The Role of Abrams Percutaneous Pleural Biopsy in the Investigation of Exudative Pleural Effusions*

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Introduction: Blind percutaneous pleural biopsy has traditionally been performed to investigate the etiology of exudative pleural effusion in which the initial thoracentesis has been nondiagnostic. In view of the increasing use of image-guided and thoracoscopic pleural biopsies, this study examines the role of blind Abrams pleural biopsy in the investigation of pleural effusion in a large urban hospital.

Method: Patients undergoing blind Abrams needle biopsy between January 1997 and 2003 were identified from the hospital pathology database. The case notes and pathology records of these patients were analyzed retrospectively. All patients had presented to respiratory teams with an exudative pleural effusion and had initial nondiagnostic thoracentesis.

Results: Seventy-five patients undergoing blind biopsy were identified. Pleural tissue was obtained in 59 biopsies (79%), with no statistically significant difference in pleural yield between respiratory specialist registrars (equivalent to pulmonary fellows in training) and senior house officers/preregistration house officers (equivalent to junior residents and interns, respectively) performing the biopsy ($\chi^2$ test, $p = 0.43$). When up to three samples were obtained per episode, sufficient pleural tissue was obtained in 18 of 25 patients (72%) compared to 80% (32 of 40 patients) in whom four to six samples were taken ($\chi^2$ test, $p = 0.55$ [not significant]). For all diagnoses, blind biopsy had a sensitivity of 38%, which rose to 43% when reviewing patients in whom sufficient pleural tissue was obtained (for malignant diagnosis alone, sensitivity values were 43% and 51%, respectively; specificity, 100%; negative and positive predictive values, 51%). No fatalities were reported, and pneumothorax was seen in eight patients (11%), with only two patients requiring specific intervention.

Conclusions: Blind Abrams needle biopsy obtaining pleural tissue was diagnostic in approximately 50% of patients presenting with malignant effusion in the sample, and can be performed safely by all grades of medical staff with due attention to technique and supervision. The data support the continued use of the Abrams needle in the investigation of malignant pleural disease.

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Key words: Abrams needle; malignancy; pleural biopsy; pleural effusion

Abbreviations: NSCLC = nonsmall cell lung cancer; PRHO = preregistration house officer; SHO = senior house officer; SpR = specialist registrar

Exudative pleural effusions occur commonly in clinical practice and can present to both respiratory and nonrespiratory specialists. Cytologic examination of pleural fluid is diagnostic in approximately 60% of patients presenting with effusion secondary to malignant disease.1 When cytology is nondiagnostic, percutaneous pleural biopsy is recommended. Biopsy has traditionally been performed...
blindly using a needle described by Abrams\textsuperscript{2} in 1958. The Abrams biopsy needle was found to be easy to use, safe, and inexpensive, and rapidly became the standard way to obtain pleural tissue samples. The blind pleural biopsy is also well established in the diagnosis of tuberculous pleuritis in which the yield from microbial analysis of pleural fluid may be poor.\textsuperscript{3}

**For editorial comment see page 1398**

The role of blind biopsy in diagnosing malignant effusion has been questioned because its diagnostic sensitivity is less than that of image-guided and thoracoscopic pleural biopsies.\textsuperscript{4,5} With the increasing use of new and more expensive pleural biopsy techniques, we have examined the role of the blind biopsy in clinical practice. The effect of the number of samples obtained per biopsy, operator seniority and pleural yield, and the diagnostic yield according to histology is evaluated. Overall, the aims of this study were to establish the sensitivity of blind Abrams pleural biopsy in a large urban hospital, and to explore whether this technique still has a routine role in the investigation of exudative pleural effusion after a nondiagnostic thoracentesis.

**Materials and Methods**

All patients who underwent blind Abrams percutaneous pleural biopsy for exudative pleural effusion (defined as pleural fluid protein content > 3.5 g/dL) between January 1997 and January 2003 at University Hospital Aintree were identified retrospectively from the Department of Pathology computerized database. Formal ethical approval was obtained from the Clinical Audit Department at University Hospital Aintree prior to commencement of the study. A single investigator scrutinized the case notes of each patient. Patients who had at least one documented nondiagnostic thoracentesis prior to undergoing blind biopsy were included in the study.

Exclusion criteria included an initial biopsy performed under image guidance, and any patient with positive microbiological analysis of pleural fluid (on microscopy, Gram stain, or culture). Information obtained from the case records included the number of pleural specimens collected, the seniority of medical staff performing the procedure, and any recorded postbiopsy complications. Histopathologic reports were examined to record the presence of pleural tissue within the specimen and any reported specific malignant or nonmalignant diagnosis. The outcome of those cases in which the initial blind pleural biopsy was nondiagnostic was charted, and the details of further investigations (e.g., surgical biopsy, thoracoscopy, and bronchoscopy) and final diagnosis were recorded.

The seniority of medical staff performing a blind biopsy procedure was categorized according to the grade of the doctor. In ascending order, preregistration house officer (PRHO; the most junior grade of doctor, and equivalent to an intern in the United States); senior house officer (SHO; equivalent to residents rotating in internal medical specialties); pulmonary specialist registrar (SpR; equivalent to pulmonology fellow or trainee specializing in respiratory medicine); and consultant pulmonary physician (senior most and equivalent to attending physician).

The χ\textsuperscript{2} test was used to ascertain statistical differences in pleural yield obtained by different grades of doctor as well as the optimum number of samples needed to obtain an adequate yield and reach a diagnosis.

**Results**

A total of 75 patients who underwent blind Abrams needle biopsy (mean age, 72 ± 13 years [± SD]; 64% male) were identified. A pulmonary physician had seen all of these patients on at least one occasion during their illness. Of these 75 patients, adequate pleural tissue for histopathologic analysis was obtained in 59 patients (79%). Figure 1 shows the diagnoses obtained in the total patient group in the form of a flow chart.

**Relationship Between Seniority of Trainee and Success of Obtaining Pleural Tissue**

SpRs performed 49 biopsies and obtained adequate pleural samples in 37 patients (76%), while the more junior grades of doctor (SHOs and PRHOs) performed 26 biopsies, obtaining pleural tissue in 22 patients (85%). The difference in pleural yield obtained by SpRs compared to that by SHOs/PRHOs did not reach statistical significance (χ\textsuperscript{2} test, \(p = 0.43\)).

**Relationship Between the Number of Biopsy Samples and Obtaining Pleural Tissue**

In all the patients studied, blind biopsies were performed at one site only. In 25 procedures, up to three samples were obtained per episode, and sufficient pleural tissue for examination was obtained during 18 of these procedures (72%). In a further 40 procedures, four to six samples were obtained per episode, and 32 of these procedures (80%) demonstrated sufficient pleural tissue. The difference in pleural yield between the group in which three samples were obtained and those in which four to six samples were obtained did not reach statistical significance (χ\textsuperscript{2} test, \(p = 0.55\)). In 10 patients, the number of specimens obtained was not recorded.

**Success of Diagnosing Malignancy Using Abrams Needle Biopsy**

Overall, in the group of 75 patients studied, malignancy was diagnosed in 46 patients (61%). The breakdown of these 46 patients is seen in Figure 2 according to the investigation used to reach the diagnosis. In 20 patients (27% of the total sample), the initial blind Abrams biopsy was diagnostic of malignancy, and in a further patient after a repeat
blind biopsy. Of the 55 patients with nondiagnostic blind biopsy findings, malignancy was eventually diagnosed in 26 patients. Fifteen patients were referred for video-assisted thoracoscopy biopsy; malignancy was diagnosed in 12 patients, and the remaining three cases were idiopathic. In the remainder of the sample, malignancy was ultimately diagnosed in seven patients after further diagnostic evaluation following the nondiagnostic blind pleural biopsy: CT-guided pleural biopsy (two patients); liver biopsy (one patient); fiberoptic bronchoscopy (two patients); lymph node fine-needle aspiration (one patient); repeat blind biopsy (one patient); and repeat thoracentesis (one patient). In two patients following an initial nondiagnostic blind biopsy, malignancy was diagnosed on clinical and radiologic grounds, and no further attempts were made to gain a histologic diagnosis. A further four patients had malignancy diagnosed within 12 months of the initial blind biopsy following serial imaging, and in each of these cases the clinician did not attempt to obtain histology. All cases in which malignancy was diagnosed on clinical grounds, rather than by histology, were because of poor performance status that did not merit further invasive investigation. Of the 46 patients with malignancy diagnosed, 40 patients had a histologic diagnosis and the cell types of these malignancies are seen in Table 1. Regarding specific histopathologic malignant diagnoses, of the 13 cases of adenocarcinoma in the group, 9 cases (69%) were diagnosed by blind biopsy. This was in contrast to mesothelioma, in which blind biopsy was diagnostic in just 4 of 13 cases (31%).
Fiberoptic bronchoscopy was performed in a total of 20 patients yet was only diagnostic in 2 patients.

Nonmalignant Diagnosis

There were 29 patients in whom malignancy was not diagnosed. Three patients were treated empirically as tuberculous pleuritis with no recurrence of any effusion, although this was not proven by histologic or microbiological analysis of the pleural biopsy specimens. In four patients, pleural effusions were thought to be a result of other etiologies: cardiac surgery (one patient), a displaced ventriculoperitoneal shunt (one patient), secondary to cardiac failure (one patient), and parapneumonia (one patient); none of these were diagnosed using blind biopsy. Pleural effusions were diagnosed as idiopathic in 22 patients (29% of the whole group) after no recurrence of the effusion or the subsequent development of neoplasia was identified on regular clinical follow-up for a minimum of 12 months following initial blind pleural biopsy (range of follow-up, 12 to 48 months). There were no pleural effusions in the group thought to be associated with rheumatoid arthritis, collagen vascular diseases, or pulmonary emboli.

Relationship Between Number of Biopsy Specimens and Diagnosis of Malignancy

In those 25 blind biopsy procedures in which up to three specimens were sent, malignancy was diagnosed in four patients (16%; NSCLC, n = 3; mesothelioma, n = 1); while in the 40 procedures in which 4 to 6 samples were obtained, 13 samples (32.5%) were diagnostic of malignancy (adenocarcinoma, n = 7; mesothelioma, n = 3; NSCLC, n = 1; other, n = 2). However, this difference in diagnostic yield did not reach statistical significance (χ² test, p = 0.14).

Complications

There was no documentation of any serious complications following the Abrams needle procedure (eg, severe hemorrhage or pleural sepsis). Complications that were recorded included pneumothorax in eight patients (11%), but only two patients (2.5% of the overall sample) required any specific intervention (both required intercostal tube drainage for 2 days and 4 days, respectively). Of these eight cases, SpRs performed five biopsies (one requiring drainage), while SHO/PRHOs performed three biopsies (one requiring drainage). No procedure-related deaths occurred in the study.

Sensitivity and Specificity

Table 2 tabulates the sensitivity, specificity, and positive and negative predictive values of the blind Abrams needle biopsy for all the diagnoses seen in this study. The results are first reported for all patients who underwent blind biopsy and second for those patients in whom sufficient pleural tissue was obtained. Overall, there was a sensitivity of 38%, which rose to 43% when reviewing the patients in whom sufficient pleural tissue was obtained (for malignant diagnosis alone, the sensitivity values were 43% and 51%, respectively). No false-positive results were found in the study, accounting for the 100% specificity. The negative predictive value for blind biopsy was 40%, falling to 33% when adequate pleural samples were obtained. The negative predictive value for diagnosing malignancy was 51% irrespective of whether adequate pleural samples were obtained.

Table 1—Patients With a Diagnosis of Malignancy Following Presentation With Exudative Pleural Effusion and Initial Nondiagnostic Thoracentesis

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Malignancy</td>
<td>21</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>Adenocarcinoma</td>
<td>9</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Mesothelioma</td>
<td>4</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>NSCLC (other)</td>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Other malignancy</td>
<td>4</td>
<td>1</td>
<td>9</td>
</tr>
</tbody>
</table>

Table 2—Sensitivity, Specificity, and Positive and Negative Predictive Values of Blind Pleural Biopsy for All Diagnoses*

<table>
<thead>
<tr>
<th>Variables</th>
<th>All Initial Blind Biopsies (n = 75)</th>
<th>Blind Biopsies Obtaining Adequate Pleural Tissue (n = 59)</th>
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<tbody>
<tr>
<td>Sensitivity</td>
<td>38 (43)</td>
<td>43 (51)</td>
</tr>
<tr>
<td>Specificity</td>
<td>100 (100)</td>
<td>100 (100)</td>
</tr>
<tr>
<td>Positive predictive value</td>
<td>100 (100)</td>
<td>100 (100)</td>
</tr>
<tr>
<td>Negative predictive value</td>
<td>40 (51)</td>
<td>33 (51)</td>
</tr>
</tbody>
</table>

*Data are presented as % (% of malignancy).
DISCUSSION

There is much controversy regarding the ideal procedure used to undertake pleural biopsy. Increasingly, blind Abrams needle biopsy is being superseded by image-guided biopsies and thoracoscopy, both of which have been demonstrated to have a higher diagnostic yield in malignant disease. In addition, thoracoscopy allows the operator to directly visualize any pleural abnormalities, thus improving yield as well as facilitating therapeutic procedures such as pleurodesis. These benefits must be weighed against the cost of performing such procedures in terms of training, equipment, skilled personnel, and hospital length of stay. Loddenkemper et al. reported that medical thoracoscopy was diagnostic in 95% of malignant pleural effusions, compared to 44% using blind biopsy and 74% when blind biopsy was combined with pleural fluid cytology. These findings are in contrast to the role of the blind biopsy in the investigation of tuberculous pleural effusion in which the diagnostic sensitivity is greater than that seen in malignancy, with a combined yield from culture and histology reaching 90%.

On conclusion of this study (minimum of 1 year after biopsy), malignancy was confirmed in 46 cases (61%), of which 21 cases (46%) were diagnosed by Abrams pleural biopsies. In the 75 patients studied, the overall diagnostic sensitivity of initial blind biopsy was 38% (rising to 43% when pleural tissue was obtained), with a negative predictive value of 40%. If those Abrams biopsies that failed to obtain pleural tissue were excluded from the study, the sensitivity for diagnosing malignancy increased to 51%. Previous studies have reported diagnostic sensitivities varying from 7 to 72%. A study of 414 patients with pleural effusion reported an additional diagnostic yield of only 7% using blind Abrams needle biopsies over cytologic analysis of pleural fluid. Mungall et al. for example, reported the highest diagnostic rates in 72% of malignant effusions and 88% of tuberculous effusions. Edmonstone et al. and McLean et al. reported slightly lower diagnostic sensitivities of 60% and 62%, respectively, while Maskell et al. found the sensitivity was 47% compared to 87% when using CT guidance. All articles report that there are few, if any, false-positive biopsy results with any of the diagnostic techniques, giving blind Abrams pleural biopsy a very high specificity.

Blind Abrams biopsy was diagnostic in 4 of 13 cases (31%) of mesothelioma. These results are not as good as Beauchamp et al., but they are comparable with the series published by Boutin et al., in which closed needle biopsy was diagnostic in 20.7% of cases, increasing to 38.7% when pleural fluid cytology was taken into account. The diagnostic sensitivity for blind biopsy in our series was greater for adenocarcinoma (69% of cases). Despite the established role of blind pleural biopsy in the diagnosis of tuberculous pleuritis, there were only three possible cases seen in our group. None of these cases were diagnosed by histology but were treated presumptively due to the overall clinical findings. The reason for the distribution of cases in different studies is likely to be the prevalence and pretest probability of lung cancer, mesothelioma, and tuberculosis in a geographic region. In our geographic catchment area, there is a very low prevalence of pulmonary tuberculosis and a very high prevalence of lung cancer; thus, in this study, exudative pleural effusions are much more likely to be due to malignancy.

Overall, adequate pleural specimens were obtained in 79% of blind biopsies performed in our unit. Walshe et al. reported 71% of biopsy samples performed by nonrespiratory teams contained pleural tissue. In contrast, Cowie et al. in a large study of 750 needle biopsies, reported a 90% success rate in obtaining pleural tissue. Regarding adequate number of specimens per procedure, Walshe et al. suggested that up to six biopsy specimens should be obtained per procedure in order to maximize the yield of pleural tissue. However, our results indicate that a smaller number of samples can produce yields > 70%, and there was no statistically significant difference seen in pleural yield when three or up to six specimens were obtained. In diagnosing tuberculous pleuritis, one study suggested that up to six samples should be obtained in order to obtain a representative sample of pleural tissue. Our study observed a nonstatistically significant trend for improved diagnostic rates of malignant disease when up to six specimens were obtained per procedure rather than three specimens (32% vs 16%, respectively).

In the current study, the seniority of the doctor undertaking the procedure did not have a great influence on the success of obtaining pleural tissue (35% of the biopsies were performed by preregistration or senior house physicians). This suggests that all grades of junior medical staff may readily acquire proficiency in this procedure following suitable training. The procedures performed by SPRs had a slightly lower pleural yield than the more junior members of staff, although this did not reach statistical significance. It is unknown whether this was due to SPRs undertaking more difficult and challenging biopsies.

There are several limitations to this study. All biopsies in the group were performed by members of a pulmonology team (SPR, SHO, or PRHO). The diagnostic yield may be reduced if nonpulmonary specialists performed such biopsies, and one previ-
ous study\textsuperscript{19} reported such an observation. The relationship between the staging of the 46 malignancies in the sample at presentation and diagnostic sensitivity of the blind biopsy was not determined in this study. The diagnostic yield of pleural biopsy could be altered by more advanced pleural malignancy, in which there is greater invasion of the parietal pleura in addition to the visceral pleural tissue. It is also recognized that exudative effusion may occur in the presence of malignancy without infiltration of malignant cells in the pleura, so-called paramalignant effusion.\textsuperscript{20} At the time of the study, pleural fluid lactate dehydrogenase and cholesterol concentrations were not measured as a matter of routine; however, it is now recognized that the absolute values of these may be suggestive of a diagnosis such as neoplasia.\textsuperscript{21} Because of this, a pleural fluid protein cut-off value of 3.5 g/dL was used to distinguish exudative from transudative effusions in order to exclude borderline cases. The experience and skill of the pathologist in the cytologic analysis of pleural fluid and histopathologic analysis of pleural biopsy specimens will also directly affect the diagnostic sensitivity of both procedures, and this may vary in different centers. In addition, the effect of the presence or absence of radiologic abnormalities on pleural yield during blind biopsy was not explored. Further detailed studies to assess the relationship between the degree of pleural thickening (eg, uniformly or diffusely focal disease) with diagnostic sensitivity of the Abrams needle biopsy are needed. The presence of significant pleural thickening may alert the clinician to a diagnosis of mesothelioma and to subsequently pursue image-guided pleural biopsy as the primary biopsy technique because of its higher diagnostic sensitivity of up to 86%.\textsuperscript{22}

This study, keeping with the literature,\textsuperscript{10,16} shows that few major complications were associated with this procedure. Despite the 11 pneumothoraces noted, only 2 were significant enough for patients to need intercostal tube drainage after the procedure. It is also recognized that in malignant pleural disease, pneumothorax may occur secondary to trapped lung, and the observation of a postprocedure pneumothorax would not be regarded as a true procedure-related complication but rather a preexisting entity made more evident after the procedure. It is not known whether trapped lung could account for any of the pneumothoraces seen in our study, as measurement of intrapleural pressures was not carried out. Another factor is that air may enter through or around the Abrams needle, giving rise to a pneumothorax. The effect of patient comorbidity on procedure-related complications was not assessed, and further detailed studies are needed to determine the relationship between patient characteristics, radiologic abnormalities, and the incidence of complications. In keeping with other reports,\textsuperscript{23} this study found that bronchoscopy was not very helpful in the diagnosis of malignant pleural effusion.

The practice of performing bedside ultrasonography may serve as a useful adjunct to performing percutaneous pleural biopsy, although this was not available in our study. Ultrasound may provide specific information on the size of the pleural effusion, identify the free-flowing effusions from those with significant loculations, and characterize other specific pleural abnormalities. Thoracic ultrasound may also enable the clinician to select an optimal biopsy site, improving the diagnostic yield and avoiding potential complications. Further detailed studies are needed to explore the role of bedside ultrasonography when performing percutaneous pleural biopsy.

Critics of the use of blind Abrams needle biopsy often cite patients’ experience of the procedure and the potential to produce pleural adhesions, which may hamper further investigations as reasons not to use this technique. Little is known of patients’ perception (eg, discomfort and pain during the procedure and discomfort afterwards) of undergoing blind pleural biopsy compared to other procedures to obtain pleural tissue, and this warrants further study. A full search of the literature did not reveal any scientific assessment of this aspect of pleural biopsy or any studies assessing the production of pleural adhesions following Abrams needle pleural biopsy. Although blind biopsy is a less sensitive diagnostic technique than thoracoscopic and image-guided pleural biopsy,\textsuperscript{5,11,24,25} blind Abrams needle biopsy established a diagnosis in approximately 50% of patients presenting with exudative pleural effusion secondary to malignant disease in this review; and its use in tuberculous effusions is well documented in the literature.\textsuperscript{7} Routine use of blind biopsy may mean that in up to half of patients, image-guided or surgical pleural biopsy is not required. This has a potential impact on health economics, as the costs of performing medical thoracoscopy or image-guided biopsy (trained medical staff, nursing assistance, equipment, operating theater time, and hospital stay) are considerable. It would also avoid reliance on the radiology department for routine image-guided pleural biopsy as well as the hazards associated with surgery and general anesthesia. These issues become particularly relevant in those areas that have limited medical resources and lack of access to medical thoracoscopy or thoracic surgical facilities. Further studies are needed to compare the cost-effectiveness and health economics of performing a routine blind biopsy rather than proceeding directly to thoracoscopy or surgical biopsy.

Provided that adequate training is given, blind
pleural biopsy can be performed safely in a ward-based setting and appears to be well tolerated by a population who often have a poor performance status, short life expectancy, and morbidities. The role of the Abrams needle biopsy may be more significant in patients with poor performance status, and this needs further study. The presence of diffuse pleural involvement radiologically in such a group may justify a less invasive biopsy technique as a suitable first approach. The data from this study suggests that blind biopsy is more likely to be diagnostic in the presence of some specific malignancies such as metastatic adenocarcinoma in contrast to others such as mesothelioma. In addition, blind pleural biopsy is less likely to be diagnostic when investigating effusions secondary to benign disease with the exception of those resulting from tuberculous pleurisy. Further detailed prospective studies are needed with the aim of attempting to stratify patients in terms of likelihood of achieving a diagnostic blind pleural biopsy. Ideally, such studies should examine factors such as the degree of radiologically abnormal pleura and the staging of any malignancy. We suggest that following nondiagnostic pleural fluid cytology, patients presenting with exudative pleural effusions are investigated with one blind percutaneous pleural biopsy procedure with between four and six biopsies obtained to maximize pleural yield. To minimize the theoretical risk of producing adhesions and to prevent delays in diagnosis, we do not advocate repeat blind Abrams needle biopsy. In patients who are fit, we suggest that following negative blind biopsy findings, image-guided or thoracoscopic pleural biopsy should be performed. The evidence cited in this article strongly suggests that the technique of Abrams needle pleural biopsy still has a place in the diagnosis of exudative pleural effusion and should not be abandoned.

References