3/71 (4.2%)	55/133 (41.3%)
Unknown	8/71 (11.2%)	25/133 (18.79%)
Needle size	Unknown	18G in majority recorded
Core biopsy characteristics		
Number of needle cores (mode)	1	2
Length	6-26mm	2-27mm
History of malignancy	19/71 (26.7%)	58/133 (43.6%)
	16 lymphoma	47 lymphoma
Pathology investigations		
Number of antibodies for IHC	6-22	2-19
	Average 10.76	Average 9.98
Molecular studies	15/71 (21.1%)	17/133 (12.7%)
	6 diagnostic	12 diagnostic
Lymphoma diagnosis		
Unequivocally lymphoma	66/73 (90.4%)	98/133 (73.6%)
Probable lymphoma	3/73 (4.1%)	23/133 (17.2%)
Atypical lymphoproliferative disorder	4/73 (5.4%)	3/133 (2.2%)
Benign, no lymphoma	0/73 (0%)	11/133 (8.2%)
Complete WHO typing	51/73 (69.8%)	75/109 (68.8%)

Table 2: WHO classification of lymphoma on CNB over the two audit periods

Diagnosis	1st Audit	2nd Audit
Diffuse large B-cell lymphoma	24 (32.8%)	30 (22.5%)
Follicular lymphoma	13 (17.8%)	23 (17.2%)
Small lymphocytic lymphoma/CLL	1 (1.3%)	8 (6%)
Mantle cell lymphoma	1 (1.3%)	0 (0%)
T-cell rich B-cell lymphoma	1 (1.3%)	0 (0%)
High grade B-NHL unclassified	2 (2.7%)	2 (1.5%)
Peripheral T-cell lymphoma	0 (0%)	1 (0.7%)
Anaplastic large cell lymphoma	0 (0%)	1 (0.7%)
NHL, not otherwise specified	8 (10.9%)	4 (3%)
Classical Hodgkin lymphoma	12 (16.4%)	9 (6.7%)
Nodular lymphocyte predominant Hodgkin lymphoma	0 (0%)	4 (3%)
Atypical lymphoproliferative disorder	4 (5.4%)	4 (3%)
Probable NHL	2 (2.7%)	6 (4.5%)
Probable diffuse large B-cell lymphoma	4 (5.4%)	9 (6.7%)
Probable follicular lymphoma	0 (0%)	5 (3.7%)
Probable Hodgkin lymphoma	1 (NLPHL) (1.3%)	3 (2.2%)
No diagnosis/insufficient/benign	0 (0%)	24 (18.04%)
Total	73	133

antibodies used (not requested in 19 cases, mean 9.98/case).

Molecular tests were performed in 15/71 cases (21.13%) in the first project and in six cases the results aided diagnosis. In the second project, molecular studies were requested in 17/133 cases (12.78%) and in 14/17 cases there was sufficient tissue for the test to be carried out. The molecular studies were diagnostically useful in 12/14 cases.

Quality of diagnoses

In the first project, a confident unequivocal histological diagnosis of lymphoma was offered in 66 samples (90.41%), probable diagnosis in three (4.11%) and atypical lymphoproliferative disorder (ALPD) in four cases (5.48%). The second project had 98 (89.80%) confident diagnoses of lymphoma, eight (7.33%) probable diagnoses and four ALPD (2.77%) (Figure 3). Twenty-four of 133 samples (8.27%) were not diagnostic of a lymphoma but included a mix of cases with benign lymphoid or connective tissue, inflammation or insufficient tissue (Table1). Thus, the percentage of cases with a definitive or probable diagnosis of lymphoma is nearly unchanged over the two audit periods.

In the first project, a complete WHO subclassification of lymphoma was offered in 51 of 73 samples (69.86%) of NHL as per the diagnostic criteria in 2001. Twenty-two samples (30.13%) were only classified as high- or low-grade NHL (8), probable diffuse large B-cell lymphoma (DLBCL) (4), probable T-cell rich B-cell lymphoma (TCRBCL) (1), ALPD (4), probable Hodgkin lymphoma (1) or probable NHL (2) and high-grade B-NHL unclassified (BCNU)(2). Nine of 12 samples of Hodgkin lymphoma (HL) (7.57%) were subtyped (Table 2).

In the second project, complete WHO subclassification (as per 2008 criteria) was possible in 75 of the 109 lymphoma (68.80%). Four cases (3.6%) had a generic diagnoses of high or low grade NHL. There were three (2.77%) cases of ALPD, eight probable NHL, eight probable DLBCL, six probable follicular lymphoma (FL), three probable HL and two cases of high-grade BCNU. All 12 (12.5%) cases of HL were subclassified. There were four (3.6%) diagnoses of inflammation, one amyloid plaque and 16 (14.67%) diagnoses of no malignancy, two necrosis and two insufficient for diagnosis.

Using WHO classification as the sole criterion for adequacy, i.e. complete diagnosis of lymphoma, 51 lymphomas (69.86%) were considered adequate for the period 2004–2008 and 22 samples (30.13%) inadequate. In the period 2008–2012, 75 CNB (68.80%) were adequate and 34 CNB (31.19%) were inadequate indicating minimal change.

In the 1st audit, the reasons for the biopsies to be considered inadequate with no WHO classification included small amount of tissue (14) with incomplete panel of IHC and or molecular studies to subclassify the lymphoma, tissue not entirely representative (5), crush and handling artefacts (2) and fragmented/fibrotic biopsies (1). Furthermore, difficulties with interpretation of relatively small number of neoplastic cells in a heterogeneous tumour infiltrate and equivocal findings on immunohistochemistry contributed to the lack of WHO subtyping in four cases. In the second project, 34 cases were reported as inadequate, i.e. not WHO classifiable. The reasons included tissue insufficient for complete IHC or molecular studies (26), tissue not representative of the lesion (4), crush and handling artefacts (2). WHO typing was impossible in four cases where the tumour cells were difficult to identify in a heterogeneous infiltrate or the findings were equivocal.

CNB inadequate for lymphoma diagnosis were submitted from all the hospitals. However, hospitals with low volume CNB practice tended to have inadequate samples/incomplete diagnosis of lymphoma (Spearman rank correlation r = 0.99, P <0.001). Table 3 compares the ten hospitals by the sites of CNB and adequacy rates. In 4/6 hospitals with the highest CNB numbers, the adequacy rates for biopsies from deep and intra-abdominal lesions is higher than superficial lymph nodes. Hospitals B and D differ from others; they carry out mostly equal numbers of deep and superficial biopsies. The superficial site CNB were categorised as inadequate due to there being small fragments that were frequently crushed, fibrotic and not representative of the whole node.

Follow-up excision biopsies

Table 4 shows the follow-up biopsies in patients with an initial CNB diagnosis of possible or definite lymphoma but insufficient information for treatment. Further biopsies were available in only 8/22 patients (36.36%) with less than completely diagnostic CNB in the 1st audit, but 22/34 patients with inadequate CNB diagnoses had additional biopsies in the re-audit.

Additional biopsy in eight patients in the first project included CNB in two, one incisional biopsy and five excisions. Two DLBCL and three FL diagnosed on CNB were confirmed in the excisions. Two nodular lymphocytic predominant Hodgkin lymphoma (NLPHL) including one withTCRBCL-

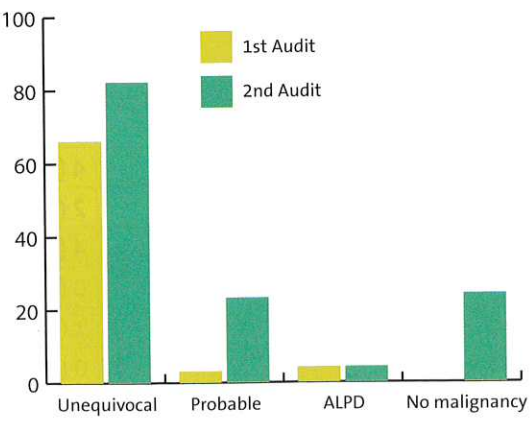

Figure 3: Confidence in lymphoma diagnosis; CNB diagnosed as definite or probable lymphoma, atypical lymphoid proliferation or non-diagnostic

Table 3: Comparison of adequacy of CNB for lymphoma diagnosis between hospitals (excludes cases for which biopsy site is unknown)

Hospitals	Adequate		Inadequate		Overall		Total
	Deep	Superficial	Deep	Superficial	Adequate	Inadequate	
A	14(56%)	5(20%)	3(12%)	3(12%)	19(76%)	6(24%)	25
B	7(21.8%)	12(37.5%)	7(21.8%)	6(18.7%)	19(59.3%)	13(40.6%)	32
C	3(60%)	0(0%)	2(40%)	0(0%)	3(60%)	2(40%)	5
D	11(28.9%)	17(44.7%)	6(15.7%)	4(10.5%)	28(73.6%)	10(26.3%)	38
E	2(25%)	3(37.5%)	0(0%)	3(37.5%)	5(62.5%)	3(37.5%)	8
F	0(0%)	1(50%)	1(50%)	0(0%)	1(50%)	1(50%)	2
G	6(54.5%)	1(9%)	2(18.1%)	2(18.1%)	7(63.6%)	4(36.3%)	11
H	0(0%)	0(0%)	0(0%)	1(100%)	0(0%)	1(100%)	1
I	0(0%)	0(0%)	0(0%)	1(100%)	0(0%)	1(100%)	1
J	24(57.1%)	4(9.5%)	9(21.4%)	5(11.9%)	28(66.6%)	14(33.3%)	42

Table 4: Histologic findings in follow up biopsies of patients in the 1st audit

Number	CNB diagnosis	Follow-up diagnosis
1	Malignant NHL	Diffuse large B-cell lymphoma
2	Follicular lymphoma	Follicular lymphoma grade 2
3	Atypical lymphoproliferative disorder	Follicular lymphoma grade 1
4	Suspicious of B-NHL	Follicular lymphoma (CNB)
5	Diffuse large B-cell lymphoma (non-germinal centre phenotype)	Diffuse large B-cell lymphoma (non germinal centre phenotype)
6	Atypical lymphoproliferative disorder	Nodular lymphocyte predominant Hodgkin lymphoma
7	Malignant NHL	EBV driven diffuse large B-cell lymphoma
8	Atypical lymphoproliferative disorder	T-cell rich B-cell lymphoma-CNB Nodular lymphocyte predominant Hodgkin lymphoma with T-cell rich B-cell lymphoma-like pattern (excision)

like pattern and one EBV driven DLBCL were diagnosed in the excision specimens of three patients with CNB diagnoses of ALPD or malignant lymphoma, not further classified.

The value of WNE after an inadequate CNB is similarly apparent in the re-audit. Twenty-two CNB reported as no diagnosis, suspected lymphoma or with an incomplete diagnosis of lymphoma had follow-up biopsies that showed FL, DLBCL or rare lymphoma subtypes or the new categories introduced in WHO 2008 classification that were not predicted on CNB and only diagnosed in the WNE (Table 5).

In the second project, 6/22 patients with repeat biopsy had concordant CNB and excision diagnosis, 8/22 had the lymphoma WHO typed on the excision and in three patients (cases 3, 13 and 18) the re-biopsy diagnosis was radically different from that rendered on the CNB. In all, there were five conventional DLBCL, five follicular lymphoma (including one transforming to DLBCL), three peripheral T-cell lymphomas (PTCL), one NLPHL, one T-cell rich DLBCL and one EBV driven DLBCL in the follow-up excisions (Table 5). Case 18 is instructive in that despite the use of a combination of routine diagnostic techniques and molecular studies in both initial and follow up biopsies of the same lesion, the CNB diagnosis of probable follicular lymphoma was different from that of the WNE diagnosis of follicular variant of PTCL (fvPTCL). In five cases (including one suspicious of lymphoma on CNB), there was no malignancy. WNE provided a specific diagnosis of sinus histiocytosis with massive lymphadenopathy (SHML) in one case that had been reported as a reactive lymph node on the CNB.

Discussion

CNB is the procedure of choice in evaluation of lymphadenopathy replacing WNE for diagnosis of lymphoma in many centres.[8] Our audit of CNB in the diagnosis of lymphoproliferative disorders over the period February 2004–June 2012 provides data with respect to volume of work, site and size of biopsy, WHO categorisation and follow up. The findings enable recommendations toward maximising clinical relevance of CNB.

Table 5: Histologic findings in follow-up biopsies of patients in the re-audit

	Diagnosis at CNB	Diagnosis at open biopsy
1	Malignant NHL, NOS	Small lymphocytic lymphoma
2	DLBCL (probable germinal centre phenotype)	DLBCL
3	Possible NHL	Reactive lymph node
4	High grade B-cell NHL probable EBV driven	DLBCL
5	Possible necrotic lymphoma	Probable T cell rich DLBCL
6	DLBCL – germinal centre phenotype	DLBCL – germinal centre phenotype
7	Probable malignant NHL	EBV driven DLBCL
8	Probable malignant lymphoma	Peripheral T-cell lymphoma
9	Probable follicular lymphoma with DLBCL transformation	Follicular lymphoma G1 + DLBCL transformation (2 parts)
10	Atypical lymphoproliferative disorder	DLBCL – germinal centre phenotype
11	No diagnosis	No malignancy
12	Probable DLBCL	DLBCL
13	No malignancy	Follicular lymphoma G1
14	Follicular lymphoma G1/2	Follicular lymphoma G1/2
15	No malignancy	Possible sinus histiocytosis with massive lymphadenopathy
16	Atypical lymphoproliferative disorder	Nodular lymphocyte predominance HL
17	Necrotic tissue	No malignancy
18	Probable follicular lymphoma – G1/2	Peripheral T-cell lymphoma, follicular variant
19	Probable NHL	CNB – probable follicular lymphoma
20	Follicular lymphoma G1	Follicular lymphoma G1/2
21	T-cell malignant lymphoma	Peripheral T-cell lymphoma
22	Inflammation	No malignancy

The CNB number nearly doubled in the last four years (2008–2012) following the 1st audit (2004–2008). It is performed in cancer units, large and small hospitals, by many interventional radiologists and surgeons. In our 1st audit, CNB were mostly obtained from deep conventionally inaccessible sites, whereas the re-audit reaffirms others' findings that CNB is commonly used to assess superficial lymphadenopathy.[1,3,8]

Lymphoma was correctly identified in most cases in both audit periods. Adopting WHO classification as a diagnostic standard, only 57.5% in the 1st audit and 67.6% cases in the re-audit could be adequately diagnosed. These figures are considerably lower than 75–98% previously reported. Direct comparison with published studies is difficult due to variations in investigative techniques (flow cytometry versus immunohistochemistry), practice setting (primary diagnosis versus staging), differences in definition of adequacy (specific WHO subtype versus general diagnosis of lymphoma), needle size, number of cores and on site assessment of samples obtained.

In common with Amador-Ortiz *et al*,[3] we found that a specific WHO lymphoma diagnosis was made in a greater number of CNB from deep rather than superficial sites. Though easier to access than retroperitoneum, abdomen or mediastinum, the superficial lymph node biopsies were more often insufficient due to poor sample quality. It is possible that the precise image guidance technique used and operator experience of sampling influences adequacy rates.[5]

The audits demonstrated that hospitals with lower CNB procedure workload tended to provide inadequate samples more often. The WHO classification defines lymphomas by a set of clinical, histological and genetic criteria and disease definitions are updated periodically (2001 and 2008) with creation of new lymphoma subtypes. Adherence to WHO diagnostic criteria requires triaging samples, good logistics and communication between biopsy takers and sections of pathology laboratories for immunophenotyping by flow cytometry or immunohistochemistry and molecular studies. The stringent use of WHO disease definition meant a significant number of CNB in 2008–2012 audit were insufficient for precise lymphoma typing and therapy.

Follow-up excision biopsies in our audit enabled comparison of the diagnostic value of CNB and WNE. In the two time periods of this audit, there were 5/8 and 8/22 WNE diagnosed as FL or DLBCL, the two most common B-NHL in the Western populations. The remaining were relatively rare diagnoses such as NLPHL, TCRBCL, EBV-driv-

en LPD and PTCL. These are of diverse architectural patterns, cell lineages, characterised by large numbers of reactive or inflammatory cells and comparatively few tumour cells; hence the need for sufficient lesional tissue. We also found WNE facilitated specific rare benign diagnoses such as sinus histiocytosis with massive lymphadenopathy (SHML). Loubeyre *et al*[9] demonstrated the utility of CNB in the diagnosis of rare lymphomas with polymorphous lymphoid infiltrates and grading the relatively frequent follicular lymphoma. The number of individual cases is small. In this and other studies,[10,11] procuring several needle cores or concurrent FNA were instrumental in accurate WHO classification.

RCPath (2008) and BCSH (2010) recommend processing CNB in separate cassettes in order to ensure tissue availability for ancillary investigations. Nonetheless, many samples submitted as multiple cores were not processed in separate blocks. This was due to friability of the tissue which distintegrated in formalin and not infrequently, disentangling the multiple thin needle biopsies was thought to be detrimental to morphology by the laboratory staff. Approximately 40% of the biopsies in the 1st audit were single needle cores. The re-audit showed 18G needle was used for most CNB and at least two needle cores were submitted but 24% cases were single CNB. In many cases lymphoma is not among differential diagnoses stated on pathology request forms, which makes it difficult for laboratories to implement RCPath-BCSH recommendations. There is evidence that a combination of FNA-CNB, rapid assessment of FNA or CNB touch imprints and dedicated collection of CNB for histology, flow cytometry and molecular studies is instrumental in high accuracy of lymphoma typing.[3,10,11,12]

The case of follicular variant of PTCL (case 18, Table 5) had some misleading morphological and molecular features of a follicular B-cell NHL on the CNB. We believe the discrepancy in the core and excision biopsy in this case is due to the over-interpretation of the non-tumour cells at both the morphological and molecular levels; a recognised pitfall in small samples.

The literature suggests multiple (4–5) needle cores obtained with 14G–18G needles are essential for a complete diagnosis of lymphoma. The 18G needle provides a core of tissue approximately 0.6 mm in diameter, which is almost a third the size of the tissue obtained by using the modified Menghini needle used by Zinzani *et al*,[13] who had a >88% success in lymphoma diagnosis in their study of CNB. Thus, friability and inherent difficulties in interpreting small thin needle cores remain limiting factors in lymphoma diagnosis and subclassification even if multiple CNB are submitted.

This audit depended on the recording of WHO 2008 classification, complete immunophenotypic data, accurate SNOMED disease and procedural codes for each case. SNOMED procedural codes (as opposed to SNOMED disease codes) are not routinely recorded. To us, this seems a major limitation in collection of data for this type of audit.

Conclusions

The use of CNB in diagnosis of lymphoma has increased and is no longer restricted to deep anatomical sites. WHO classification on CNB requires multiple needle cores, ready use of ancillary investigations and understanding limitations of CNB in certain categories of lymphoma. Adherence to RCPath-BCSH guidance for tissue handling may be supplemented by dedicated collection of samples for morphology, immunophenotyping and molecular studies.

Action plan

The audit findings are disseminated to the members of the haematopathology (MDT) and histopathology, cytology and haematology laboratory personnel. The following actions are to be performed or facilitated by the laboratory. The responsible personnel are in parenthesis.

1. Obtaining ≥2 CNB and processing in separate blocks (pathologists to convey this at all organ system MDT, laboratory and teaching sessions).
2. Dedicated collection of fresh CNB for flow cytometry, molecular studies and histology (pathologists/biomedical scientists attending image guided FNA/CNB procedures when immediate assessment indicates lymphoma).
3. Using correct SNOMED disease and procedure codes to enable future data retrieval (pathologists).
4. Performing the CNB in compliance with national lymphoma guidelines and local patient care pathways (haematologists and radiologists).
5. Inadequate CNB specimens are followed up with repeat CNB or WNE for full diagnosis (pathologists to convey need for follow-up biopsies in the reports).
6. A complete re-audit will be performed in four years (mid 2016), with interim annual audits of laboratory processing and lymphoma diagnostic adequacy on CNB.

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The audits including data collection and analysis were performed by Dr S Sah and Mr S McIlwaine. The project design, data verification and article preparation were done by Dr L Venkatraman.

Competing interests
None

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Clinical audit templates

Clinical audit templates on a range of topics in pathology are now available online. These templates provide a step-by-step guide to planning an audit. All the templates can be downloaded and adapted for local or individual use from www.rcpath.org/clinical-effectiveness/clinical-audit/clinical-audit-templates

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