Self-Learning Experience in Transbronchial Needle Aspiration in Diagnosis of Intrathoracic Lymphadenopathy

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Background: *Lack of a training program and experience result in underutilized transbronchial needle aspiration (TBNA). Pulmonologists who are not graduated from Europe or the United States might have little chance to learn and gain experience in this procedure.*
Objective: *To determine the authors' diagnostic yield from self-learning TBNA in diagnosis of intrathoracic lymphadenopathy.*
Material and Method: *After reviewing a videotape recorded TBNA procedure repetitively and receiving training in tracheobronchial lung model, the authors performed TBNA according to standard techniques using 21-guage cytology needles connected to a flexible bronchoscope in diagnosis of intrathoracic lymphadenopathy and performed data collection on all TBNA procedures at Ramathibodi Hospital, a tertiary university hospital in Bangkok, Thailand between January 1, 2006 and December 31, 2007.*
Results: *Thirty-eight consecutive patients were examined. Twenty-seven nodes (71.1%) were malignancies and 11 nodes (28.9%) were benign diseases. During the first 6-month, the authors' diagnostic yield and frequency of adequate specimens were low. With some modification of the TBNA technique and learning experience, the frequency of inadequate specimens significant decreased from 36.4% to 0% ($p = 0.03$). Although the diagnostic yield increased from 45.5% to 84.6%, it did not reach statistical significance ($p = 0.09$). No complication, in either the patients or the bronchoscopes, was found.*
Conclusion: *TBNA is a safe procedure that can be self-mastered by pulmonologists with interest, intent, and who exert themselves. TBNA performance will be improved over time with practice.*

Keywords: *Transbronchial needle aspiration, Fiberoptic bronchoscopy, Lymph node, Diagnostic yield*

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Transbronchial needle aspiration (TBNA) is a useful simple technique for diagnosis of intrathoracic lymphadenopathy. It was first described via the rigid bronchoscope by Schieppati in 1949[1] and was adapted for the flexible bronchoscope by Wang in 1983[2]. However, this technique was still underused by pulmonologists in both Europe and the United States[3,4]. Lack of training program was one of the reasons for limited acceptance of TBNA. European Respiratory Society (ERS), American Thoracic Society (ATS), and American College of Chest Physicians (ACCP) stated that trainees should perform 10-25 supervised procedures before attempting TBNA alone[5,6]. Thus, training program and various condensed hands-on courses in TBNA are offered and most of pulmonary

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fellows can achieve the competency numbers[7]. Nevertheless, pulmonologists who are not graduated from Europe or the United States might have little chance to learn and gain experience in this procedure. In the present report, the authors have presented their 2-year experience in self-learning in TBNA.

Material and Method

In 1999, Professor Atul C. Mehta came to Ramathibodi Hospital to demonstrate TBNA procedure. The authors asked him for permission to record the procedure he demonstrated. He showed the power and safety of TBNA in the diagnosis of mediastinal lymphadenopathy. However, this procedure was not continually performed in Ramathibodi Hospital. The main reason was related to the perceived level of difficulty of the technique and some initially discouraging results regarding its conduct.

VB was trained in pulmonary and critical care fellowships in Ramathibodi Hospital and graduated in 2003. He has been working as an attending physician at pulmonary and critical care unit in Ramathibodi Hospital since 2005. His main interest of practice was in interventional pulmonology. He learnt TBNA himself from videotape that recorded TBNA performing by Professor Mehta. After he had improved his skill by performing TBNA in tracheobronchial teaching model, he then practiced it in the patients in January 2006.

The authors performed data collection on all TBNA procedures at Ramathibodi Hospital, a tertiary university hospital in Bangkok, Thailand between January 1, 2006 and December 31, 2007. Patients were selected and performed by a single pulmonologist (VB) including those in whom TBNA was used for the diagnosis of intrathoracic lymphadenopathy. Computed tomography (CT) of the chest was conducted for all patients. Only patients that had enlarged intrathoracic lymph nodes in areas accessible by TBNA were included.

Before bronchoscopic examination, intrathoracic adenopathy was identified based on chest CT and a target site for TBNA was defined. Short axis diameter of target node was recorded. TBNA was performed with a 21-guage TBNA needle that was 13 mm in length with a side hole (NA-2C-1; Olympus; Tokyo, Japan), using fiberoptic bronchoscopy (FOB) (FB-15X; Pentax; Tokyo, Japan) with local anaesthesia. The needle was inserted perpendicularly through the bronchial wall via intercartilagenous space using the "jabbing", "piggy back", or "cough" methods[8]. All of these techniques were used singly or in combination for complete penetration of the needle through the tracheobronchial wall. Once the needle had been completely inserted, suction was applied at the proximal port using a 5-mL syringe to ensure that the tip of needle was in the lymph node. If blood was aspirated, indicating penetration of the vessel, suction was released, the needle retracted, and a new location was selected. Once the safety of the aspiration was confirmed, a 50-mL syringe was replaced and manual aspiration was applied with negative pressure as much as possible. Then, the needle catheter was agitated to and fro to shear off cells from the node. After the suction was released, the needle was pulled out and the catheter was then withdrawn from FOB. The specimen from the needle was blown onto a slide using air from the syringe (smear technique). Another glass slide was used to press and smear the specimen, which was immediately fixed in a 95% alcohol jar and then stained by using the Papanicolaou method. In addition, 1-mL of sterile normal saline was used to flush the rest of the specimen from the needle (fluid technique) and the fluid was then sent to the cytology laboratory for centrifugation and staining by the Papanicolaou method. TBNA was repeated at least four times per lymph node target site in the same manner. Other conventional diagnostic procedures such as bronchial lavage, bronchoalveolar lavage (BAL), transbronchial biopsy (TBB), and endobronchial biopsy procedures were performed as clinically indicated after completion of the TBNA examination. Rapid on-site cytology evaluation (ROSE) service was not available during the period of the present study. All specimens were examined by a single cytopathologist (AP).

Criteria for adequacy of the lymph node specimens were the presence of malignant cells or numerous benign lymphoid cells, or, alternatively, the ability to diagnose a specific nonneoplastic disease from the specimen. A final diagnosis was established using the results of the specimens of malignant disease or specific nonneoplastic disease. A cytological diagnosis of nonspecific lymphadenopathy was considered non-diagnostic even when the final diagnosis proved to be a benign process. If a definite diagnosis was not obtained by TBNA or conventional diagnostic bronchoscopic procedures, the patient underwent video-assisted thoracoscopy (VAT) or clinical and radiologic follow-up to confirm the diagnosis of lymphadenopathy.

From the authors' first 6-month experience, it was found that adequacy and diagnostic value of

TBNA were low. The authors' cytological specimens were highly contaminated with bronchial cells and cartilaginous tissue (Fig. 1A). Therefore, the authors modified their TBNA technique. After the full length of needle had completely penetrated the airway wall and the tip of needle was ensured to be in the node by manual aspiration with a 5-mL syringe, 1-mL of air was flushed to wash out the bronchial tissue that might obstruct the tip of the needle during penetration through the bronchial wall before manual aspiration with a 50-mL syringe. With this modified technique, the authors found that contamination with bronchial cells was less and the diagnostic yield of TBNA was increased (Fig. 1B).

All values were expressed as the median and range for continuous variables, and percent for categorical variables. Lymph node stations were classified according to the recent ATS proposal[9]. Lymph node size was grouped into two categories (< 20 mm and ≥ 20 mm). The influence of size and anatomical location of the lymph node on the outcome of TBNA was analyzed using χ^2-test, or by Fisher's exact test, as appropriate. The influence of learning experience during the period was assessed by χ^2-test. All statistical tests were 2-sided, and $p < 0.05$ was considered statistically significant. All data were analyzed with a statistical software package (SPSS, version 11.5 for windows; SPSS Inc; Chicago IL).The study protocol was approved by the Ethics Committee on Human Experimentation of Ramathibodi Hospital, Faculty of Medicine, Mahidol University and all patients signed a informed consent before the procedure.

Results

Between January 2006 and December 2007, 38 of 824 patients undergoing diagnostic bronchoscopy were selected for TBNA for the diagnosis of intrathoracic lymphadenopathy. Twenty-six (68.4%) of these were male. The median age was 61.5 years (range, 23 to 86 years). TBNA was performed at five sites that included subcarina (n = 17), paratrachea (n = 11), hilar (n = 4), interlobar (n = 4), and lobar lymph node (n = 2). Median nodal size was 25 mm (range, 12 to 32 mm).

Final diagnosis is shown in Table 1. Adequate lymph node samples were obtained in 33 of 38 stations (86.8%) and TBNA revealed definite diagnosis for 28 nodes (73.7%). For ten patients whose TBNA proved to be nondiagnostic, the final diagnosis in seven patients was established on clinical grounds - three by findings of clinical and radiographic response to antituberculous drugs, two by bone marrow biopsy diagnosed of leukemia and lymphoma each and resolution of lymph node after chemotherapy, and two by the

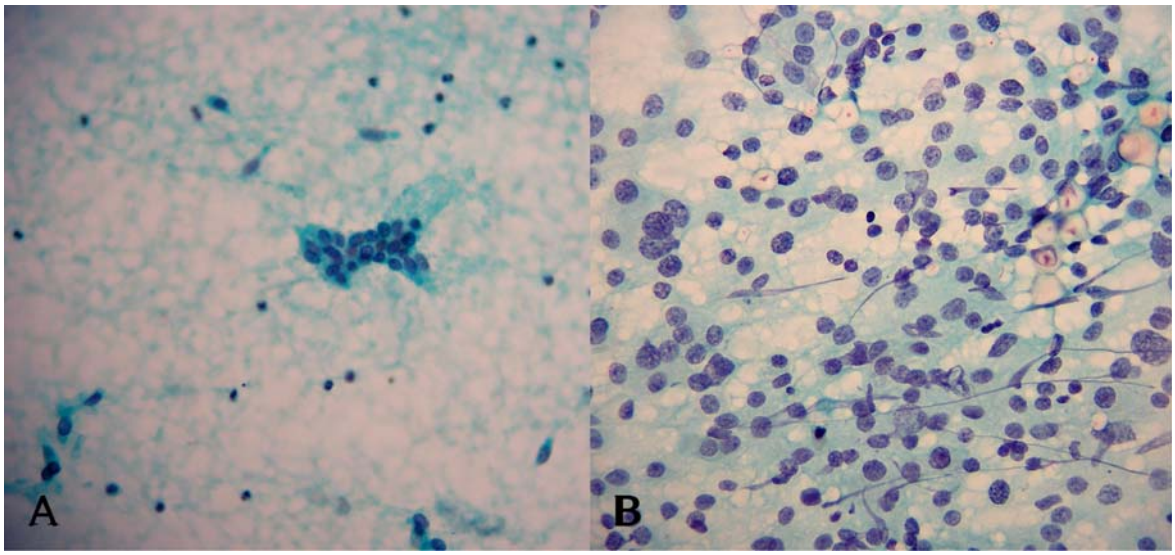

Fig. 1 A: TBNA cytology sample in the authors' first 6-month experience showing collection of sheets of bronchial cells with some reactive ones admixed with a small number of inflammatory cells, consistent with inadequate specimen B: Cytology sample obtained by modified TBNA technique showing numerous lymphoid cells of the targeted lymph node (Papanicolaou staining, original x 400)

Table 1. Established diagnosis in all 38 lesions

Diagnosis	Jan-Jun 2006		Jul-Dec 2006		Jan-Jun 2007		Jul-Dec 2007		Total lesions, No.	Diagnostic yield n (%)
	Total lesions, No.	Diagnostic yield n (%)	Total lesions, No.	Diagnostic yield n (%)	Total lesions, No.	Diagnostic yield n (%)	Total lesions, No.	Diagnostic yield n (%)		
Malignant	6	3 (50.0)	5	4 (80.0)	7	7 (100)	9	9 (100)	27	23 (85.2)
Lung cancer	3	2 (66.7)	5	4 (80.0)	7	7 (100)	9	9 (100)	24	22 (91.7)
Non-small cell carcinoma	3	2 (66.7)	5	4 (80.0)	5	5 (100)	4	4 (100)	17	15 (88.2)
Small cell carcinoma	-	-	-	-	2	2 (100)	5	5 (100)	7	7 (100)
Metastatic melanoma	1	1 (100)	-	-	-	-	-	-	1	1 (100)
Leukemia	1	0	-	-	-	-	-	-	1	0 (0.0)
Lymphoma	1	0	-	-	-	-	-	-	1	0 (0.0)
Benign	5	2 (40.0)	1	1 (100)	1	0 (0.0)	4	2 (50.0)	11	5 (45.5)
Tuberculosis	4	1 (25.0)	1	1 (100)	-	-	3	2 (66.7)	8	4 (50.0)
Sarcoidosis	1	1 (100)	-	-	-	-	-	-	1	1 (100)
Silicosis	-	-	-	-	-	-	1	0 (0.0)	1	0 (0.0)
Castleman's disease	-	-	-	-	1	0 (0.0)	-	-	1	0 (0.0)

subsequent nodal progression in a malignant manner and one patient refused to have further work up.

In three patients, a definite diagnosis was established by other means- one by transbronchial needle biopsy (TBNB) with a 19-guage TBNB needle that revealed a granuloma and two by VAT diagnosed of Castleman's disease and silicotic lymph node in one each.

All of the definite diagnostic specimens were obtained from the smear technique while the fluid technique yielded diagnostic result in 28.9% of patients and did not add on diagnostic result over the smear technique. According to the etiology of lymphadenopathy, TBNA had a higher diagnostic yield in malignancy than in the benign process (85.2% vs. 45.5% for malignancy and benign disease, respectively, $p = 0.01$). Lymph node size had an impact on the outcome of TBNA ($p = 0.03$) while location did not ($p = 0.38$) (Table 2).

The number of TBNA procedures performed at Ramathibodi Hospital institute increased over time as well as the authors' experience. During the first 6-months, the proportion of inadequate specimens was high, resulting in low diagnostic yield. After modifying some techniques, the frequency of inadequate specimens decreased significantly ($p = 0.03$). Although the diagnostic yield increased, it did not reach statistical significance, probably because of small sample size ($p = 0.09$) (Fig. 2).

In the present study, there were no associated bleeding complications, pneumothorax, or pneumomediastinum. Neither was there any damage to the bronchoscope.

Discussion

Despite its proven safety and usefulness, TBNA has remained a largely underutilized technique. The possible reasons for this include concern with its safety (in both the patients and the bronchoscopes), lack of familiarity with the equipment and needles, lack of expertise and training, and low yield or unpredicted results. Ramathibodi Hospital also faced these problems prior to the study.

During the first 6-months after self-learning experience in TBNA, the authors found low diagnostic yield and high frequency of inadequate specimens. Various guidance techniques such as endobronchial ultrasound (EBUS) and CT fluoroscopy guidance have been shown to be feasible and gave a significant increase in yield higher than TBNA[10-12]. Unfortunately, they were not available in Ramathibodi Hospital. ROSE

Table 2. Locations and sizes of lymph nodes examined by transbronchial needle aspiration

	Diagnosed by TBNA		p-value
	Yes, n (%)	No, n (%)	
Location			0.38
Paratracheal	8 (72.7)	3 (27.3)	
Subcarina	11 (64.7)	6 (35.3)	
Hilar	4 (100.0)	0 (0.0)	
Interlobar	4 (100.0)	0 (0.0)	
Lobar	1 (50.0)	1 (50.0)	
Size			0.03
< 20 mm	4 (44.4)	5 (55.6)	
≥ 20 mm	24 (85.7)	5 (17.2)	

was proved very useful in determining the adequacy of the sample and cost-effective[13,14]. However, due to inadequate number of cytopathologists in Ramathibodi Hospital, it was not available during the present study period and in the earlier days. By communication with cytopathologists, the authors found that the specimens were highly contaminated with bronchial cells. As evidence by full penetration of the needle through the airway wall and high bronchial cell contamination in specimen, the authors thought that the bronchial cells might obstruct the tip of the needle and the required tissue could not be aspirated in the needle. Thus, the authors flushed 1-mL of air to wash out the bronchial tissue that might plug inside the needle before manual aspiration with a 50-mL syringe. With this modified technique and the learning experience, we found that the frequency of inadequate specimens significantly decreased and diagnostic yield of TBNA increased, comparable with previous studies[10,13,15-18]. Furthermore, the authors also found that the fluid technique did not add on the diagnostic result over the smear technique. Thus, it might be disregarded, as it incurs labor costs not appropriately reimbursed.

In this group of patients, lymph node size was found to be significantly associated with TBNA diagnostic yield. The diagnostic yield is influenced by the size of lymph node in some studies[16,17], while some are not[18]. Nevertheless, the authors believe that in small lymph nodes less than 10 mm, EBUS-guided TBNA should be indicated. On the other hand, the present study did not demonstrate any significant effect of the lymph node stations on TBNA yield. Different nodal location other than upper paratracheal and

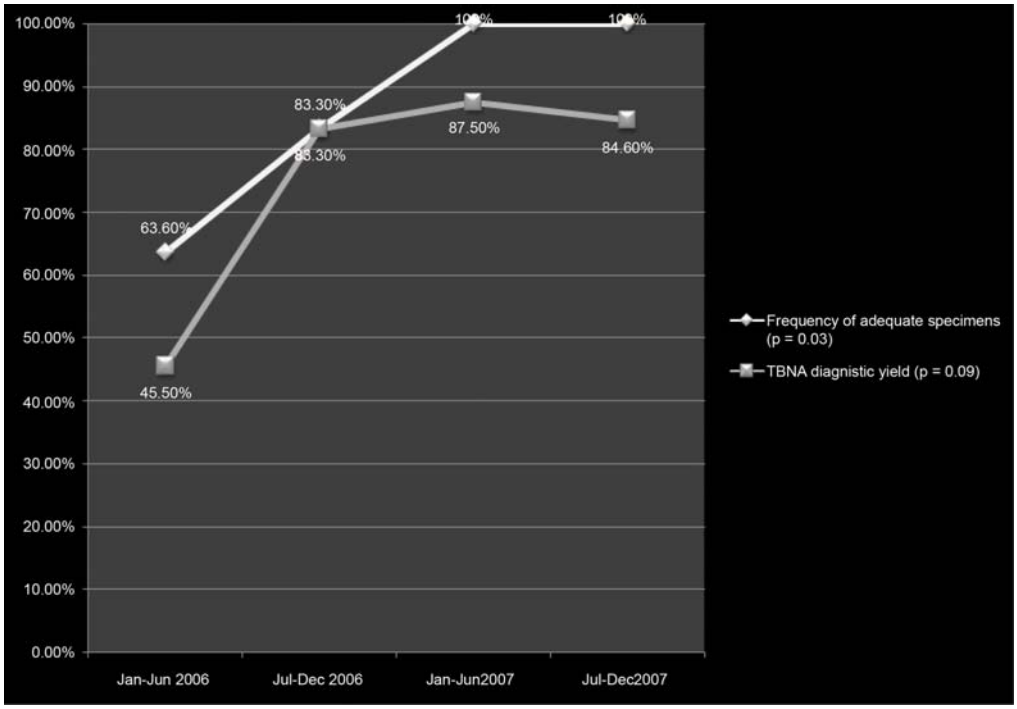

Fig. 2 A learning curve for TBNA proficiency

aorto-pulmonary window (APW) lymph node station does not affect TBNA yield in most studies[10,16-19]. Upper paratracheal station has a vague bronchological landmark while APW station locates between the great vessels; thus, EBUS-guided TBNA would be safe and useful in these stations. Herth et al[10] have demonstrated the benefit of EBUS-guided TBNA over conventional TBNA in these specific nodal stations.

Consistent with previous studies, sensitivity of TBNA for diagnosis of benign lymphadenopathy in the present study was low when compared with malignant lymph node[15,17,18]. The specific nature of the underlying pathologic change may also affect the yield of TBNA. Hence, when benign lymphadenopathy or some specific malignant diseases such as lymphoma and leukemia are suspected clinically, TBNB should be performed to obtain a histological specimen.

Although relatively small in number of patients, the authors believed our TBNA yield was constantly high compared with previous studies[10,13,15-18]. Moreover, the authors want to describe their self-learning and learning experience to encourage the pulmonologist who has less chance to learn this procedure in the training program or who is already using this technique but discouraged. Collaboration between pulmonologists and cytopathologists is essential to gain increased experience and success in TBNA.

In conclusion, TBNA is a safe and useful procedure that can be self-learned by interested pulmonologists. Practice will result in increased experience and success in TBNA.

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Conflict of interest statement

All of the authors declare that they do not have a conflict of interest and that they do not have a financial relationship with a commercial entity that has an interest in the subject of this manuscript.

Abbreviations

TBNA, transbronchial needle aspiration; ERS, European Respiratory Society; ATS, American Thoracic Society; ACCP, American College of Chest Physicians; CT, Computed tomography; FOB, fiberoptic bronchoscopy; BAL, bronchoalveolar lavage; TBB, transbronchial biopsy; ROSE, rapid on-site cytology evaluation; VAT, video-assisted thoracoscopy; TBNB, transbronchial needle biopsy; EBUS, endobronchial ultrasound; APW, aorto-pulmonary window

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ประสบการณ์การศึกษาด้วยตนเองในการทำการเจาะตรวจต่อมน้ำเหลืองในช่องทรวงอกผ่านกล้องส่องหลอดลม

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***ภูมิหลัง**: การใช้เข็มเจาะตรวจต่อมน้ำเหลืองในช่องทรวงอกผ่านกล้องส่องหลอดลมได้รับความนิยมน้อยเนื่องจากมีการสอนไม่ทั่วถึงและต้องอาศัยประสบการณ์ อุรแพทย์ที่ไม่ได้ผ่านการศึกษาจากต่างประเทศมักมีโอกาสที่จะได้รับการเรียนรู้รวมถึงประสบการณ์ในการทำหัตถการนี้น้อย*

***วัตถุประสงค์**: เพื่อประเมินประสิทธิผลจากการเรียนรู้ด้วยตนเองในการทำการเจาะตรวจต่อมน้ำเหลืองในช่องทรวงอกผ่านกล้องส่องหลอดลม*

***วัสดุและวิธีการ**: ภายหลังจากการดูเทปบันทึกการทำการเจาะตรวจต่อมน้ำเหลืองในช่องทรวงอกผ่านกล้องส่องหลอดลม และได้ฝึกในหลอดลมจำลอง ผู้ศึกษาได้ทำการเจาะตรวจต่อมน้ำเหลืองในช่องทรวงอกผ่านกล้องส่องหลอดลมในคนไข้ โดยใช้เข็มเจาะเบอร์ 21 และได้เก็บรวบรวมข้อมูลที่โรงพยาบาลรามาธิบดีโดยเริ่มตั้งแต่เดือนมกราคม พ.ศ. 2549 ถึงเดือนธันวาคม พ.ศ. 2550*

***ผลการศึกษา**: มีผู้ป่วยที่ได้รับการทำการเจาะตรวจต่อมน้ำเหลืองในช่องทรวงอกผ่านกล้องส่องหลอดลมทั้งสิ้น 38 ราย มีต่อมน้ำเหลือง 27 ต่อม (ร้อยละ 71.1) เป็นมะเร็ง และ 11 ต่อมน้ำเหลือง (ร้อยละ 28.9) ไม่เป็นมะเร็ง ในช่วง 6 เดือนแรก พบว่าประสิทธิผลของการทำหัตถการและคุณภาพของเนื้อเยื่อที่ได้ค่อนข้างน้อย จึงได้มีการปรับเปลี่ยนวิธีบางอย่างในการทำ รวมกับประสบการณ์ที่เพิ่มขึ้น ทำให้สัดส่วนของการได้เนื้อเยื่อที่ไม่เพียงพอลดลงจากร้อยละ 36.4 เป็น ร้อยละ 0 และประสิทธิผลเพิ่มขึ้นจากร้อยละ 45.5 เป็น ร้อยละ 84.6 แม้ว่าไม่ถึงระดับนัยสำคัญทางสถิติ ในการศึกษานี้ไม่พบผลข้างเคียงเกิดขึ้นทั้งกับผู้ป่วยและตัวกล้องส่องหลอดลม*

***สรุป**: การทำการเจาะตรวจต่อมน้ำเหลืองในช่องทรวงอกผ่านกล้องส่องหลอดลมเป็นหัตถการที่ปลอดภัย สามารถศึกษาได้เองในอุรแพทย์ที่มีความสนใจ ตั้งใจ และพยายาม ซึ่งประสิทธิผลของหัตถการจะเพิ่มขึ้นเมื่อมีการทำที่มากขึ้นเรื่อย ๆ*