Factors Affecting Swallowing During Thyroid Fine-Needle Aspiration Biopsy

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Objective. This prospective study was conducted to examine the factors that affect swallowing during thyroid fine-needle aspiration biopsy (FNAB). ***Methods.*** Consecutive patients who were to undergo FNAB were approached for inclusion in the study. The depth and size of the nodule were measured in all patients. In a random fashion, patients were told not to swallow during the procedure, or they were not given any instructions regarding swallowing. ***Results.*** Regarding the 143 participants in the study, no significant differences in age ($P = .07$), diameter and depth of the thyroid nodules ($P = .14$; $P = .46$, respectively), or cytologic diagnosis of thyroid aspirates ($P > .20$) were found between the swallowing (n = 50) and nonswallowing (n = 93) patient groups. Swallowing was observed in 29 patients who were instructed not to swallow (36%) and in 21 patients who were not given any instructions regarding swallowing (34%; $P = .95$). The mean duration of the procedure for swallowing patients was 19.8 seconds, and it was 15.7 seconds for nonswallowing patients. The duration of the procedure was significantly shorter in patients who did not swallow ($P = .001$). More male patients swallowed than female patients ($P = .003$). ***Conclusions.*** Giving specific instructions about not swallowing did not make a difference regarding swallowing by patients during the FNAB procedure. More male patients swallowed than female patients. A longer duration of the FNAB procedure meant that the operator was more likely to encounter swallowing (and thus displacement of the thyroid) while doing the procedure. Completing the procedure quickly is the surest method to avoid a moving thyroid while performing FNAB. ***Key words:*** biopsy; deglutition; fine-needle aspiration; thyroid gland; ultrasound.

Abbreviations
FNAB, fine-needle aspiration biopsy

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Fine-needle aspiration biopsy (FNAB) is widely considered the most accurate diagnostic technique for the assessment of thyroid nodules: given an adequate sample, its accuracy approaches 95%. Unfortunately, inadequate sampling is common, occurring in up to 20% of cases.[1]

Although complications of FNAB of the thyroid gland occur only rarely, radiologists should be highly cautious during biopsy of small nodules in the vicinity of large vessels; patients should not be allowed to swallow, or injury to these vessels may occur. Extra care should be taken during biopsy of nodules lying posteriorly in the thyroid gland to prevent injury to the recurrent laryngeal nerve. The most common cause of movement during the procedure is swallowing. Movement of the gland during aspiration may cause tissues to tear and hematoma formation in the soft tissues.[2,3]

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We prospectively recruited patients about to undergo FNAB to determine whether telling them not to swallow would affect their swallowing behavior, success of the procedure, and occurrence of complications.

Materials and Methods

Our study protocol was approved by our university's Ethics Committee. Between January and September 2007, patients about to undergo FNAB were approached for inclusion in this prospective study. After written informed consent was obtained, a senior radiology resident (U.S.Y.) measured the depth and size of the nodule in all patients with ultrasound. The size of each nodule was recorded as its largest diameter. Just before the procedure, patients were given details about how the procedure would be performed, and they were instructed not to move or talk during the procedure. In addition, in a random fashion, some patients were told not to swallow during the procedure, whereas the rest were not given specific instructions regarding swallowing.

Ultrasound-assisted FNAB was performed (as detailed below) by an experienced consultant radiologist assisted by a senior radiology resident using the freehand technique with an 8-MHz linear probe and an SSA-34EA ultrasound machine (Toshiba Medical Systems Co, Ltd, Tokyo, Japan). Patients were placed in the supine position; the anterior neck was cleansed with alcohol and dried with a gauze sponge; and no local anesthesia was given. Fine-needle aspiration biopsy was performed using a 22-gauge needle and a 10-mL disposable syringe. The needle was inserted obliquely along a path parallel to the scanning plane so that the tip and the shaft were always visible. When the needle reached the target, it was moved back and forth, sideways, and obliquely several times for aspiration of tissue. The aspiration was always stopped when blood appeared in the tube; the suction was then released, and the needle was withdrawn.

During the procedure, all movements of the needle were visible in real time. The duration of the biopsy (time between insertion and withdrawal of the needle) and information regarding the patient's swallowing (or not) were noted by the senior radiology resident who guided the biopsy. A maximum of 2 separate needle passes were made in the case of large nodules, which were aspirated in 2 separate locations. The aspirated material was expelled onto glass slides. Slides were air dried and then stained using the May-Grunwald-Giemsa technique. Pathologically, samples were classified as inadequate, benign, suspicious, or malignant.

The Yates χ^2 test, receiver operating characteristic curve analysis, the Student t test, and the Fisher exact test were used for statistical analyses with SPSS version 15.0 (SPSS Inc, Chicago, IL) and MedCalc version 9.3.5.0 (MedCalc Software, Mariakerke, Belgium) statistical packages.

Results

A total of 143 patients (mean age, 50 years; age range, 17–85 years; 86% female) participated in the study. Of these, 81 (mean age, 48 years; 83% female) were specifically told not to swallow during the procedure, whereas specific instructions about swallowing were not given to the remaining 62 patients (mean age, 52 years; 85% female).

As shown in Table 1, the two groups were not significantly different in their mean age (student t test, $P = .07$), sex (Yates χ^2 test, $P > .99$), and size and depth of the thyroid nodules (Student t test, $P = .37$; $P = .86$, respectively). A total of 50 patients (35%) swallowed either 1 time or several times during the procedure. Swallowing was observed in 36% (29 of 81) of the patients who were instructed not to swallow and in 34% (21 of 62) of the patients without any instructions regarding swallowing (Yates χ^2 test, $P = .95$; Table 2). During the procedure, more male patients swallowed than female patients (75% versus 36%; Fisher exact test, $P = .003$), but the mean ages of the patients who swallowed and did not swallow were similar (Student t test, $P = .72$; Table 3).

The duration (mean ± SD) of the biopsy procedure in the nonswallowing patients was shorter than that in the swallowing patients (15.7 ± 2.9 seconds [minimum, 11 seconds; maximum, 23 seconds] and 19.8 ± 3.8 seconds [minimum, 13 seconds; maximum, 31 seconds], respectively; Student t test: $P < .001$; Table 3). The depth and size of the nodules were similar in the patients who swallowed and did not swallow (receiver

Table 1. Mean Demographic Characteristics and Procedural Results of Patients Who Were Told Not to Swallow During FNAB of a Thyroid Nodule (n = 81) and Patients Who Were Not Given Specific Instructions About Swallowing (n = 62)

Characteristic	Told Not to Swallow	Not Given Specific Instructions	*P*
Age, y	48.4	52.2	.07
Sex, male/female	11/70	9/53	>.99
Depth of nodule, mm	10.5	10.4	.86
Diameter of nodule, mm	20.3	21.7	.37

operating characteristic curve analysis, $P = .46$; $P = .14$, respectively; Table 3).

Swallowing made no difference regarding the adequacy of the sampling or cytologic diagnosis of the thyroid aspirates (Table 4). With our procedure, 92% of samples were adequate for diagnostic purposes.

We did not observe any minor or major complications.

Discussion

Since the introduction of FNAB in the assessment of thyroid nodules, the cost of patient evaluation has fallen overall because fewer patients are undergoing surgery for benign thyroid nodules; in contrast, the proportion of malignancy in thyroid nodules that are surgically removed has increased sharply.[4–7] Although FNAB of the thyroid is an invasive procedure, it rarely results in complications.[8,9] Needle puncture may cause some skin discoloration at the aspiration site, but bleeding at the aspiration site does not occur often, especially if firm pressure is applied.[10] Major complications such as tumor seeding and needle track implantation of carcinoma cells are very rare occurrences.[11,12] The development of a hematoma in the subcutaneous tissues is the most common complication associated with this procedure. Suen[10] reported a life-threatening complication, which occurred in the early years of application of this procedure in their hospital: a massive hematoma developed in a patient after he had been discharged from the hospital; the hematoma led to tracheal compression, which necessitated emergent surgical ligation of a superficial thyroid artery. Since that event, Suen's group has advised all patients to report promptly to the emergency department if it is not possible to stop the expansion of a hematoma by applying pressure to the bleeding site.[10] Another major complication is transient vocal cord paralysis. Tomoda et al[11] described 4 cases of vocal cord paralysis among 10,974 patients (0.036%) who underwent FNAB to evaluate a thyroid nodule. All patients with vocal cord paralysis recovered spontaneously within 6 months (4 months on average).[11] In our study, no minor or major complications occurred during or after FNAB of the thyroid.

The minor and major complications during ultrasound-assisted FNAB are often attributed to displacement of the thyroid gland (eg, as occurs during swallowing, talking, or moving the neck) while the procedure is being performed. Swallowing involves the transport of fluids or a bolus of food from the mouth to the stomach through the pharynx and the esophagus. It is initiated voluntarily, but once triggered, it cannot be stopped because of complex neuromuscular interactions. Using a new multisensory noninvasive portable system, Afkari[13] determined the mean spontaneous swallowing frequency to be 1.3 swallows per minute.

Table 2. Occurrence of Swallowing During FNAB of a Thyroid Nodule Among Patients Who Were Told Not to Swallow (n = 81) and Patients Who Were Not Given Specific Instructions About Swallowing (n = 62)

Parameter	Told Not to Swallow	Not Given Specific Instructions
Swallowed, n	29	21
Did not swallow, n	52	41
Swallowed, %	36	34

$P = .95$, Yates χ^2 test.

Table 3. Mean Demographic Characteristics of Patients Who Swallowed and Did Not Swallow During FNAB of a Thyroid Nodule

Characteristic	Swallowed	Did Not Swallow	*P*
Age, y	50.7	48.8	.72
Sex, male/female	15/35	5/88	.003
Depth of nodule, mm	10.6	10.3	.46
Diameter of nodule, mm	21.9	19.4	.14
Duration of biopsy, s	19.8	15.7	<.001

Pehlivan et al[14] found the mean frequency of spontaneous swallowing to be 1.2 swallows per minute in their healthy study participants. If spontaneous swallowing is initiated voluntary, it seems that we would be able to avoid it with proper precautions. If spontaneous swallowing is involuntary and cannot be resisted, then swallowing will occur, and FNAB must be performed in the shortest time possible to avoid a complication created by entrance of the needle into the wrong structure or area. Interestingly, we found that specific instructions to avoid swallowing made no difference in the occurrence of swallowing during the procedure. However, some patients may have succeeded in consciously avoiding swallowing, whereas others were simply unable to do so. If spontaneous swallowing is difficult to suppress, then FNAB must be performed between swallows in the shortest time possible.

In our study group, more male patients swallowed than female patients. Psychological factors are probably related to swallowing rates. Cuevas et al[15] reported that changes in emotional states alter spontaneous swallowing rates in generally healthy individuals. Patients with elevated levels of anxiety could be more susceptible to higher swallowing rates.[16] Previous studies of spontaneous swallowing have not explored sex effects. Recently, Ritz and Thöns[16] found that swallowing rates were higher in men during some emotional states. Because we found swallowing to be more common in male patients, we try especially hard to complete the FNAB in the shortest time possible.

Table 4. Pathologic Diagnosis in Patients Who Swallowed (n = 50) and Did Not Swallow (n = 93) While FNAB of a Thyroid Nodule Was Performed

Result	Swallowed	Did Not Swallow	*P*
Inadequate sample, n	4	7	>.99
Benign, n	37	77	.303
Suspicious or malignant, n	9	9	.243

One might expect that deeply located or small nodules prolong the duration of the biopsy because extra care is needed for proper positioning of the needle, and reaching the nodule takes time. During this longer time, swallowing might occur, thus increasing the chance of complications. We did not observe a significant difference in swallowing based on the depth or size of the nodule, and no complications occurred. This may be attributed to ultrasound guidance in experienced hands, making biopsy of deeply located or small nodules relatively easy.

Although they may not be statistically significant, results show that suspicious or malignant nodules have higher rates of swallowing. Could it be that the suspicion of malignancy at the time of FNAB prolongs the aspiration time, or are there other factors?

In summary, about 35% of our patients swallowed during thyroid FNAB, whether they received specific instructions not to swallow. Swallowing during the procedure occurred more often among male patients than female patients. The age of the patients did not affect the rate of swallowing, and neither did the size or depth of the thyroid nodules. The duration of the FNAB was significantly shorter in patients who refrained from swallowing during the procedure. Completion of FNAB, within 1 minute, if possible, is the most effective way to avoid biopsy during swallowing and subsequent displacement of the thyroid gland.

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