# Value of biomedical scientists providing on-site specimen adequacy assessment for fine-needle aspirations

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**ABSTRACT**

Fine-needle aspiration (FNA) is accepted as a first-line investigation in patients with superficial or deep-seated mass lesions. One of the fundamental principles of successful aspiration is harvesting sufficient numbers of cells that are representative of the lesion being investigated. Central Manchester University Hospitals NHS Foundation Trust provides FNA services to Christie Hospital, including non-attended and biomedical scientist-attended aspirations, some of which are assessed on-site for specimen adequacy. This study audits the FNA coverage provided to Christie Hospital by exploring the contribution of biomedical scientist on-site specimen adequacy assessment to successful aspirations and identifies potential areas for service improvement such that unsatisfactory sampling is reduced. Satisfactory sampling rates varied between biomedical scientist-attended (79%) and non-attended (70%) procedures. Within the former group, 100% satisfactory sampling was achieved with on-site assessment, falling to 77% without on-site assessment. The highest unsatisfactory sampling rate was identified at 33% for thyroid aspirations in endocrinology, while rates elsewhere varied between 21% and 23%. This audit demonstrated the value of on-site specimen adequacy assessment as the ultimate goal of any FNA is to negate the need for more invasive procedures. In terms of flexibility and economic value, having adequately trained biomedical scientists to perform on-site assessment is quite feasible. Extending this biomedical scientist-led service to other departments would reduce unsatisfactory sample rates and the requirement for more invasive procedures.

KEY WORDS: Adequacy.
Cytopathology.
Fine-needle aspiration.
On-site assessment.

## Introduction

Although fine-needle aspiration (FNA) for cytological evaluation of a neck mass was fist reported in the 19th centaury by Kun (1847), Libert (1851) and Menetrier (1886), it was not until the 1950s and 1960s that haematologists across Europe became proponents of the technique, and it began to flourish.[1] With improved technique, scientific rigour, radiological imaging and smaller bore needles, FNA has become accepted as a first-line investigation in patients with superficial or deep-seated mass lesions. Although initially conceived as a means to confirm clinical suspicion of local recurrence or metastasis of known malignancy, FNA is now widely accepted as a diagnostic technique in inflammatory/degenerative conditions, infections and graft rejection patients. However, its greatest contribution is preliminary preoperative or pretreatment diagnosis of benign, equivocal and malignant lesions.

According to Orell, Sterrett and Whitaker,[1] the practice of FNA has clear advantages to patients, practitioners and taxpayers, as the technique is relatively painless, produces speedy results and is inexpensive. The authors define four fundamental principles for successful FNA cytology and these include: i) relevant clinical/radiological information, ii) cells representative of the lesions under investigation, iii) sufficient numbers of cells or tissue components, and iv) correctly smeared, processed and interpreted samples. These principles, in no small measure, contribute to reduce unsatisfactory sampling rates for FNA cytology, which can be as high as 32% in some instances.[2] Another beneficial aspect of the process is to have on-site assessment of samples by experienced cytopathologists, which can entail not only reduced unsatisfactory rates but also higher diagnostic rates of malignancy.[3]

On-site specimen adequacy assessment, however, is limited by the shortage of experienced cyto/histopathologists, clinical commitments, off-site location of FNA clinics, and the financial costs incurred by having clinicians at FNA centres for extended periods, especially if there are prolonged waiting times between patients. Thus, in many hospitals and out-patient centres, biomedical scientists (in the UK) or cytotechnologists (in North America) provide assistance at FNA clinics.

Central Manchester University Hospitals NHS Foundation Trust (CMFT) provides FNA service to Christie Hospital, including non-attended and biomedical scientist-attended aspirations, some of which are assessed on-site for specimen adequacy. This is performed by microscopic examination of stained, air-dried slides prepared from the aspirated material. These are assessed for satisfactory numbers of cells

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and/or material that is representative of the lesion and organ aspirated.

With a view towards service improvement, this study audits the FNA service provided to the Christie Hospital by CMFT for the period 1 January to 30 June 2009, the aim being to determine if there is a difference in satisfactory sampling rates between biomedical scientist-attended and non-attended FNAs, and assessed and non-assessed (attended) aspirations. As a follow-up measure, it re-audits one of the sections (plastics) to determine if there was improvement after some training was provided to clinicians involved in performing aspirations by one of the consultant cytopathologists (DNR).

## Materials and methods

The setting for the six-month audit was the Christie Hospital NHS Foundation Trust, and the FNA service provided by CMFT. The attended service is provided by biomedical scientists at a senior level (regarded as having the equivalent of a Masters-level qualification and at least five years' experience in cytology), from Monday to Friday between the hours of 09.00 and 12.30, inclusive. All other aspirations are classified as non-attended. Attended and non-attended FNA samples are transported to CMFT, where they are reported by consultant cytopathologists after processing and quality control checking by biomedical scientists.

The training of biomedical scientists to assess specimen adequacy is performed mainly 'in house' and much of the experience is gained by performing quality control of prepared non-gynaecological samples before they are passed to consultant cytopathologists for reporting.

Aspirations were performed in many departments including radiology, endocrinology, plastics (an out-patient department handling patients with superficial lesions apart from ENT) and ENT (Table 1 and Fig 1). Sampling sites included head and neck, lung (including mediastinal lymph nodes), organs of the abdomen, the groin and any other superficial lumps. Breast was not included. In the majority of cases, two passes were performed and the attending biomedical scientist made on average two air-dried smears, one or two alcohol-fixed smears, and then flushed the needles into preservative (CytoLyt).

On-site assessment was carried out on radiologically-guided samples, if requested by the aspirating clinician, and this was performed on one or two air-dried spreads stained by HemaGurr (VWR/Jencons, Poole, United Kingdom). Microscopic examination was then carried out on the uncoverslipped, stained spread with a view to determine sufficient numbers of cells representative of the lesion and organ aspirated. Samples were deemed unsatisfactory if they contained blood/fat/connective tissue only, depending on the organ aspirated, or if the cellular elements were obscured by blood/ultrasound jelly/necrosis. Conversely, a satisfactory sample contained elements and/or cells consistent with the aspiration site (e.g., lymphoid cells from a lymph node). Only adequacy was communicated to the clinicians, not the diagnosis (i.e., whether malignant or benign).

Once this initial audit was completed, some training was provided to clinicians in the plastics department of Christie Hospital who were involved in aspirations by one of the consultant cytopathologists (DNR). This session consisted of a verbal presentation on the technique of performing an FNA, followed by a practical exercise making one direct spread per aspiration and leaving it to air dry, flushing the needle into CytoLyt, completion of the request card and packaging the sample for the laboratory.

**Table 1.** Non-attended FNA by departments with satisfactory/unsatisfactory rates

| Department | Satisfactory | Unsatisfactory | Total |
|---|---|---|---|
| Plastics | 14 | 2 | 16 (80%) |
| Endocrinology | 0 | 3 | 3 (15%) |
| ENT | 0 | 1 | 1 (5%) |
| Total | 14 (70%) | 6 (30%) | 20 (100%) |

Owing to problems associated with spray fixation, clinicians were asked to make only air-dried spreads. This did not compromise diagnosis as fixed material in CytoLyt was available to complement morphology of the air-dried spreads and also to perform ancillary tests such as immunocytochemistry.

Written instructions (including access to an online user manual), together with consumables, were left with the clinicians. The non-attended FNA from the plastics department was then re-audited.

## Results

*Non-attended fine-needle aspiration*

For the period January to June 2009, a total of 20 non-attended FNA samples were received. Plastics accounted for 16 (80%), with ENT submitting one (5%) and endocrinology submitting three (15%) (Table 1).

The samples were sent to the laboratory as follows:

- fluid samples only: 14 (70%) – these were received either in formalin or saline
- mixture of fluid samples and spread slides: five (25%) – the slides were received either fixed or unfixed
- one sample (5%) received as unfixed slides only.

Of the 16 samples taken in the plastics department, 14 (88%) were satisfactory and two (12%) were unsatisfactory. The three samples taken in endocrinology and the single aspirate from the ENT department were all unsatisfactory. As these numbers were only small, the decision was taken to re-audit the plastics department only. Overall, the satisfactory sampling rate was 70% ($n$=14) while unsatisfactory samples accounted for 30% ($n$=6) (Table 1).

*Attended fine-needle aspiration*

For the same audited period, a total of 148 FNAs were attended by a senior-level biomedical scientist. Radiology accounted for 73 samples (49%), endocrinology for 33 (22%), ENT for 14 (10%) and plastics for 28 (19%) (Fig. 1). The overall satisfactory sampling rate was 79% ($n$=117), while unsatisfactory samples accounted for 21% ($n$=31). The radiology department accounted for 73 samples, of which 25 were assessed on-site (Fig. 1). For specimens assessed on-site, the satisfactory rate was 100% ($P<0.05$),

while for the non-assessed samples the satisfactory rate was 77%. Of the samples assessed on-site, malignancy was diagnosed in 14 cases (56%). Hurtle cell neoplasm was found in one case (4%) and a negative report issued in 10 cases (40%).

Ear, nose and throat (ENT) and plastics are designated non-radiological departments and accounted for 42 samples, of which 33 (79%) were satisfactory (Fig. 1).

Endocrinology is different from other non-radiological departments as samples taken here were performed under ultrasound guidance, albeit by an endocrinologist. Of 33 samples taken in this department, 22 (67%) were satisfactory (Fig. 1). The relatively poor satisfactory rate may be explained by the criteria used to determine adequacy of thyroid samples, the vascular nature of the gland, and the type of needle used in aspiration.

Overall, there was no association between attended FNA and satisfactory sampling ($P>0.05$); however, there was significant association between on-site assessed FNA and satisfactory sampling ($P<0.05$).

### *Re-audit of the plastics department*

The re-audit was for the period January to June 2010, during which time 43 FNAs were performed in the plastics department. Of these, 24 (56%) were biomedical scientist-attended, while 19 (44%) were non-attended. Satisfactory sampling was achieved in all cases.

## Discussion

Fine-needle aspiration has clear advantages to patients, practitioners and taxpayers, as the technique is relatively painless, inexpensive and produces accurate results. This may be one of the many reasons why FNA cytology is included alongside histological biopsy as first-line diagnostic tools in the National Institute for Health and Clinical Excellence's (NICE) *Guidance on cancer services – improving outcomes in head and neck cancers*.[4] The guidance recommends on-site support by cytopathologists at head and neck clinics for timely diagnosis and triage; however, this is not always possible. According to Kocjan, Ramsay, Beal and Flynn,[5] many district hospitals may be staffed by histopathologists with an interest in cytology as opposed to specialist cytopathologists. There is also the issue of the wide and varied location of FNA centres, timing of such clinics, the tumour-specific expertise of the histo/cytopathologists and other clinical duties of cytopathologists.[5]

These factors have led to cytological on-site support being increasingly taken up by suitably trained biomedical scientists in the UK and their counterparts, cytotechnologists, in North America and elsewhere. In providing on-site specimen assessment, a biomedical scientist can communicate the quality and cellularity of the sample to the aspirating clinician (Fig. 2) and assist cytopathologists in diagnosis by allocating appropriate samples for ancillary tests such as immunocytochemistry (Fig 3). This is the service provided by CMFT, which, although not providing rapid diagnoses, is important as, according to Bardales *et al*.,[6] samples of sufficient cellularity are required to avoid false-negative diagnosis. In addition, this avoids repeated aspirations or more invasive diagnostic procedures.

In the present audit, the authors found satisfactory sampling in 70% of non-attended versus 79% attended FNAs. However, when on-site assessment was performed, satisfactory sampling increased to 100% ($P<0.05$). This is promising and corresponds to international studies assessing validity of scientific staff providing on-site assistance at FNA clinics. For example, Savoy *et al*.[7] found cytotechnologists had superior abilities to determine adequacy as compared to trained endosonographers, Alsohaibani *et al*.[8] found cytotechnologist on-site-assessed endoscopic guided ultrasound (EUS) FNA had significantly improved adequacy rate as compared to non-assessed EUS-FNA (77% *vs*. 53%, $P=0.01$), and Cleveland *et al*.,[9] in a large multi-physician practice, found on-site assessment by cytotechnologists was the single most important factor in achieving successful FNA.

A limitation of the present audit was the inability to correlate diagnosis with final clinical outcome due to the inherent difficulties encountered with accessing medical records of other hospitals; however, it was possible to provide a malignant report in 14 cases, diagnose a Hurtle cell neoplasm in one instance, and negative reports in 10 cases. It should be possible to apply this success to other attended FNA clinics, especially those in the endocrinology department, where, according to Middleton,[10] with adequate training to recognise colloid nodules, thyroditis, follicular neoplasms and malignant lesions, biomedical scientists/cytotechnologists can provide assistance both in making spreads and in on-site specimen assessment.

There is also the added advantage of providing immediate feedback to the clinician performing the aspiration; for example, sample contamination by ultrasound gel (Fig. 2) or

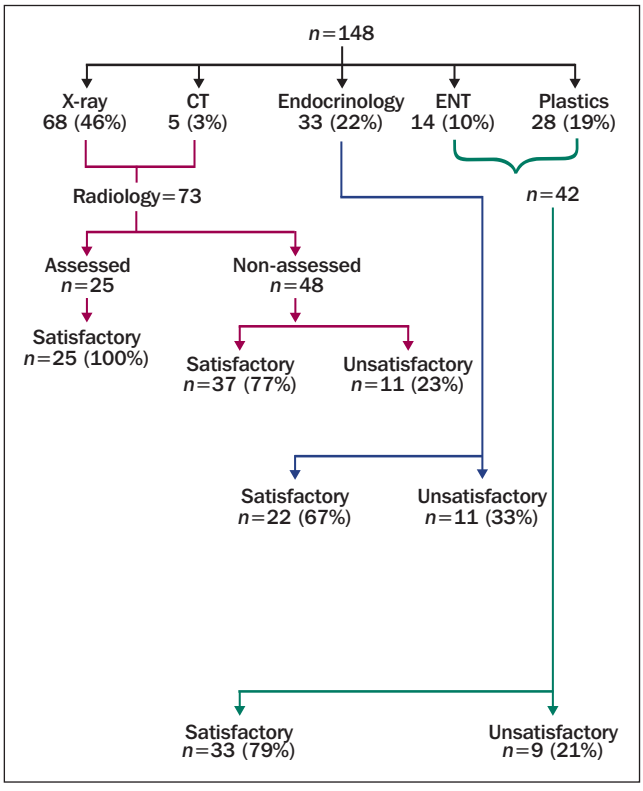


**Fig. 1.** Attended FNA by departments with satisfactory/unsatisfactory rates.

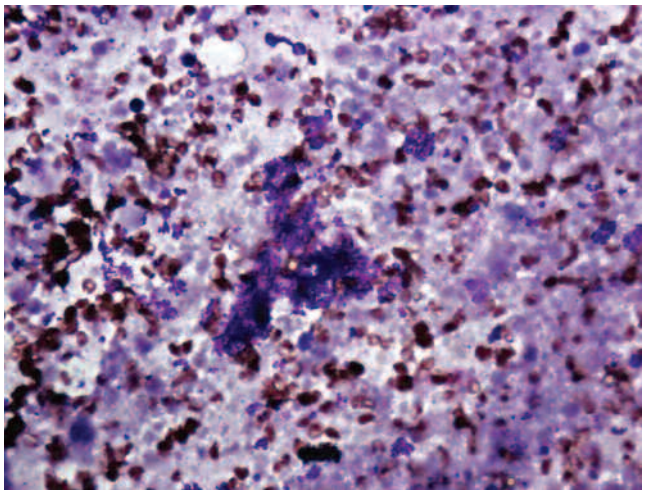

**Fig. 2.** Fine-needle aspiration showing ultrasound jelly and background necrosis. The clinician may be directed to remove ultrasound jelly and sample the periphery of the lesion in order to obtain viable diagnostic cells.

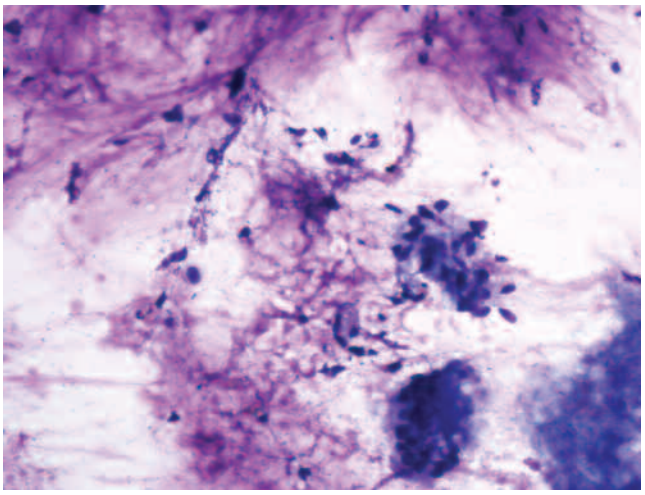

**Fig. 3.** Fine-needle aspiration of pancreas showing adenocarcinoma cells and extracellular mucin. Remaining material would be placed by the biomedical scientist into preservative for ancillary tests.

lesion not sampled adequately when only necrotic material is visualised microscopically.

The authors propose to implement such on-site adequacy assessment at all endocrinology and head and neck clinics at the Christie hospital and CMFT where biomedical scientists also attend FNAs, having been trained to a high degree of excellence. This will be done in accordance with British Association for Cytopathology (BAC) guidance for FNA and under the lead clinical cytopathologists. It is hoped that this audit serves to remind service commissioners of the value of biomedical scientist assistance at FNA clinics, as this is an under-utilised role, despite being recommended by the BAC.

In the absence of biomedical scientist assistance at out-of-hours clinics, clinicians can be trained to prepare air-dried spreads and conserve material in a transport medium or fixative. Such training has resulted in an improvement in satisfactory sampling rate from the plastics department (rising from 88% to 100%). It is envisioned that such training will be repeated every four to six months to coincide with the rotation of junior doctors, including access to the online user manual that contains detailed instructions on aspiration and sample preparation. □

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