An assessment of fine-needle sampling techniques

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ABSTRACT

INTRODUCTION Fine-needle cytology sampling, when adequate, is highly sensitive and specific for tissue-type diagnosis, with figures of 94% and 88%, respectively. This study explores the technique of sampling to reduce interoperator variability and ensure maximal tissue yield.

MATERIALS AND METHODS Apple cortical tissue was sampled as a proxy of human lymph node. A total of 200 samples, by four methods, with 50 by each sampling method, were taken using blue venepuncture needles and weighed to assess tissue yield.

RESULTS Results were analysed using one-way analysis of variance and Tukey's HSD test. Comparable yields, by mass, were achieved by both straight lance and coring techniques ($P > 0.05$). Significantly greater yield was achieved with a multiplanar technique ($P < 0.05$).

CONCLUSIONS Multiplanar sampling increases mass yield of tissue in fine-needle sampling. Coring appears to have little bearing on yield.

KEYWORDS

Fine needle sample – Lymph node – Yield – Cytology

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Cytology is an integral part of most cancer diagnosis and investigation and head and neck oncology is no exception. Fine-needle aspiration (FNA), or sampling (FNS), is the method normally used to obtain the samples. When an adequate sample is taken, the sensitivity is 94% and specificity is 88%.¹

However, the adequacy of sampling varies widely between operators and technique used, and this has been confirmed in several local departmental audits carried out by the authors. There are two elements in the acquisition of an adequate sample: (i) accurate targeting of the 'lesion'; and (ii) obtaining a sufficient volume of tissue once the target has been acquired. There is evidence to suggest that targeting can be greatly improved using ultrasound guidance and this is now gaining acceptance as a mainstream technique. However, Medline searches have not revealed any past work looking in to how different sampling or aspiration techniques affect the yield of tissue obtained. There has been work on the effectiveness of FNA versus FNS,^{2,3} but very little on other technique variations that are possible.

The main issue with regards to diagnostic adequacy is to ensure that the sample obtained is relatively blood-free and spreads across a slide in a layer one cell thick. Cytology may also be obtained using washings.

Our aim, in this study, was to assess different techniques of fine-needle sampling to see what yield of tissue was obtained, and to see if there was a significant difference between different methods. If present, this would enable practitioners to enhance further their tissue yield obtained, using both accurate targeting and an effective acquisition technique.

Materials and Methods

Four different methods of fine needle sample acquisition were selected (Fig. 1):

1. Repeated passes with a needle, within the target, in the same directional plane.
2. Repeated passes with a needle, within the target, in different directional planes, perpendicular to each other.
3. Repeated passes with a needle, within the target, using a 'coring' motion throughout, in the same plane.
4. Repeated passes with a needle, within the target, using a 'coring' motion throughout, in different directional planes.

A 23-G (Blue) needle (B & D Microlance 3) was used, in line with standard procedural recommendations. Previous

work has established that this needle size gives tissue yields comparable to those obtained with larger needles whilst being more comfortable for the patient. Aspiration was not used as previous studies have shown there not to be any benefit to using aspiration when compared to sampling alone.^{2,5}

The study was carried out on a single sample of apples, of comparable consistency, size and shape. Apples, in particular, were chosen due to their largely homogeneous cortices, when compared to other, easily available, plant or fruit materials. This ensured that each sample taken with the needle would be of equivalent and comparable tissue to that taken in any other pass and any variation in yield would be due to technique alone.

On each puncture of the needle, care was taken not to enter a previous perforation. All the different methods men-

Table 1 Summary table of results obtained

Method	1	2	3	4
Range ($\times 10^{-4}$ g)	1–37	2–112	1–38	11–158
SD	7.67	30.09	9.11	30.09
Mean ($\times 10^{-4}$ g)	13	59	17	54
Median ($\times 10^{-4}$ g)	11	63	16	48
Mode ($\times 10^{-4}$ g)	7	71	8	51

tioned were used on the same target apple, to ensure any differences in yield obtained were solely due to the method of sampling used, rather than variable factors between different apples.

Weighing scales (Sartorius Balance BP210D), sensitive to ± 0.0001 g, were used. The accuracy of the weighing scales was checked with four dry runs, giving a random error of 0.0001 g. Each needle used was weighed on the scales. The sampling process then took place. A total of 10 passes of the needle were made, roughly equivalent to what would be done in clinical practice. The needle was then withdrawn and re-weighed and the needle mass was subtracted from the new (needle + sample) mass to give the sample mass. This process was repeated for all the different methods described. Each method had 50 different samples taken.

Statistical analysis

A one-way analysis of variance was used to compare means ($P < 0.001$) followed by Tukey's pair-wise comparisons. Levine's variance test indicated a significant difference in variances ($P < 0.001$). The data were logged to stabilise the

Table 2 Tukey's HSD test results, comparing each method with the others

	Difference of means ($\times 10^{-4}$ g)	Standard error of difference	t-Value	Adjusted P-value
Method 1 versus Method				
2	46.62	4.42	10.5516	0.0000
3	4.18	4.42	0.9461	0.7800
4	40.90	4.42	9.2570	0.0000
Method 2 versus Method				
3	-42.44	4.42	-9.606	0.0000
4	-5.72	4.42	-1.295	0.5674
Method 3 versus Method				
4	36.72	4.42	8.311	0.0000

$P < 0.05$ taken as significant.

variances and re-analysed by analysis of variance. This analysis yielded the same conclusions.

As there has not been any previous work done in this area, we were unable to carry out a power calculation and have, therefore, conducted this experiment as a pilot study.

Results

There was no significant difference between yields obtained in Method 1 (single-plane passes, no coring) and Method 3 (single-plane passes, with coring) or between yields using Method 2 (multi-plane passes, no coring) and Method 4 (multi-plane, with coring), with $P > 0.05$ (Table 1). That is to say, there was no significant difference in yield between the single-pass samples, with or without coring, and the multi-pass samples, again, with or without coring. Both multipass yield results (Methods 2 and 4) were significantly greater than the single-plane yields (Methods 1 and 3), with $P < 0.05$ (Table 2). Coring does not appear to influence tissue yield.

Discussion

The results of this study showed a significant difference between the single-planar multipass technique and multipass technique, with the latter giving a greater mass yield ($P < 0.05$). However, the coring motion adopted by many clinicians did not appear to influence the yield significantly in either a positive or negative manner. This complements what we already know about fine-needle cytology, namely that aspiration is unnecessary,⁴ that Blue (23-G) needles are optimal^{2,5} and that ultrasound guidance is the optimal targeting method.

In this experiment, apple tissue yield was used as a proxy for adequate sampling. In reality, the quality of the sample, in diagnostic terms, also involves targeting, which is without the remit of this study, as well as the ability of the acquired sample to be spread in a layer one cell thick, across a slide. However, overall mass may be useful if one also takes into account the use of spun-down needle washings.

It was noted, during the procurement of needles for this study, that there are some significant differences in design of the needles themselves. Of the two major manufacturers that are used within departments in our region (B & D, Terumo), one boasted that it provided a polished lumen to the needle with a silicone-based lubricant (Terumo Neolus), which presumably enhances the needles function in venepuncture. This needle was not used in this study, though we presume that having a lubricated inner surface to the needle would decrease tissue yield due to the decrease in tissue adhesion to the needle surface.

Conclusions

A multiplanar sampling technique is advocated, given the findings of this study. A clinician's preference for coring or not would seem to be inconsequential with respect to yield and, therefore, one could carry on with their current practice without criticism. From this pilot study, one may plan larger *in vivo* studies. In addition, we suggest a case-controlled series of multipass sampling versus a control group of single-pass sampling. Finally, the issue of needle lumen surfacing may be studied as an independent variable.

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