The Scottish multi-centre prospective study of bronchoscopy for bronchial carcinoma and suggested audit standards

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Fibre-optic bronchoscopy is widely used to diagnose bronchial carcinoma. There is considerable variation in techniques for patient sedation, methods of obtaining samples and histopathological yield. We wished to examine variations in practice in different centres throughout Scotland and derive realistic audit standards for best clinical practice from these results.

Diagnostic bronchoscopies from five centres were included. Patient details, grade of individual performing the test, endobronchial abnormalities, specimens taken and the histocytological yield were recorded. A patient satisfaction questionnaire was completed. One thousand eight hundred and two bronchoscopies were performed to look for bronchial carcinoma. Sedation and anaesthesia techniques varied considerably between centres. There were marked differences in patient satisfaction between centres. Nearly twice as many females as males would prefer not to have bronchoscopy repeated. Six hundred and fifty-eight carcinomas were confirmed by histocytology. Yield was unaffected by the grade of doctor performing bronchoscopy. Improving yield may be achieved by increasing the number of sampling techniques employed and changing the order in which specimens are taken (biopsies first and washings last). Eighty-seven percent of endoscopically visible tumours were confirmed histocytologically. There was a considerable variation in histological spectra between centres that may relate to differences in pathological interpretation rather than actual differences in case mix. Suggested audit standards are discussed.

This study demonstrates the variety of techniques and also the levels of histocytological yield and patient satisfaction that can be achieved. Provisional standards of practice for this procedure have been agreed with a view to auditing performance against these. It is hoped that centres will adopt the methods that are shown to achieve the highest standards.

Introduction

Bronchoscopy is used primarily to establish or exclude the diagnosis of bronchial carcinoma and to assess the possibility of surgical resection. The development of fibre-optic bronchoscopy and its associated techniques of bronchial biopsy, brush smears and washings are widely used.

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Histological confirmation of malignancy is the prime aim of the procedure but there is no clear agreement as to which specimens should be taken, in which order and in the degree of yield of positive results which should be achieved. It has been suggested by Mak et al. (5) that to obtain maximum histological yield a combination of all three techniques should be applied. Mak et al. confirmed 87% total histocytological yield where tumour was seen where other authors report yields of 86% (6) and 94% (7).

The aim of this study was to compare methods of sedation, tolerance of the procedure and histocytological yield in five centres in Scotland. We hoped to derive a realistic set of standards against which clinicians could compare their own performance in future audit projects.

Methods

From January 1991 to December 1992, details of all diagnostic fibre-optic bronchoscopies for bronchial carcinoma performed in Inverclyde Royal Hospital and Aberdeen Royal Infirmary were collected, together with those carried out at Raigmore Hospital, Inverness from March 1991. Patient details, indications for the procedure and grade of bronchoscopist were noted. The bronchoscopist was given, for coding purposes, a choice of descriptions: normal, possibly malignant, probably malignant, definitely malignant but no frank tumour, or frank tumour. We thought these terms would give a spread of descriptions found in common clinical usage. Bronchoscopists used their own clinical judgement in recording appearances.

Specimens taken and the eventual histocytological yield were recorded. Patients then completed an unsupervised questionnaire usually before review or explanation of results. This was returned either by post or by hand at the next clinic appointment. Patients were asked if they would agree to another bronchoscopy 'if it were felt to be necessary'. The project was co-ordinated by the Audit Centre of the Royal College of Physicians & Surgeons in Glasgow where anonymised data were coded and analysed.

Following a review of the initial findings in March 1992 the study was broadened to include bronchoscopies performed in Fife and the Western Infirmary, Glasgow for the following 6 months.

Results

A total of 2238 bronchoscopies from the five centres were studied. The number by centre ranged from 325 to 644. Of the total, 1802 were performed to exclude bronchial carcinoma and will be discussed further in this paper. The remaining 19% were performed for other indications such as transbronchial lung biopsy, bronchography, foreign body removal, bronchial toilet etc. The level of supervision of junior doctors varied, with centres B and E having respectively, 33% and 24% unsupervised bronchoscopies performed and the other centres having very few or none.

SEDATION AND ANAESTHESIA

A wide variation in sedation and anaesthesia techniques was found in the five centres. One centre routinely used general anaesthesia and another performed fibre-optic bronchoscopy in a side room using the perioral route without sedation or topical anaesthesia unless the patient was particularly apprehensive. The remaining three centres routinely used either intravenous phenoperidol and droperidol, oral temazepam or intramuscular pethidine. For topical anaesthesia two of these centres gave nebulized lignocaine before the procedure and all three used lignocaine directly into the nose, oropharynx and via the bronchoscope as the procedure progressed.

BRONCHOSCOPIC INTERPRETATION

The bronchoscopic description was compared with histocytological yield as detected by the combination of biopsies, brushings and bronchial washings. For those in whom there appeared to be definite malignancy or frank tumour, the positive yield varied from 74% to 88% between centres. In those bronchoscopies where only probable or possible tumour was seen the positive yield dropped to between 29% and 40%. Suspicious or frankly malignant pathology was reported in 4–14% of bronchoscopies reported as normal. Overall for the five centres, when definite tumour tissue was seen biopsy was positive in 82% while the total histocytological yield was 87% when adding the contribution made by brush smears and washings.

SPECIMENS TAKEN TO CONFIRM THE DIAGNOSIS

Table 1 shows the histocytological yield for all centres. The categories of bronchoscopic description are given with the positive yield for each combination of specimens taken. Considering the orders of taking specimens, if all three specimens were taken then more biopsies were positive when taken first (59 vs 40%) while washings were more likely to be positive if taken last (27 vs 19%).

The histocytological yield was unaffected by the seniority of staff performing the procedure. Of 68 diagnostic bronchoscopies carried out by junior trainees where tumour tissue was definitely seen, 78% were confirmed as being malignant while 80% yield was achieved by consultants or senior trainees. Similarly, the combination of specimens taken was not influenced by the seniority of staff performing the procedure.

Table 2 shows the specificity of the different histocytological techniques from the five centres. There appear to be major variations between centres which may relate to the success in obtaining an adequate specimen or to pathological interpretation. In particular centre B shows poor specificity for smears and washings and centre C shows poor specificity for biopsies.

An attempt was made to determine whether the number of biopsies taken correlated with the subsequent histocytological yield. Where frank tumour was seen there was no
clear association but where appearances were definitely malignant but no tumour seen, where three or fewer biopsies were taken the yield was 56% and where four or more were taken the yield was 71% (31/57 vs 34/48).

In the categories of possibly malignant and normal taken together, where three biopsies or less were taken the yield was 14% and where four or more biopsies were taken the yield was 21% (20/142 vs 11/53).

HISTOLOGICAL RESULTS
Table 3 illustrates the histological spectrum of cell type description as reported by each centre.

PATIENT SATISFACTION AND DAY CASE PROCEDURES
Figure 1 shows the proportion of patients in each centre who would be willing to have repeat bronchoscopy as an indication of patient satisfaction with the procedure. In centres B and E, which apparently have lower patient satisfaction levels, more bronchoscopies were performed by junior staff. However, further analysis in these two centres showed no significant difference in this index of patient satisfaction comparing consultants and junior staff. A more uniform finding was that nearly twice as many women are either ambivalent about or emphatically against repeat bronchoscopy (14% of 1079 men and 26% of 593 women). The percentage of day case bronchoscopies for those patients living within the urban surroundings (10 miles) of each centre are given at the foot of the columns. Centre E did no day case bronchoscopies while centre D did 50%.

Discussion
Diagnostic bronchoscopy is a common invasive procedure carried out by most respiratory physicians and by many

Table 3. Cell type descriptions of 693 histologically positive bronchoscopies in five centres

<table>
<thead>
<tr>
<th>Centre</th>
<th>A (117)</th>
<th>B (101)</th>
<th>C (222)</th>
<th>D (129)</th>
<th>E (124)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Squamous (%)</td>
<td>58</td>
<td>38</td>
<td>39</td>
<td>60</td>
<td>38</td>
</tr>
<tr>
<td>Small cell</td>
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<td>24</td>
<td>19</td>
<td>12</td>
<td>24</td>
</tr>
<tr>
<td>Adenocarcinoma</td>
<td>8</td>
<td>9</td>
<td>17</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td>Other</td>
<td>10</td>
<td>29</td>
<td>25</td>
<td>20</td>
<td>25</td>
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<tr>
<td>Total</td>
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thoracic and ENT surgeons. This study of 1802 bronchoscopies performed to exclude bronchial carcinoma from five centres in Scotland demonstrates the wide variety of techniques involved and also the histocytological yield and levels of patient satisfaction which can be achieved. We are unaware of any other comparative study of bronchoscopy and feel that these data do allow for the setting of realistic standards for this procedure.

Histocytological confirmation of malignancy is the prime aim of diagnostic bronchoscopy for bronchial carcinoma. It has been suggested that biopsy with cytological examination of both bronchial brushings and washings are required to achieve maximum histocytological yield (5). In this study, biopsy alone in patients with 'frank tumour seen or definitely malignant' confirmed malignancy in 71% of patients and bronchial brushings and washings together were positive in 32% of the remainder giving a combined yield of 80%. Considering where frank tumour was seen, our centres reported histocytological confirmation ranging between 80% and 95%; very similar to previously reported results of between 86% and 94% (5-7). The centre with a yield of 95% almost invariably took a full house of specimens whereas the centre with a yield of 80% only did so in 2% of cases.

In those bronchoscopies seen to be 'possibly malignant or normal' only 4% confirmed malignancy on biopsy while 5% of the remainder were positive on bronchial brushings or washings giving a combined yield of 9%. The relative yield from bronchial brushings and washings therefore appears to be greater when tumour is not clearly visible. This finding and that in Table 1 suggests that to obtain maximum histocytological yield, a combination of either biopsies and washings or of biopsies and smears and perhaps all three should be used.

Where the bronchoscopist reports 'extrinsic compression by extrabronchial tumour' yields have been shown to be as low as 18% (3). Our category of 'definitely malignant but no frank tumour seen' includes many cases of extrinsic compression which explains a yield lower than where frank tumour seen'. However, some critics by participants in this study were made of the rather subjective categories of likelihood of tumours seen and so reliable comparisons between our centres in this study and with previous series may not be valid.

The order in which specimens should be taken to achieve maximum histocytological yield is unclear. This study suggests that bronchial biopsies are more likely to be positive when taken first while bronchial washings have a higher yield when taken last. However, this finding could equally be explained by a tendency for bronchoscopists to take biopsies first where frank tumour is seen and washings first where tumour is not seen.

The number of biopsies taken may also affect histocytological yield. Gellert reported that in those bronchoscopies where tumour was seen a single biopsy was positive in 65-2% while taking five or more biopsies increased this yield to greater than 90% (8). As many as 10 biopsies have been suggested as being necessary to confirm malignancy in peripheral lesions (9). This study shows no clear association between the number of biopsies taken and histological yield where frank tumour is seen. The reason for this difference may be that if our bronchoscopists obtained two or three biopsies which they consider adequate they were less likely to take more whereas if the specimens seemed inadequate more substandard specimens were taken. Our results lend some support to the suggestion that where tumours are not visible multiple biopsies may give higher yields. Further investigation of the best order of specimen taking and the optimum number of biopsies would require a randomized study.

It has been suggested that bronchoscopic yield should improve with practice and experience. In an analysis of the first 300 bronchoscopies at the Brompton Hospital, the histocytological yield where a tumour was seen as 61% for the first 150 and 89% for the second 150 cases (10). In our study, the yield achieved was not influenced by the seniority of staff with 78% of bronchoscopies performed by a junior trainee being confirmed as malignant compared with 80% achieved by senior trainees and consultants. While this appears reassuring it probably merely reflects the training which junior bronchoscopists have received before being allowed to perform the procedure unsupervised. In those of our centres where junior trainees performed bronchoscopies, patient satisfaction as judged by the percentage who said that they would have bronchoscopy again was no different when the procedure was carried out by consultants or by junior staff. This could be due to lack of subtlety in this measurement of patient satisfaction but also may reflect the high standard of training in bronchoscopy that juniors undergo. It may be that social skills are as important as competence with the bronchoscopic techniques in ensuring patient comfort.

Opinions vary on sedation required for fibre-optic bronchoscopy and whether general anaesthesia is appropriate. One of our original centres still uses general anaesthesia as their usual technique but this was not associated with an improvement in histocytological yield or willingness to have the procedure repeated. Good patient satisfaction has been reported where only local anaesthesia was used with no sedation (3,4). Although, in these previous studies, some patients report unpleasant

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**Fig. 1.** Patient satisfaction; percentage in each centre who would have repeat bronchoscopy and percentage of day cases in brackets.
side-effects during and after bronchoscopy it seems that patient satisfaction was unrelated to the type of anaesthesia or sedation used.

In the present study there was also considerable variation in patient satisfaction between the different centres but we were unable to determine the reasons for this and there was no clear evidence that the type of sedation or anaesthetic was important. The knowledge of a diagnosis of cancer might affect the patients' perception of the recent bronchoscopy although usually patients completed the questionnaire before being reviewed with the results. The finding that 26% of women compared with only 14% of men were ambivalent about or emphatically against repeat bronchoscopy may suggest that men conceal their true feelings. Patient satisfaction is an important aspect of medical care and would require more rigorous evaluation. Simply asking whether a patient would be willing to undergo a repeat procedure by itself can encourage bronchoscopists to review their techniques. The variation in proportion of day cases is marked. There may always be a need for overnight admission for some frail patients, those living far from the hospital or those requiring further investigation. We suggest that 50% of bronchoscopies would be performed as day cases and that this would be a feasible aim for future studies.

The variations in histological spectra between hospitals is of considerable interest and concern. It is not felt that differences of this magnitude are likely to be due to differences in case mix. The inference is that some cases may have been wrongly classified and reinforces the recently expressed view that there is a need for standardization of classification of bronchial carcinoma histology (11). Overall the incidence of different bronchial carcinoma cell types was similar to that seen in a Scottish study of pathology specimens \( n = 2117 \) (12). However, the bronchosopic findings in the present study should not be considered representative of the full histocytological spectra as it is well recognized that some cancers, for instance early adenocarcinomas, may be underrepresented at bronchoscopy (13). The findings of this study were discussed with local consultant pathologists and it is hoped that this will lead to improvements in and standardization of histocytological reporting and reduction in the number of specimens deemed suspicious. A wider audit by pathologists may be indicated.

Although there was a variety of bronchoscopic methods employed we felt that the above data gave a reasonable basis for standards against which units could judge their individual performance in the future. Following the study the clinicians involved agreed to set themselves explicit standard which were felt to be reasonable and achievable measurements of good practice:

1. Bronchoscopies to be performed or supervised by consultant or senior registrar unless the junior doctor has performed at least 100 under supervision.
2. Where definite tumour seen, aim to achieve histocytological confirmation in greater than 85% of cases.
3. Of cases where histocytology is reported as malignant or suspicious, less than 5% should be classed as suspicious.
4. For patients living within 10 miles of the hospital, day case bronchoscopy should be performed in greater than 50%.
5. Over 90% of male and 80% of female patients should be prepared to have bronchoscopy repeated.

Following completion of the project a conference involving 30 bronchoscopists and pathologists in Scotland was held to discuss the content and implications of the study. It was decided that a Scottish Thoracic Society Steering Group should further refine the standards with the aim of inviting bronchoscopy units in Scotland to be involved in prospective audit of their performance against these standards. It is hoped that in time best practice will be recognized and centres will adopt methods of bronchoscopy which achieve the highest standards.

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