ORIGINAL ARTICLE

Comparison on the use of semi-automated and automated core biopsy needle in ultrasound guided breast biopsy

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ABSTRACT

Objective: The aim of this study was to compare the use of semi-automated (Medax Velox 2; Poggio Rusco, Italy) and automated (Bard Magnum Biopsy Instrument; Covington, GA, USA) core biopsy needles, for ultrasound guided breast biopsy.

Materials and Methods: A 14G semi-automatic spring loaded core biopsy needle with a 22-mm-throw (Medax Velox 2; Poggio Rusco, Italy) and 14-gauge automated needle device with a 22-mm-throw biopsy gun (Bard-Magnum Biopsy Instrument, Covington, GA, USA) were used for breast biopsies under ultrasound guidance on alternate months during the study period between July 2009 and May 2011. One hundred and sixty lesions were biopsied and specimens were sent for histological evaluation.

Results: The automated needle obtained a higher number of histology reports at 84% (67/80) as compared with the semi-automated needle at 60% (48/80) (Fisher exact test, p value=0.023). Inadequate samples with the automated needle were much less at 9% (7/60) than with the semi-automated needle at 23% (18/60) (Fisher exact test, p value=0.028). The semi-automated needle showed slightly less fragmented samples. However, the number of fragmented samples with definitive diagnosis was slightly higher with the automated compared with the semi-automated needle, at 16% (13/80) and 13% (10/80) respectively. Compared with histology of 29 lesions that were excised, the semi-automated needle had higher sensitivity (100%) but lower specificity (75%) and accuracy (90%) compared with the automated needle (88% sensitivity, 100% specificity, 95% accuracy).

Conclusion: Definitive diagnosis from the study samples slightly favours the use of automated core biopsy needle as compared to semi-automated core biopsy needle.

KEY WORDS:
Semi-automated, automated, core biopsy, ultrasound, breast

INTRODUCTION

Breast cancer is the commonest cancer among Malaysian women. A woman in Malaysia has a 1 in 20 chance of getting breast cancer in her lifetime. From 2003 to 2005, the age-standardised rate (ASR) of female breast cancer in Malaysia was 47.4 per 100,000 women.[1]

The diagnosis of breast cancer is established via clinical and radiological assessments, and biopsy (also known as the triple assessment). The use of ultrasound to examine the breast was first described in 1951. Since then, the ultrasound examination is well established as an important technique for the investigation of breast problems.[2] In our current practice, ultrasound is widely used to guide breast biopsy and the 5-point breast imaging classification system is used to categorise the breast lesions. Category 1 is normal, category 2 is benign, and category 3 is probably benign or indeterminate whereas categories 4 and 5 are suspicious of malignancy and highly suspicious of malignancy respectively.

Most women who undergo breast biopsy do not have malignant lesions and do not require follow-up treatment. Only 20 to 30% of women who undergo breast biopsy procedures are diagnosed to have carcinoma.[3] The primary goal of the initial biopsy of any abnormality is to diagnose the abnormality as benign or malignant.

Core biopsy of the breast has been accepted as a precise and cost-effective method of diagnosing breast lesions.[4] It is now considered the method of choice for tissue sampling and published data suggest that the use of core biopsy has increased the preoperative diagnosis rate in screen detected breast cancers.[5]

There are numerous automated cutting needles. In previous studies, comparisons of performance of various automated needles for autopsy, breast and lung biopsy have been made. The earliest study was done in 1993 where twenty different automated needles were evaluated.[6] It was noted that the semi-automated needle did not perform as well as the fully automated needle. A later study in 1996 where seven large core biopsy needles were compared for yield of breast tissue also concluded that the semi-automated needle obtained smaller volumes of tissue than the automated type. This finding was statistically significant.[7] To our knowledge, no other study has been conducted to compare these two devices for breast biopsy since then. The latest study in 2012

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compared these two devices for lung biopsy under computed tomography guidance.8 Therefore, the aim of the present study was to compare the accuracy of ultrasound guided breast biopsy performed with these two different core biopsy needles with histology of excised lesions as the gold standard. The semi-automated needle used in this study was available in Malaysia circa 2000 and the automated needle had been available in Malaysia circa 1995. The authors aimed to describe the yield obtained from both types of needles, that is, whether a diagnostic or just a descriptive report was possible. The authors also aimed to ascertain sample adequacy for histological evaluation as well as to determine the occurrence of fragmentation of the samples and whether a definite diagnosis could be made from fragmented samples. Lastly, the authors wanted to determine if the yield from semi-automated and automated core biopsy needles were affected by the tumour size and type.

MATERIALS AND METHODS

This was a retrospective descriptive study involving all patients who had breast biopsy at the Radiology Department of a tertiary hospital in the Klang Valley from July 2009 till May 2011. All patients with category 3 to 5 breast lesions detected on ultrasound examination were included in this study. Patients with category 2 breast lesions were also included when there was family history of breast cancer, likelihood of poor compliance for close follow-up, or presence of undue patient anxiety.

Informed consent for the data analysis in this study was waived by the institutional ethics committee. From July 2009 through June 2010, a 7.5 MHz linear array transducer was used (Siemens Sonoline G20 Imaging System; USA) and from July 2010 till May 2011, a 14MHz high frequency linear transducer was used (Siemens Acuson S2000 Ultrasound System; USA).

A 14-gauge semi-automatic spring loaded core biopsy needle with a 22-mm-throw (Medax Velox 2; Poggio Rusco, Italy) and a 14-gauge automated needle device with a 22-mm-throw biopsy gun (Bard-Magnum Biopsy Instrument,Covington, GA, USA) were used on alternate months during the study period.

The semi-automated spring loaded biopsy needle has centimetre markings to facilitate precise depth placement. The tip is treated to make it echogenic and facilitate its positioning under ultrasound guidance. It requires manual advancement of the trocar to expose the side notch. With pressure on its plunger, an automated biopsy action rapidly advances the cutting cannula over the specimen-containing side notch of the trocar.

The automated core biopsy needle has echogenic markings on both stylet tip and cannula to help confirm the placement of the sample notch for precise ultrasound positioning. The centimetre depth markings assist in needle placement. There are no serrations within the cutting notch to ensure removal of specimen. It has a thin-wall cannula for larger core and automatic spring loaded action for fast, accurate penetration. It uses a two-stage biopsy action. A spring action thrusts the inner trocar forward, followed almost instantaneously by a similar forward thrust of the outer cutting cannula. The specimen is trapped in the side notch of the trocar when the cutting cannula is advanced. The stylet cavity is designed to collect the core sample without any damage and reinforced to avoid bending.

All procedures were done by a radiologist in the mammography unit. This was to reduce bias from inexperienced operators. The biopsies were performed with patients in the supine or supine oblique position. A minimum of 3 samples per lesion were obtained. The specimens were placed in a sterile bottle with 10% formalin. Core biopsy specimens were formalin fixed, paraffin embedded, and processed according to standard protocol.

The decision to obtain a minimum of 3 samples per lesion is based on a report that showed that cells which indicate the diagnosis were contained in the the 1st specimen in 70% of lesions, in the 2nd specimen in 92% of lesions, and in the 3rd specimen in 96% of lesions.[9] This study also found that 93% of malignancies were diagnosed with the 1st and 2nd specimens.

The following are definitions of terms that were used for the purpose of data analyses. A histology report is defined as a histology description of cells and tissues that leads to diagnosis of a disease. A descriptive report is a histology description of cells and tissues that does not lead to a definitive diagnosis but conclusively excludes a malignancy. An adequate sample indicates an adequate amount of tissue from the lesion of interest that leads to a histology report or a descriptive report. An inadequate or unsatisfactory sample indicates tissue that does not include breast ducts and ductal epithelium and therefore a histology report or a descriptive report is not possible. Fragmentation of samples indicates fragments of tissue instead of a core of tissue.

RESULTS

One hundred and sixty breast biopsy samples were collected in this study. A total of 80 samples were obtained from using the semi-automated and another 80 samples from using the automated core biopsy needle.

From 160 samples taken using the core biopsy needles, 115 samples produced histology reports, 20 samples produced descriptive reports and 25 samples were inadequate or unsatisfactory for histology evaluation (Table I). Samples obtained using the semi-automated needle yielded less histology reports (60%) and more descriptive reports (18%) compared with samples obtained using the automated needle which had 84% histology reports and 8% descriptive reports. Using Fisher exact test, these findings were statistically significant with p value of 0.023 (<0.05). This indicates that there was significant difference between yields of breast tissue obtained using semi-automated and automated needles.

Adequacy of Breast Tissue Samples

When the samples obtained using semi-automated and automated needles were compared, results showed that

Table I: Type of biopsy reports obtained with semi-automated and automated core needles

TYPE OF BIOPSY REPORT	SEMI-AUTOMATED CORE NEEDLE	AUTOMATED CORE NEEDLE
HISTOLOGY	48 (60%)	67 (84%)
DESCRIPTIVE	14 (18%)	6 (8%)
INADEQUATE FOR HISTOLOGY EVALUATION	18 (23%)	7 (9%)
FRAGMENTED SAMPLE WITH DEFINITIVE DIAGNOSIS	10 (13%)	13 (16%)
FRAGMENTED SAMPLE WITH NON-DEFINITIVE DIAGNOSIS	10 (13%)	4 (5%)

Table II: Tumour size and yield obtained with semi-automated core needle

TUMOUR SIZE	HISTOLOGY	DESCRIPTIVE	INADEQUATE	TOTAL
≤2	37 (46%)	14 (17%)	18 (23%)	69 (86%)
>2	11 (14%)	0	0	11 (14%)
TOTAL	48 (60%)	14 (17%)	18 (23%)	80 (100%)

Table III: Tumour size and yield obtained with automated core needle

TUMOUR SIZE	HISTOLOGY	DESCRIPTIVE	INADEQUATE	TOTAL
≤2	52 (65%)	4 (5%)	6 (8%)	62 (78%)
>2	15 (19%)	2 (2%)	1 (1%)	18 (22%)
TOTAL	67 (84%)	6 (7%)	7 (9%)	80 (100%)

Table IV: Histology outcome in relation to 5-point breast imaging classification of the breast lesions

CATEGORY	BENIGN	MALIGNANT	DESCRIPTIVE	INADEQUATE
2	21 (13%)	0	3 (2%)	6 (4%)
3	45 (28%)	5 (3%)	14 (9%)	15 (10%)
4	26 (16%)	8 (5%)	3 (2%)	4 (3%)
5	0	10 (6%)	0	0
TOTAL	92 (57%)	23 (14%)	20 (13%)	25 (16%)

Table V: Benign and malignant outcome with automated and semi-automated needles

TYPE OF BIOPSY NEEDLE	BENIGN LESION	MALIGNANT LESION
SEMI-AUTOMATED	37	11
AUTOMATED	55	12
TOTAL	92	23

Fisher exact test: p value = 0.64

Table VI: Statistical analysis of core biopsy with semi-automated and automated core needles in comparison with histology of excised lesions

STATISTICAL TEST	SEMI-AUTOMATED CORE NEEDLE	AUTOMATED CORE NEEDLE
	Number of excised lesions = 10 True Positive (TP) = 6 False negative (FN) = 0 True Negative (TN) = 3 False Positive (FP) = 1	Number of excised lesions = 19 True Positive (TP) = 7 False negative (FN) = 1 True Negative (TN) = 11 False Positive (FP) = 0
Positive predictive value TP/(TP+FP)	86%	100%
Negative predictive value TN/(TN+FN)	100%	92%
Sensitivity TP/(TP+FN)	100%	88%
Specificity TN/(TN+FP)	75%	100%
Accuracy (TP+TN)/ Total	90%	95%
False positive ratio FP/ (FP+TN)	25%	0%
False negative ratio FN/(FN+TN)	0%	8.3%

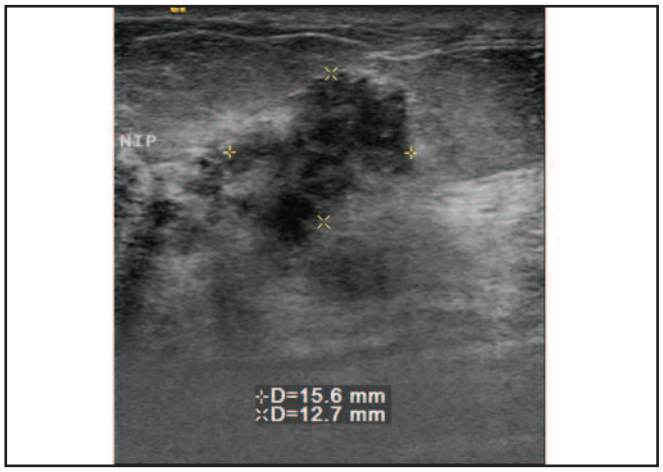

Fig. 1: Ultrasound image shows an example of a breast lesion <2cm. The maximum dimension is taken as the size of the tumour. This category 5 lesion was biopsied with an automated core biopsy needle. The histopathology report was infiltrating ductal carcinoma.

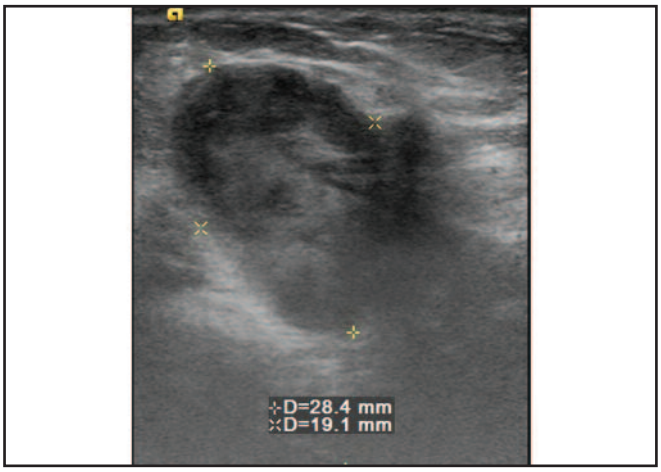

Fig. 2: Ultrasound image shows an example of a breast lesion >2cm. The maximum dimension is taken as the size of the tumour. This category 3 lesion was biopsied with a semi-automated core needle. The samples were fragmented but satisfactory for evaluation. The histology report stated two fragments of fibrous connective tissue partly infiltrated by sheets and individual malignant cells. Tumour cells show hyperchromatic, pleomorphic and large nuclei with indistinct cytoplasmic borders. A few number of tubules noted. Diagnosis of high grade spindle cell carcinoma was made.

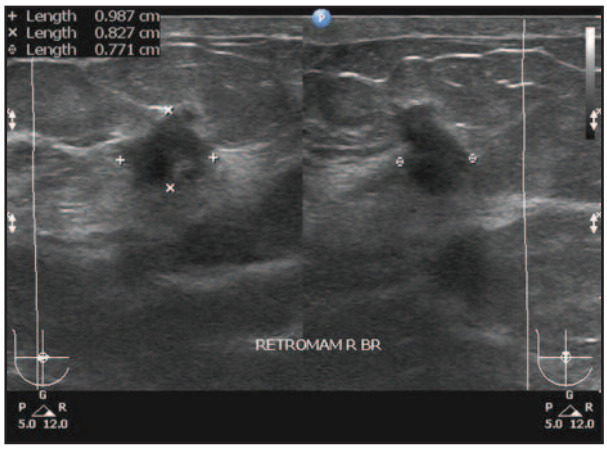

Fig. 3: Ultrasound image shows an example of a category 4 breast lesion. This lesion was biopsied with an automated needle. The samples were fragmented but satisfactory for histology evaluation. The report stated fragments of fibroconnective tissue containing few breast ducts and stroma tissue. One of the breast ducts is lined by hyperplastic epithelium showing atypical features, such as nuclear pleomorphism, and prominent nucleoli. The surrounding tissues are unremarkable. Diagnosis was atypical ductal hyperplasia.

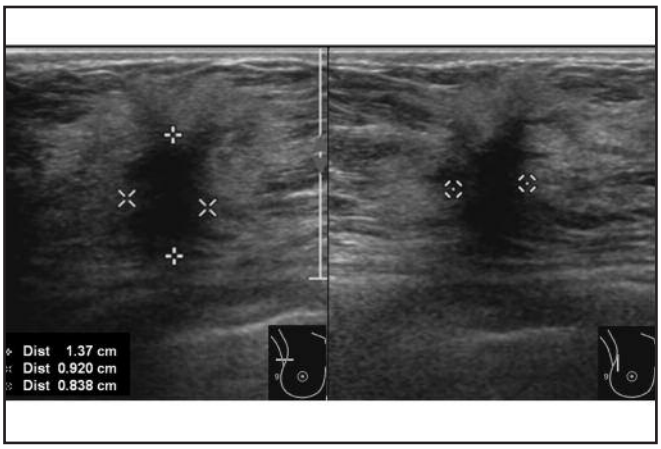

Fig. 4: Ultrasound image shows example of category 5 breast lesion. This lesion was biopsied with a semi-automated needle. The samples were satisfactory for histology evaluation and a diagnosis of infiltrating ductal carcinoma, Grade 2 was made.

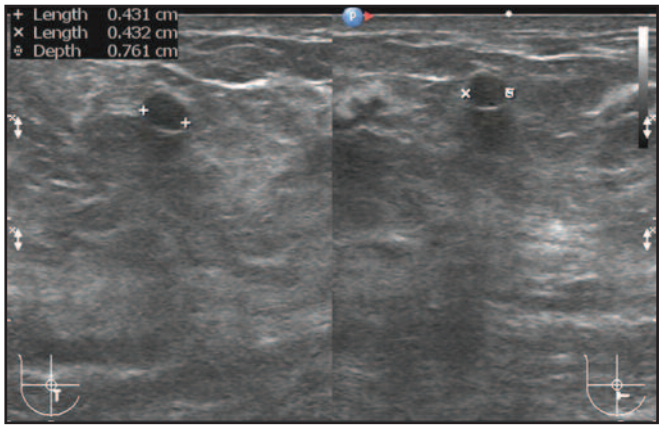

Fig. 5: Ultrasound image shows an example of category 2 breast lesion. This lesion was biopsied with an automated needle. The samples were small and a descriptive report stated fibroconnective tissue containing benign looking breast acini with some blood clots. The breast acini are lined by two-tiered epithelium. Apocrine changes are not seen. No microcalcification seen. No evidence of adenosis or malignancy seen.

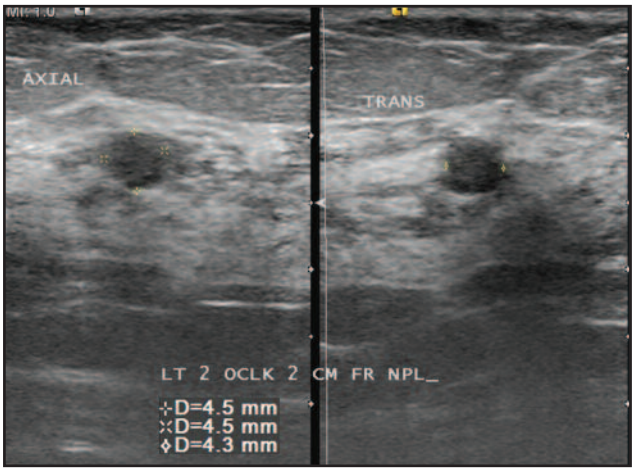

Fig. 6: Ultrasound image shows an example of a category 3 breast lesion. This lesion was biopsied with a semi-automated needle. The descriptive report stated that the core biopsy samples composed of sclerotic stroma with some breast ductular elements. There is no definite evidence of a cyst. No microcalcification. No evidence of malignancy.

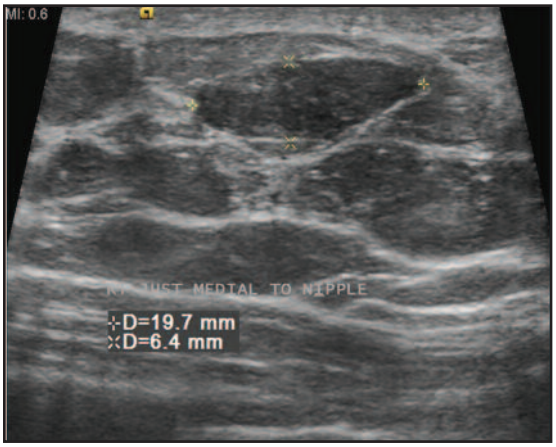

Fig. 7: Ultrasound image shows an example of a category 3 breast lesion. This lesion was biopsied with a semi-automated needle. The samples were fragmented and the descriptive report stated fragments of breast tissue displaying ducts and acini lined by two-tiered epithelium within fibrocollagenous stroma. No evidence of malignancy.

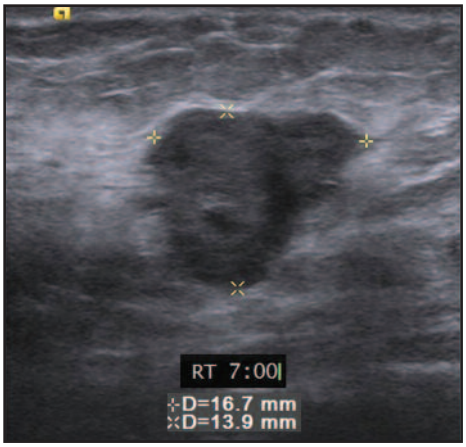

Fig. 8: Ultrasound image shows an example of a category 4 breast lesion. This lesion was biopsied with an automated needle. Histology report came back as unsatisfactory for evaluation. Repeat biopsy again with an automated needle, showed a necrotic lesion probably from a breast tumour and suggested excision of the lesion for a more definitive diagnosis. Excision confirmed diagnosis of infiltrating ductal carcinoma with florid ductal carcinoma in situ (DCIS).

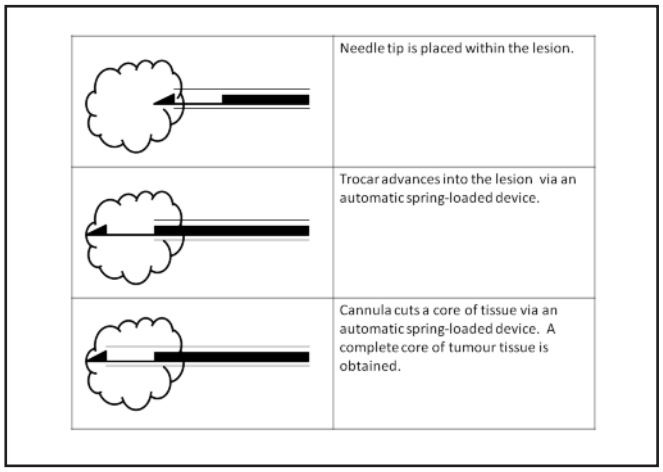

Fig. 9: Diagram shows biopsy mechanism of the automated needle to explain how a complete core of tumour tissue is obtained.

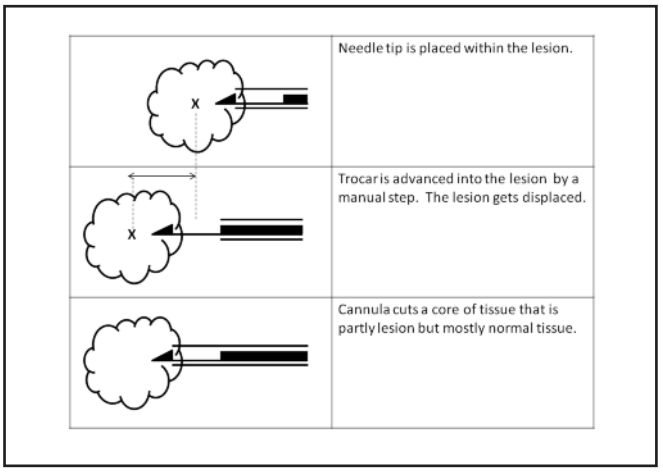

Fig. 10: Diagram shows biopsy mechanism of the semi-automated needle to explain why an incomplete core of tumour tissue is obtained.

samples obtained using the semi-automated needle yielded 23% inadequate or unsatisfactory results as compared to 9% when using the automated needle (Table I). Using Fisher exact test, these findings were statistically significant with p value of 0.023 (<0.05). Therefore, this study demonstrated that there was a statistically significant difference in the adequacy of breast tissue yield between semi-automated and automated needles.

Fragmentation of Breast Tissue Samples
From 160 samples collected, 123 (77%) were not fragmented while 37 (23%) were fragmented (Table I).

Results showed more fragmented samples were obtained by the semi-automated needle. Fragmented samples with definitive diagnosis were slightly higher (16%) with automated than semi-automated needles (13%). Fisher exact test showed p value of 0.07 (>0.05). This indicates that there was no statistically significant difference in the fragmented samples obtained using the semi-automated and automated needles.

Association between Tumour Size and Needle Type
Table II and III show that a total of 131 (82%) breast lesions less than or equal to 2cm and 29 (18%) breast lesions more than 2cm were biopsied. Examples of breast lesions ≤2cm and >2cm are shown in Figures 1 and 2 respectively.

Table II shows that based on 80 samples, biopsies taken from breast lesions less or equal to 2cm using the semi-automated core needle had 46% histology reports, 17% descriptive reports and 23% inadequate or unsatisfactory samples for evaluation. For breast lesions more than 2cm, 14% had histology reports and none with descriptive report or insufficient sample. Fisher exact test p value was 0.056 (>0.05). This indicates that tumour size had no significant effect on the yield of breast tissue obtained using the semi-automated needle.

Table III shows that based on 80 samples, biopsies taken from breast lesions less or equal to 2cm using the automated core biopsy needle, had 65% histology reports, 5% descriptive reports and 8% inadequate or unsatisfactory samples. While for breast lesions more than 2cm, 19% had histology reports, 2% had descriptive reports and 1% had inadequate or insufficient samples. Fisher exact test p value was 0.62 (>0.05). This indicates that tumour size had no significant effect on yield of breast tissue obtained using automated core biopsy needle.

Association between Tumour Type and Needle Type
Table IV shows the 5-point breast imaging classification of lesions and histology findings. From 160 samples obtained from the biopsies, the histology report showed 57% to be benign (Figure 3), 14% malignant (Figures 1, 2 and 4), 13% with descriptive reports (Figures 5, 6 and 7) and 16% with inadequate or unsatisfactory samples for evaluation (Figure 8). It was noted that most of the benign lesions in this study (28%) were category 3 and all lesions in category 5 were shown to be malignant on histology.

Table V shows benign or malignant histology obtained with the semi-automated and automated needles. Fisher exact test p value was 0.64 (>0.05). This indicates that there was no statistically significant difference between semi-automated and automated needles in the yield of breast tissue taken from a benign or malignant lesion.

Accuracy of Core Biopsy When Using the Semi-automated and Automated Needles
Patients (n=23) with malignant histology on core biopsy (Table IV) were advised to have excision of lesion and further treatment when necessary. Patients (n=26) with discordant ultrasound findings and core biopsy histology (category 4 on ultrasound, benign on core biopsy histology) (Table IV) were advised to have either a repeat core biopsy or excision of lesion. Of these patients, 29 had lesion excision in this hospital. Therefore the histology reports of the excised lesions were available and were used as the gold standard to determine accuracy of core biopsy with the semi-automated and automated needles. Of these 29 excised lesions, 13 category 4 and 5 lesions had malignant histology on core

biopsy and histology of excised lesion (true positive). One category 3 lesion that had malignant core biopsy was benign on histology of excised lesion (false positive). Of the 15 category 4 lesions that had benign histology on core biopsy (discordant ultrasound and core biopsy results), 13 were benign on histology of excised lesion (true negative) and 1 was malignant on histology of excised lesion (false negative). Statistical analysis for accuracy of biopsy of 10 lesions with the semi-automated needle was performed with histology of excised lesion as the gold standard. Results show that the sensitivity and specificity were 100% and 75% respectively (Table VI). The positive and negative predictive values were 86% and 100% respectively while the accuracy for lesions highly suspicious of malignancy was 90%.

Statistical analysis for accuracy of biopsy of 19 lesions with the automated needle was performed with histology of excised lesion as the gold standard. Results show that the sensitivity and specificity calculated were 88% and 100% respectively (Table VI). The positive and negative predictive values were 100% and 92% respectively while the accuracy for lesions highly suspicious of malignancy was 95%.

DISCUSSION

A previous study comparing semi-automated and automated core needles in the biopsy of breast lesions showed better yield with the automated needle.[7] Another study comparing these two devices in the biopsy of lung lesions also showed better yield with the automated needle.[8] Similarly, in this study the automated needle obtained a higher number of histology reports. This study also noted that inadequate samples with the automated needle were much less.

There are two possible reasons for the above results. Firstly, although both devices were 14 G with a 22 mm notch size, the cannula of the automated needle has a thinner wall and therefore the total diameter of this needle is smaller and hence easier to introduce into a lesion. It is important to position the needle tip within the lesion before deploying the biopsy mechanism so that the force of the biopsy mechanism does not displace the lesion distally. Secondly, the automated needle uses a bi-stage spring-deployed action in which the inner trocar is initially propelled forward to expose a side notch, and this is followed almost immediately by an outer cutting cannula. The two stages of the biopsy mechanism are fully automated, and are therefore forceful and rapid. As such, there is less chance of the lesion being displaced distally (Figure 9). In the semi-automated needle, the inner trocar is advanced manually. This movement lacks force and speed. Only the movement of the cutting cannula over the trocar is automated. During the manual advancement of the trocar, there is a higher possibility of displacing the lesion distally. Therefore the cannula will partially cut the lesion and the rest of the core tissue would be the adjacent surrounding tissue (Figure 10). This is especially so for hard lesions.

Occurrence of sample fragmentation when using the semi-automated needle compared to the automated needle showed no statistically significant difference in the number of fragmented samples. The semi-automated needle showed slightly less fragmented samples. However, the number of fragmented samples with a definitive diagnosis was slightly higher with the automated needle. These findings were also noted in an earlier study.[7] A possible reason could be that the rapid biopsy mechanism of the automated device could easily fragment lesions. However, its rapid movement would not crush the tissue sample. The semi-automated needle moves more slowly and therefore would cause less fragmentation of lesions but more likely to crush the tissue sample and render histological evaluation difficult.

It has been reported that the advantage of the semi-automated over the automated needle might be its potential for higher targeting precision.[10] With manual insertion of the needle tip through the target followed by manual adjustment of the notch to the preferred area of the target, a more precise targeting might be expected. Therefore, it was concluded that the semi-automatic was better when targeting small breast tumours or pathologic axillary lymph nodes.[10] However, it was not proven statistically as there was no comparison between the devices.

This study revealed that the yield of breast tissue was not significantly affected by tumour size although a higher percentage of histology report was obtained from larger lesions using both devices. This study also showed that yield from the automated needle had a slightly higher percentage of histology reports for tumours 2 cm and smaller as well as for tumours more than 2 cm.

The histology of most of the breast lesions biopsied was benign. A benign lesion is usually mobile and it is difficult to place the needle tip within especially when the lesion is small. Furthermore, a mobile benign lesion is more likely to be displaced distally by the force of the biopsy mechanism. On the contrary, malignant lesions are relatively fixed to surrounding tissue. It is therefore easier to place the needle tip within the lesion and it is unlikely to be displaced distally by the force of the biopsy mechanism. However, comparison of the yield of breast tissue obtained with the semi-automated and automated needles in relation to whether a tumour proved benign or malignant, showed no statistically significant difference between these two devices.

In this study, a total of 29 lesions were excised. The semi-automated biopsy needle had higher sensitivity (100%) but lower specificity (75%) compared with the automated biopsy needle (88% sensitivity, 100% specificity). The semi-automated needle had one false positive. The core biopsy showed intraductal apocrine carcinoma in situ while the excision biopsy showed papillary apocrine hyperplasia. The automated needle had one false negative. The core biopsy showed atypical ductal hyperplasia while the excision biopsy showed infiltrating ductal carcinoma. An earlier study reported sensitivity and specificity of 100% and 91.1% respectively.11 However, the authors did not specify the type of biopsy needle used.

The semi-automated needle is for once-use only and the whole device is discarded after one use, that is, one needle per patient. These needles cost between RM 95 to RM 135 each depending on the make and number of devices purchased (The price is reduced when a large consignment is

purchased). The gun for the fully automated device costs between RM 3000 to RM 5000 each depending on the number of devices purchased (There is a discount when more than one device is purchased). The needle itself costs RM 88 each. Servicing for the gun is provided free of charge. Based on 100 patients, with the cheapest semi-automatic needle at RM 95, the total cost would be RM 9500. Based on 100 patients, the total cost when using the fully automated device is RM 8800 plus RM 3000 i.e. RM11800. It is more costly to use the fully automated needle. However, the cost of using the fully automated needle decreases with increasing number of patients. Centres that do not do many biopsies might still prefer to use the semi-automated needle. At our centre, the automated needle is now our preference for biopsy of breast lesions.

Apart from cost, there is the problem of ensuring sterility of the equipment. The semi-automated needle is for single use only and is discarded after use. Therefore, the user is assured of sterility of the equipment used for every patient. For the fully automated device, the biopsy gun cannot be sterilised. Between patients, the gun is cleaned with *povidone* followed by saline. This seems adequate considering that this part of the equipment does not enter the patient. However, extra care should be taken when handling the gun so that it does not become a route for spread of infection between patients, especially hepatitis B.

CONCLUSION

In ultrasound guided breast core biopsy, the automated core biopsy needle produced better yield of breast tissue compared with semi-automated core biopsy needle. The higher yield of breast tissue enabled histological evaluation and provided adequate samples for making a definitive diagnosis. There was no significant difference in the fragmented breast tissue obtained. However, definitive diagnosis from these fragmented samples still slightly favours the use of the automated needle. Tumour size and type of breast lesion were not statistically proven to affect the yield of breast tissue obtained by the semi-automated and automated needles. For lesions that were excised, semi-automated and automated needles had an accuracy of 90% and 95% respectively.

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