

Surgeon-Performed Ultrasound-Guided Fine-Needle Aspiration Cytology (SP-US-FNAC) Shortens Time for Diagnosis of Thyroid Nodules

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Abstract

Introduction: Ultrasound-guided fine-needle aspiration cytology (US-FNAC) of thyroid nodules is an important diagnostic procedure. In most hospitals, patients are referred to radiologists for US-FNAC, but this often results in a long waiting time before results are available. Surgeon-performed US-FNAC (SP-US-FNAC) during the initial patient consultation attempts to reduce the waiting time but it is not known whether this is as accurate as radiologist-performed US-FNAC (RP-US-FNAC). The aim of this study is to compare the clinical efficiency between SP-US-FNAC and RP-US-FNAC. **Materials and Methods:** A retrospective study was performed on patients from the Department of General Surgery, Tan Tock Seng Hospital (TTSH) who underwent an US-FNAC from August 2011 to May 2012. All cases of SP-US-FNAC were performed by a single surgeon. This study compared the rates of positive diagnoses achieved by SP-US-FNAC and RP-US-FNAC as well as the time interval to reach a cytological diagnosis by each group. **Results:** A total of 40 cases of SP-US-FNAC and 72 cases of RP-US-FNAC were included in the study. SP-US-FNAC resulted in 28 (70%) positive diagnoses and 12 (30%) non-diagnoses while RP-US-FNAC resulted in 47 (65.3%) positive diagnoses and 25 (34.7%) non-diagnoses. These results were comparable ($P = 0.678$). The median time taken to reach a cytological diagnosis was 1 working day for SP-US-FNAC and 29.5 working days for RP-US-FNAC resulting in a shorter interval to reaching a cytological diagnosis for SP-US-FNAC ($P < 0.001$). **Conclusion:** In the workup of thyroid nodules, SP-US-FNAC is as accurate as RP-US-FNAC but significantly reduces the time taken to reach a cytological diagnosis. This leads to greater clinical efficiency in the management of patients with thyroid nodules, which in turn leads to other benefits such as decreased patient anxiety and increased patient satisfaction.

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Introduction

Fine-needle aspiration cytology (FNAC) is an efficient and reliable diagnostic test that is important in the evaluation of thyroid nodules.¹ This is to exclude the possibility of a cancer, even though the vast majority of thyroid nodules are actually benign.² FNAC is known to have high rates of sensitivity, specificity and diagnostic accuracy, and this has been further improved with the introduction of ultrasound guidance in FNAC. Ultrasound-guided FNAC (US-FNAC) has been proven to be superior to palpation-guided FNAC in many studies worldwide.³⁻⁷ This is due to increased sensitivity and specificity, as well as decreased rate of false negatives and sample inadequacy. This ultimately decreases

the need for repeat FNAC, which incurs time and monetary cost to patients.⁶

US-FNAC has traditionally been performed by trained radiologists. This requires a referral from the clinician to the radiologist, and the procedure is often performed at a different date and venue. This additional visit inevitably results in patient's inconvenience and delay in making a diagnosis. However there has been an increasing shift towards surgeons performing US-FNAC.⁷⁻⁹ Recent studies have shown benefits of surgeon-performed US-FNAC (SP-US-FNAC), which include patient convenience by reducing the number of physician visits and direct feedback of information for surgeons, allowing for faster decision-

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making on whether surgery is needed.^{7,9-11} The shift towards surgeon-based ultrasonography also helps in streamlining patient care and improving patient satisfaction.¹² SP-US-FNAC is a relatively new practice in Singapore, and to our knowledge, it has not been consistently offered by surgeons. The senior author is the first clinician to consistently perform US-FNAC in his practice at Tan Tock Seng Hospital.

To further assess the benefits of SP-US-FNAC, we conducted a retrospective study to compare the diagnostic accuracy between radiologist-performed US-FNAC (RP-US-FNAC) and SP-US-FNAC, and more importantly, to compare the time taken to reach a cytological diagnosis between radiologist and SP-US-FNAC.

Materials and Methods

We performed a retrospective review of 112 patients who underwent US-FNAC between 1 August 2011 and 31 May 2012 at Tan Tock Seng Hospital (TTSH). SP-US-FNAC was performed in the outpatient clinic by a single consultant surgeon from the Head and Neck Services of General Surgery Department, and RP-US-FNAC was performed by several radiologists from the Radiology Department. Information retrieved included patient's age, gender, nodule size, consistency of nodule and location, appearance of nodule on ultrasonography, date of first visit to the surgeon, cytology results, date of cytology results, as well as histology results for patients who subsequently underwent surgery. The information was retrieved from patient's case notes and online databases. Institutional Review Board approval was obtained prior to data collection.

Imaging Technique

Using a hand-held probe, the thyroid gland was imaged to determine the size and presence of nodules. Nodules were then examined with regard to size (in centimetres), consistency (solid, cystic or mixed solid-cystic), margins (well-defined or poorly-defined), echogenicity (hypoechoic, hyperechoic, isoechoic or anechoic), and for presence of microcalcifications. Internal vascularity was assessed using biphasic Doppler mode.

US-FNAC Technique

SP-US-FNAC was performed by one surgeon, using 23-gauge needles with no negative pressure, unless there were cystic contents that required aspiration. Needle placement into the nodule was visualised real-time on the ultrasound monitor, and multiple passes into each nodule were made. The cells were then expelled using a syringe onto a glass slide which was immediately smeared and placed in fixation medium. The surgeon then assessed

sample adequacy by visualising for cellular material against a light source, without the help of on-site cytotechnicians or cytologists. In some cases, more than one nodule was sampled from a single patient, in which some took place during the same visit and others during separate visits. RP-US-FNAC was commonly performed using 25-gauge needles with no negative pressure, and with the support of on-site cytotechnicians. The number of passes into each nodule was dependent on the on-site cytological evaluation.

Cytology Reporting

The Department of Pathology at TTSH analysed and reported the slides. The results were reported based on the Bethesda system.¹³ "Insufficient" samples may be further reported by the pathologists as "low cellular yield", "bloody" or "cystic contents". We considered any result that is not reported as "insufficient" as a positive diagnosis.

Time Taken to Reach Cytological Diagnosis

The time taken to reach a cytological diagnosis was calculated as the number of working days from the patient's first visit to the surgeon's clinic to the day which the cytological diagnosis was made available on the hospital's online reporting system by the reporting pathologist. A working day is taken to be any day that is not a Saturday, Sunday or public holiday. Patients who underwent more than one FNAC during the same visit were considered as a single case.

Statistical Analysis

Univariate analysis was performed using Fisher's exact test for categorical variables and Mann-Whitney U test for continuous variables. A *P* value <0.05 was considered statistically significant. Statistical analysis was performed using IBM SPSS 20.

Results

A total of 130 US-FNAC studies were performed on 112 patients over the same time period. Of these, 40 patients underwent SP-US-FNAC and 72 patients underwent RP-US-FNAC. We excluded repeated visits within our study period. There were more patients in radiology due to hospital-wide referrals from multiple departments. Nevertheless, the age, gender, nodule size distribution and proportion of nodules with cystic components between both groups were comparable (Table 1).

Positive Diagnosis Rate

The positive diagnosis rate between SP-US-FNAC and RP-US-FNAC were comparable. SP-US-FNAC resulted in 28 (70%) positive diagnoses and 12 (30%) non-diagnoses while RP-US-FNAC resulted in 47 (65.3%) positive diagnoses and 25 (34.7%) non-diagnoses. The difference in inadequacy rate between SP-US-FNAC and RP-US-FNAC was not statistically significant ($P = 0.68$) (Table 2). Likewise, the non-diagnosis rate for nodules with cystic components was also not statistically significant between SP-US-FNAC and RP-US-FNAC ($P = 0.434$) (Table 3).

Time Taken to Establish Diagnosis

The median time taken to establish a cytological diagnosis was 1 working day for SP-US-FNAC (interquartile range, 1, 1) and 25 working days for RP-US-FNAC (interquartile range, 16, 39.8). There was a significantly shorter time taken in reaching a diagnosis for SP-US-FNAC ($P < 0.001$) (Table 2). All nodules which underwent SP-US-FNAC reached a cytological diagnosis within 2 working days. The time taken to diagnosis was plotted on the Kaplan-Meier curves (Fig. 1).

Table 1. Characteristics of Patients and Nodules

	SP-US-FNAC (n = 40)	RP-US-FNAC (n = 72)	P value
Patient's age (years), median (interquartile range)	45.5 (33.5, 61.3)	54 (41.5, 62.3)	0.099
Patient's gender			
Female	30 (75%)	58 (80.6%)	0.631
Male	10 (25%)	14 (19.4%)	
Size of nodule (cm), median (interquartile range)	3 (2.2,3.8)	2.8 (1.6,3.6)	0.183
Nodules with cystic component	21 (52.5%)	41 (56.9%)	0.695

RP-US-FNAC: Radiologist-performed ultrasound-guided fine-needle aspiration cytology; SP-US-FNAC: Surgeon-performed ultrasound-guided fine-needle aspiration cytology; US-FNAC: Ultrasound-guided fine-needle aspiration cytology

Table 2. Comparison of Positive Diagnosis Rate between SP-US-FNAC and RP-US-FNAC

	SP-US-FNAC (n = 40)	RP-US-FNAC (n = 72)	P value
Positive diagnosis rate	28 (70%)	47 (65.3%)	0.678
Time taken to reach a cytological diagnosis (working days), median (interquartile range)	1 (1,1)	29.5 (16,39.8)	<0.001

RP-US-FNAC: Radiologist-performed ultrasound-guided fine-needle aspiration cytology; SP-US-FNAC: Surgeon-performed ultrasound-guided fine-needle aspiration cytology; US-FNAC: Ultrasound-guided fine-needle aspiration cytology

Table 3. Comparison of Non-Diagnosis Rate for Nodules with Cystic Components between SP-US-FNAC and RP-US-FNAC

	Cystic nodules which underwent SP-US-FNAC (n = 21)	Cystic nodules which underwent RP-US-FNAC (n = 41)	P value
Non-diagnosis rate	11 (52.4%)	17 (41.5%)	0.434

RP-US-FNAC: Radiologist-performed ultrasound-guided fine-needle aspiration cytology; SP-US-FNAC: Surgeon-performed ultrasound-guided fine-needle aspiration cytology

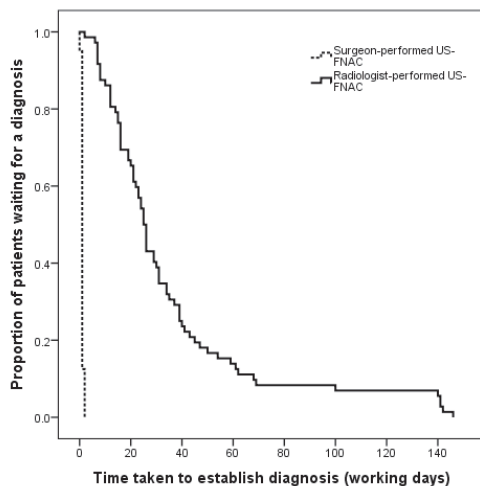


Fig. 1. Kaplan-Meier curves for the time taken to reach a cytological diagnosis as calculated from the patient's first visit at the surgeon's clinic to the time a cytological diagnosis is made by the Pathology Department based on the fine-needle aspiration cytology (FNAC) sample. Surgeon-performed ultrasound-guided fine-needle aspiration cytology (SP-US-FNAC) had a significantly shorter time to diagnosis ($P < 0.001$).

Discussion

In recent years, there has been much focus on evaluating the use of ultrasound in head and neck surgery, in particular the role of ultrasound-guidance in FNAC.^{4,7,14-16} US-FNAC, whether performed by radiologists or clinicians, has shown multiple benefits such as increased sensitivity and specificity, decreased inadequate specimen rate, increasing patient safety by visualising the needle tip and avoiding trachea and surrounding vessels, allowing for selection of the most suspicious-looking nodule or the solid part of cystic nodules to be sampled, and permitting FNAC of poorly felt nodules which may be small or posteriorly located.¹⁴ Bringing US-FNAC into the domain of clinicians further adds on to the above benefits. There is a reduction in the number of consultations, resulting in decreased time and monetary costs.^{11,12} Compared to radiologists, surgeons have the distinct advantage of being able to correlate ultrasound findings within the patient's clinical context.^{14,17} As such, US-FNAC performed by the surgeon is associated with a low sampling error rate.¹¹

The aim of our study was to determine: 1) whether the rate of positive diagnoses was comparable between SP-US-FNAC and RP-US-FNAC within a single institution, and if so, 2) whether there is a significant reduction in time taken to reach a cytological diagnosis for SP-US-FNAC. Our results show a comparable rate of positive diagnoses between SP-US-FNAC (70%) and RP-US-FNAC (65.3%), with a significantly reduced time taken to reach a diagnosis for SP-US-FNAC (1 working day compared to 25 working

days). Though the results of our study is limited by a small sample size, it indicates that a shift of US-FNAC from the domain of radiologists to surgeons can decrease the waiting time to diagnosis for patients without compromising on the rate of positive diagnosis.

Other authors have reported non-diagnostic rates of US-FNAC between 3.5% and 32%^{4,9} with an average rate of 10%.¹ It has been observed that institutions with higher case loads and more extensive experience have much lower non-diagnostic rates in the range of 5%.^{4,7,10} Our institution's higher non-diagnostic rates of 30% for SP-US-FNAC and 34.7% for RP-US-FNAC is likely due to a multitude of factors such as the inclusion of all patients who underwent US-FNAC within the study period and an initial lack of experience for SP-US-FNAC. The sampling of nodules with large cystic components and sending of cystic aspirates for cytological analysis using cell-block technique may also have contributed to the higher non-diagnostic rates.¹⁸

Many studies examining the role of immediate on-site cytological evaluation in thyroid FNAC have produced conflicting results.¹⁹⁻²³ Redman et al²⁰ and Baloch et al²¹ showed a significant improvement in diagnostic accuracy and decreased false-negative rates with the addition of on-site cytological evaluation to US-FNAC. On the other hand, a study by O'Malley et al which specifically investigated the differences between cytological evaluation in US-FNAC concluded that immediate on-site cytological evaluation only increased procedure time without a concomitant increase in specimen adequacy.²² Nevertheless, authors who oppose the routine use of on-site cytological evaluation would agree there is a role for such evaluation in cases where rates of inadequacy are expected to be higher, such as in large cystic masses, multiple large nodules or repeat procedures.²³ Our study demonstrated a higher rate of positive diagnosis with SP-US-FNAC compared to RP-US-FNAC. However, this may have resulted from the small study size.

Another advantage of surgeon-performed ultrasound over a radiology-referral-based ultrasound was illustrated in a study involving breast cancer patients.¹² Rahman et al showed that surgeon-performed ultrasound enabled a diagnosis to be established within 48 hours, which was shorter than radiologist-based ultrasound (median time of 23 days). This resulted in a significant reduction in patient anxiety, which was prevalent in this patient group.^{12,24} Patients also found the surgeon-based system to be more efficient and satisfactory. Our present study on thyroid nodules shows a similar trend in time taken to establish a diagnosis, and corroborates the benefits outlined by Rahman et al. A follow-up study involving patient surveys can be conducted to validate this point.

Another benefit of SP-US-FNAC over RP-US-FNAC is the opportunity for the surgeon to exercise his clinical

judgement using results of both the US and FNAC findings. Al-azawi et al reported two instances in which patients underwent SP-US-FNAC and received a negative result.⁷ Despite that, the surgeon went on to perform thyroidectomy based on suspicious features on the US, and the final pathology confirmed a missed malignancy in both instances. Such scenarios are rare, but they highlight the benefit of having a more streamlined patient management through SP-US-FNAC.

Conclusion

Based on the results of our study, we recommend that head and neck surgeons be trained and routinely perform US-FNAC themselves. This would lead to shorter waiting times and therefore increased patient satisfaction as a result of a more streamlined care and reduction of referrals. Given the benefits of US-FNAC, we also advise that clinicians who are unable to perform US-FNAC should continue to routinely refer their patients to radiologists for US-FNAC of thyroid nodules.

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