Sputum cytology: a limited role

A Gledhill, C Bates, D Henderson, P DaCosta, G Thomas

Abstract

Aims—To determine the cost and sensitivity of sputum cytology in routine use and to determine when sputum cytology is most appropriate.

Methods—A retrospective study, based on all sputum cytology requests received in five histopathology/cytopathology laboratories in Yorkshire from 1 January to 31 December 1993. Cytology findings were correlated with histological diagnosis or clinical outcome, and related to the speciality of the referring clinician.

Results—Laboratory practice and performance was similar in all five centres. The average laboratory cost of sputum cytology was £26.93. The mean absolute sensitivity was 36% and the specificity was 99.6%. The majority of specimens was submitted by general physicians or geriatricians. The largest proportion of positive specimens were submitted by chest physicians.

Conclusions—Often sputum cytology is used inappropriately as a screening investigation on, or soon after, admission. In addition, it is used inappropriately before bronchoscopy. Sputum cytology should be limited to individuals in whom a histological diagnosis is desired, but in whom bronchoscopy is inappropriate or unsuccessful.

(*J Clin Pathol* 1997;50:566-568)

Keywords: sputum cytology; sensitivity; cost; specificity; laboratory practice

Sputum cytology is a common diagnostic test, forming much of the non-gynaecological cytology workload in many laboratories. Before the development of fiberoptic bronchoscopy, sputum cytology was the only alternative to thoracotomy for tissue diagnosis of many pulmonary neoplasms. It is regarded by clinicians as a simple, cheap, and non-invasive investigation. However, sputum cytology is relatively costly in terms of laboratory time, both during specimen preparation and screening; also, it has a low sensitivity. While there are individuals in whom it is the most appropriate means of investigation, there is an increasing recognition by cytopathologists and chest physicians that in many instances it is not a cost-effective investigation. This study examines the cost of sputum cytology and the laboratory practices of a selection of hospitals in Yorkshire. It also examines the sensitivity and specificity of sputum cytology requests from clinicians in different specialities to delineate better the appropriate role of sputum cytology.

Methods

Five centres participated in the study, ranging from a relatively small district general hospital (350 beds) to a large general hospital with a significant teaching commitment (800 beds), and including one specialist cardiothoracic hospital. The participating pathologists were all consultants with a minimum of four years consultancy experience. All have a sizeable cytology workload, and one has a special interest in cardiothoracic pathology. All sputum cytology requests received from 1 January to 31 December 1993 were analysed with respect to age, sex, clinical details, requesting clinician, and cytology findings. Subsequent investigative procedures and final diagnosis were obtained either from the hospital's clinical information system or from case notes. The number of bronchoscopic examinations undertaken during the same period was also determined. These were categorised according to histological diagnosis on biopsy, and whether there had been previous sputum examination.

The laboratory procedure for examination of sputum cytology was compared for each of the participating hospitals. The cost per request was determined using the costing method outlined by the Audit Commission for "Critical Path", the study of Pathology services in Great Britain.¹

Results

LABORATORY PROCEDURES

All five centres followed a similar laboratory protocol. All centres recommend that at least three separate samples are submitted from each individual, in accordance with the literature.^{2,3} One centre prepared three slides from each sample, the remainder prepared two slides. In all centres, initial screening was by a medical laboratory scientific officer (MLSO) or experienced cytoscreener. In one centre, a consultant "checked out" all specimens, including negative tests. In the remaining four centres, consultants only checked suspicious and positive specimens. The cost per request ranged from £16.83 to £36.78 (mean £26.93). Therefore, a minimum set of three samples would cost an average of £79.17. The major factor influencing cost was laboratory overheads, the laboratory in which all slides were checked by a consultant having the lowest cost.

CYTOLOGY DATA

Table 1 shows the number of samples received in each laboratory, the corresponding number of patients, and the cytological diagnosis. Evidently, most centres were not even submitting the three samples recommended as a minimum for reliable diagnosis.

Harrogate General Hospital,
Knaresborough Road,
Harrogate HG2 7ND,
UK

A Gledhill

York District Hospital,
Wiggington Lane, York
YO3 7HE, UK

C Bates

Friarage Hospital,
North Allerton, North
Yorkshire DL6 1JG, UK

D Henderson

Seacroft Hospital,
York Road, Leeds
LS14 6UH, UK

P DaCosta

Halifax Royal Infirmary, Free School Lane,
Halifax
HX1 2YP, UK

G Thomas

Correspondence to:
Dr Gledhill.

Accepted for publication
8 April 1997

Table 1 Number of samples received in each hospital, numbers of patients, and final diagnosis

	Hospital				
	A	B	C	D	E
Total number of samples	252	569	301	134	137
Total number of patients	137	264	99	110	95
Number of samples per patient	1.8	2.2	3	1.2	1.4
Number (%) of patients positive	6 (4.4)	24 (9.1)	3 (3)	11 (10)	3 (2.1)
Number (%) of patients suspicious	11 (8)	22 (8.3)	6 (6)	3 (2.7)	2 (1.4)
Number (%) of patients negative	120 (87.6)	218 (82.6)	90 (90.9)	96 (87.3)	90 (94.7)

Table 2 Number of patients in whom a positive diagnosis of malignancy was obtained by sputum cytology and clinical outcome

	Hospital					Total
	A	B	C	D	E	
Total number of patients	137	264	99	110	95	705
Positive diagnosis	6	24	3	11	3	47
False positive	1	1	0	0	0	2
True positive	5	23	3	11	3	45
Negative/suspicious	112	240	96	99	92	639
False negative/suspicious	13	16	7	21	6	63
True negative	99	224	89	78	86	576
Outcome malignant	18	39	10	32	9	108
Outcome benign	119	225	89	78	86	597
Sensitivity	27.8	59	30	34.4	33.3	41.7

The diagnostic yield was low. The proportion of positive samples varied with the speciality of the submitting clinician, a higher proportion of positive sputum coming from chest physicians, and few coming from geriatricians (fig 1). The sensitivity of a test can be expressed in terms of each specimen submitted, or as a cumulative sensitivity for the series of samples submitted from that patient. We have chosen to look at the cumulative sensitivity. This expresses the sensitivity of the use of sputum cytology for that patient during that admission, measuring what was actually achieved, rather than what might be achieved. Comparing the cytology diagnosis with the discharge diagnosis (based on clinical course, radiology, or bronchoscopy), the absolute cumulative sensitivity was low, ranging from

Figure 1 Proportion of positive samples submitted by differing specialities.

28% to 58% (mean 36%) (table 2). The specificity was 99.6%.

BRONCHOSCOPY

In each centre, the majority of bronchoscopies was undertaken without prior cytology. Analysis of the subgroup who underwent bronchoscopy and had sputum cytology shows that on average only 20% of individuals proven subsequently to have a bronchial carcinoma had positive sputum cytology, with a further 20% having a borderline or suspicious report (table 3). Of those with a positive cytological diagnosis before bronchoscopy, the decision to undertake bronchoscopy did not appear to be determined by the cell type of the tumour.

Discussion

This study demonstrates two main points. The first is that the majority of specimens came from patients who did not have pulmonary cancer. The second is that of those who did have cancer, the sensitivity of sputum cytology was low in the centres participating in the study.

It would appear that requests for sputum cytology fall into two categories. Many specimens are received from elderly people admitted with a productive cough. Sputum cytology is requested as part of the admission procedure. The expectation of a positive result is low, and little attention is paid to optimum specimen collection and submission. Many of these individuals have an acute exacerbation of chronic obstructive airways disease or congestive cardiac failure. The clinical response to treatment lowers suspicion of neoplasia, and no further investigations are undertaken. Sputum cytology is being used as a "screening" procedure on admission. The findings of this study suggest that this is inappropriate. The sensitivity is low (36%) and the cost is high. A negative finding does not exclude malignancy, and the risk of a false positive is highest in the presence of active infection.⁴ If there is a high suspicion of neoplasia, early bronchoscopy should be considered. If bronchoscopy is inappropriate owing to age or general health, it follows that surgery will also be inappropriate, and there is less urgency about making a diagnosis of neoplasia. In this group, it would be more appropriate to treat the acute problem, and cytology should only be submitted if there is a persistent abnormality following treatment. This is the practice of most chest physicians and has already led to a considerable fall in the use of cervical cytology.⁵ Most of the screening samples are now submitted by clinicians in other specialities.

The second category are those patients in whom there is a strong clinical suspicion of bronchial carcinoma. Many of these proceed directly to bronchoscopy or needle biopsy to obtain histological diagnosis and to assess operability. In this group of patients, the decision to undertake bronchoscopy is based on clinical and radiological findings. A combination of bronchial aspirates and bronchial biopsy may yield a diagnosis in up to 85% of cases.⁶ The additional cost of sputum cytology

Table 3 Cytological findings in individuals with positive bronchoscopy

	Hospital				
	A	B	C	D	E
Number of positive bronchoscopies	54	73	58	122	44
Number with previous cytology	20	21	11	38	5
Number with negative or suspicious cytology	14	13	8	23	4
Number with positive cytology	4	7	2	10	1
Number with inadequate cytology	2	1	1	5	0

seldom can be justified before bronchoscopy and is requested only rarely by chest physicians. However, within this second group there are some individuals in whom there is an absolute, or relative, contraindication to bronchoscopy, and sputum cytology has an important role to play in these patients. If surgery is unlikely to be considered, and it is still highly desirable to obtain a tissue diagnosis in order to plan medical management, sputum cytology is appropriate as a non-invasive investigation. Sputum also may provide the diagnosis in peripheral lesions, inaccessible to bronchoscopy, or on occasions when bronchoscopy has failed to yield diagnostic material.

Early reports on sputum cytology suggested that positive identification of lung cancer could be achieved in 57% to 66% of individuals with a clinically obvious tumour.²⁻⁹ In the present study, the identification rates for cytology alone are considerably lower. The low level could be attributed to either poor sampling, poor specimen preparation, poor cytological examination, or specimens coming from a subset of patients in whom sputum cytology has a low sensitivity (for example, peripheral tumours).

The single most important factor in the low sensitivity demonstrated in this study was the low number of specimens received from each patient, a mean of 1.9 per patient. Sensitivity improves with increasing number of samples, and it has been suggested that a minimum of five samples must be examined to exclude pulmonary cancer with confidence.⁸⁻¹⁰ While 95% of patients with bronchial carcinoma will require no more than six samples before malignant cells are seen, 5% will require seven or more repeated specimens.⁷ The number of slides prepared from each sample may also be significant, but probably less so. It has been recommended that four slides should be prepared from each sample.³ In this series,

centres prepared two or three, the highest detection rate being in a centre preparing two slides per sample.

In addition, we believe that poor specimen collection limited the detection rate. Informal inquiries among ward staff suggest that the attention paid to the collection of sputum often is less than ideal, with specimens coming "as and when", and not being early morning deep cough specimens. Previous authors have expressed the extreme importance of the early morning, deep cough specimen.^{9, 10}

We conclude that sputum cytology is being requested inappropriately as part of the routine investigations on admission. Also, it is requested inappropriately as part of the work-up for bronchoscopy. Sputum examination should be limited to individuals with a high clinical suspicion of neoplasia, in whom bronchoscopy is contraindicated or inappropriate. When used, due attention must be paid to specimen collection, and to the collection of multiple specimens. This is the practice already followed by most chest physicians. If practitioners in other areas adopted the same approach, the investigation costs of many patients would be reduced, allowing a more appropriate use of resources. There would also be the benefit that the non-gynaecological workload in many laboratories could be reduced, job satisfaction would increase because of the higher positive detection rate in the remaining work, and the ever present infection risk in handling sputum would be diminished.

- 1 Audit Commission. Critical path: an analysis of the pathology services. London: HMSO, 1993.
- 2 Koss IG. Cytological diagnosis of lung cancer. *Acta Cytologica Pathol Jpn* 1958;8:99-111.
- 3 Young JA. Techniques in pulmonary cytopathology. *J Clin Pathol* 1993;46:598-5.
- 4 Benbassat J, Regev A, Slater PE. Predictive value of sputum cytology. *Thorax* 1987;42:165-72.
- 5 Fraire AF, McLarty JW, Greenberg SD. Changing utilization of cytopathology versus histopathology in the diagnosis of lung cancer. *Diagn Cytopathol* 1991;7:359-62.
- 6 Piaton E, Grillet-Ravigneaux M, Suagier B, Pellet H. Prospective study of combined use of bronchial aspirates and biopsy specimens in diagnosis and typing of centrally located lung tumours. *BMJ* 1995;310:624-7.
- 7 Truong LD, Underwood RU, Greenberg SD, McLarty JW. Diagnosis and typing of lung cancers by cytopathological methods: a review of 108 cases. *Acta Cytologica* 1985;29:379-84.
- 8 Tanaka T, Yamamoto M, Tamaru T, Moritani Y, Miyai M, Hiraki S, et al. Cytological and histological correlation in primary lung cancer—a study of 154 cases with resectable tumours. *Acta Cytol* 1985;29:49-56.
- 9 Erozan YS, Frost JK. Cytopathological diagnosis of cancer in pulmonary material: a critical histopathological correlation. *Acta Cytol* 1970;14:560-5.
- 10 Johnston WW, Bossen EH. Ten years of respiratory cytopathology at Duke University Medical Center. *Acta Cytol* 1981;25:103-7.