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Chapter

Ultrasound Detection Acupuncture Needling Training: Description of the Method

Ying-Ling Chen and Mark C. Hou

Abstract

Acupuncture is unique to Chinese medicine and is widely used in practice. In order to avoid the complication of pneumothorax due to needle puncture of the lungs, we developed an ultrasound detection acupuncture (UDA) approach to measure the safe needle depth to improve patient safety. This study established a UDA training program and recruited trainees in our hospital to validate the effectiveness of the program. The trainees attended an eight-hour course, and practiced their skills using an acupuncture simulator model of GB21. Pre- and post-test data were analyzed. The level of satisfaction of the trainees was assessed by interview. In total, 16 trainees completed the course. Kendall's coefficient for the program was 0.82, and the average CVI was 0.98, showing good reliability and validity. Trainees exhibited significant improvement in terms of reduction of the incidence of pneumothorax after completing the course ($P < 0.05$), and the trainees were satisfied with the teaching of the ultrasound skill. Feedback from interviews showed that use of ultrasound to measure the safe needle depth may improve the mastery of acupuncture point GB21 and reduce the fear of causing pneumothorax.

Keywords: acupuncture, ultrasound, medical education, patient safety

1. Introduction

Acupuncture is a technique that is unique to Traditional Chinese medicine for treating illness and improving health [1]. Since it was introduced to Western countries in the 1970s, acupuncture has been widely-studied using modern clinical research approaches. In 2000, a large-scale acupuncture clinical trial was conducted in Germany due to controversy over insurance reimbursements for acupuncture treatment. According to the results of the trial, acupuncture was found to be valuable for pain relief, benefiting patients with back pain, knee pain and headache. In 2002, the World Health Organization (WHO) conducted a review of the results of controlled clinical trials, and concluded that the indications for acupuncture can be classified into four groups of disorders. The first group is diseases, symptoms or conditions for which acupuncture has been proved to be an effective management technique through controlled trials. There are 28 disorders belonging to this group, including stroke, lower back pain, headache, and hypertension [2]. In recent years, more clinical trials have been performed in patients with other disorders, such as dysmenorrhea [3]. Although the scientific community does not yet

completely understand the mechanism of acupuncture, its efficacy is widely-accepted worldwide.

As with most medical interventions, acupuncture can also cause varying degrees of side effects. In a study by White [4], the risk of adverse events occurring in association with acupuncture was found to be very low when performed by qualified practitioners. As some serious adverse events may cause life-threatening complications, it is very important to actively prevent serious side effects. Common acupuncture side effects include pain at the punctured region, ecchymosis or hematoma, lightheadedness/dizziness, and pneumothorax [4–7]. With the exception of lightheadedness/dizziness, which is more relevant to the patient's physiological condition during acupuncture, the adverse events are related to the practitioner's technique and the depths of needles at acupoints. Among the major acupuncture-related adverse events, pneumothorax is the most severe, and therefore it is crucial that acupuncture practitioners identify safe depths of insertion of acupuncture needles for individual patients. Studies by Professor Lin and colleagues have extensively investigated the safe needle depth [8–12]. In one study of 11 acupuncture points in the neck and shoulder region, they found that the mean depths for the points around the shoulder in all study subjects, regardless of BMI and gender, were as follows: GB21 = 5.6 cm, SI14 = 5.2 cm, and SI15 = 8.8 cm. Subjects with a higher BMI had greater measured depths for most points [9]. However, the researchers also pointed out that differences between individuals are present, and it is difficult to set a standard. Therefore, study has been performed using modern imaging techniques, such as tomography, nuclear magnetic resonance, and ultrasonography, to directly measure the safe needle depths at acupuncture points in patients [12]. Ultrasound-guided aspiration has been widely-used to remove extra fluid from parts of the body, such as paracentesis of ascitic fluid, thoracentesis of pleural fluid [13], insertion of small-bore chest tubes in patients on clopidogrel [14], and placement of a central venous catheter [15]. Ultrasound-aided procedures are non-invasive, and the device is easy to access and relatively simple to operate. It is therefore the most suitable technique for detecting the needle depth during acupuncture. When practitioners perform acupuncture at dangerous acupoints, ultrasound imaging can help to identify the safe needle depth and prevent damage to organs. We named this technique, which combines acupuncture with ultrasound, ultrasound detection acupuncture (UDA). Taking acupoint GB21 (Jianjing; Gallbladder 21) in the chest area as an example, ultrasound was first used to measure the distance from the skin surface at the acupoint to the pleura, and the safe needle depth at the acupoint was then defined as a distance shorter than the one measured. In this way, pneumothorax can be avoided by preventing the needle from puncturing the lung or pleural cavity, which improves the safety and quality of treatment.

This study aimed to integrate the ultrasound technique into acupuncture training, and developed a course that teaches the use of ultrasound to measure the safe needle depth at difficult acupoints (e.g., GB21). We created a model of an acupoint for the course participants to practice on, and evaluated the efficacy of the training by qualitative and quantitative assessment.

2. Educational efficacy of an ultrasound detection acupuncture program

2.1 Materials and methods

2.1.1 Participants

This study was approved by the Institutional Review Board of our hospital (IRB No.: 151211) before the study was initiated. Residents in our hospital were recruited,

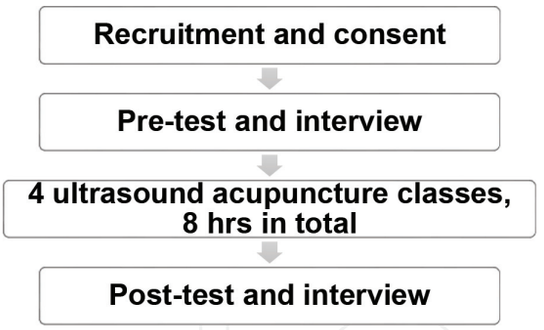


Figure 1.
Study flow chart.

the inclusion criterion being medical residents of the Department of Chinese Medicine who volunteered to participate in the training course. The participants were informed in detail about the training and completed a consent form before the start of the course. As the residents were trainees, which constitute a vulnerable group, and therefore in order to safeguard their rights, the recruitment process was publicly announced, and there was no mentor-trainee or colleague relationship between the recruiter and potential participants in order to ensure that the participants joined the study completely of their own accord.

After enrollment in the study, a pre-test and an interview were carried out for each participant, followed by a program of four 2-h ultrasound acupuncture training classes. After completion of the course, a post-test and another interview were performed to assess the efficacy of the training (**Figure 1**).

2.1.2 Development of the ultrasound detection acupuncture program

2.1.2.1 Design

A preliminary draft of the course was designed by ultrasound clinicians, clinical acupuncturists, and medical education experts, and then reviewed by a committee comprising five Chinese medical physicians qualified to teach in traditional Chinese medicine medical institutions under the regulations implemented by The Ministry of Health and Welfare, Taiwan. Course standards and DOPS (Direct Observation Procedural Skills) were then established to assess trainee skills.

Four experts were invited to serve as lecturers for the program. After the initial course content had been established, two lecturers generated teaching slides, and a test course was taught to two students. The students were then asked to provide feedback in order to improve the course, and the review committee also gave suggestions on the revision of the teaching content, enabling completion of the first draft of the course.

Next, we generated a questionnaire, which was reviewed by the five members of the review committee. The questionnaire was then revised until it passed validity and reliability testing, and the teaching content was modified to obtain the final teaching materials for the program. The classes of the program were taught by four lecturers (**Figure 2**).

Meeting agenda for course planning:

1. Clinical experience of dangerous acupoints.

2. Discussion of the ultrasound technique to be taught in the course.

3. Design of DOPS as the tool to assess the effectiveness of the course (**Table 1**).

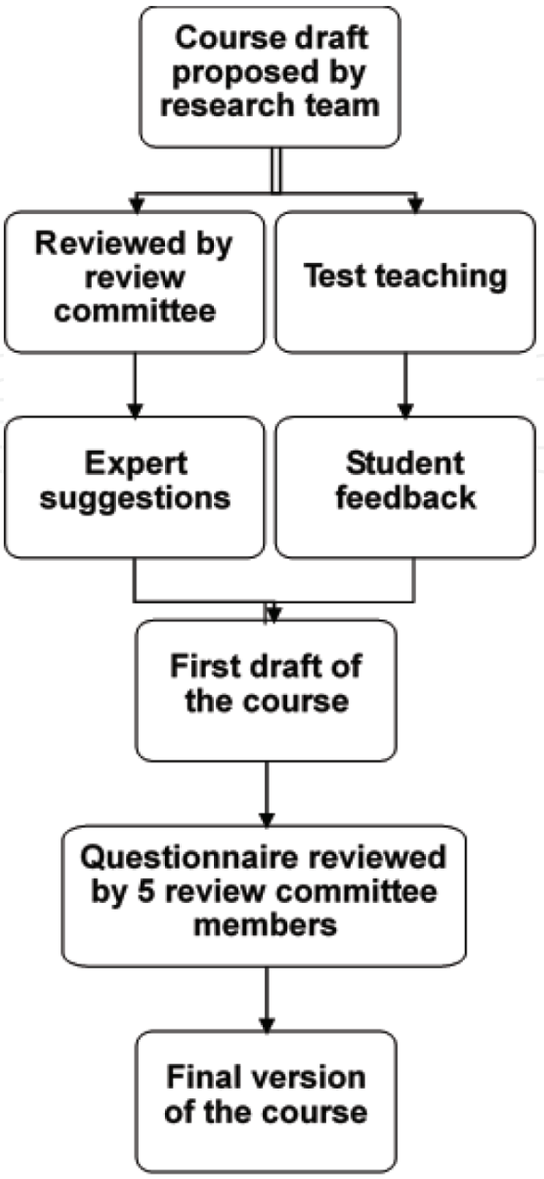


Figure 2.
Establishment of the ultrasound detection acupuncture course.

DOPS is an assessment tool developed by the Royal College of Physicians that is used to evaluate the performance of a trainee in learning a practical procedure in the United Kingdom [16]. This study used DOPS to assess the performance of the students after taking the course.

2.1.2.2 Ultrasound acupuncture course content

1. Principles and operation of ultrasound (2 h): this module of the course introduced the principles of ultrasonography in diagnosis, its use in visualizing different tissues and organs, and advanced medical ultrasound. The trainees learned the configuration and operation of a Sonosite ultrasound machine (model: NanoMaxx; Fujifilm Sonosite Inc), and had hands-on practice on an acupuncture simulator model of GB21 (ASM21), in addition to practice on a human body.

2. Patient safety and safe needle depth (2 h): clinical requirements and precautions for patient safety, introduction to simulation training, and the importance of improving patient safety.

Evaluation items	Under expected standard	Close to expected standard	Achieved expected standard	Over expected standard	Total
1. Ability in acupoint identification and acupoint selection.	☐1☐2	☐3	☐4	☐5☐6	☐
2. Ultrasound operation skills	☐1☐2	☐3	☐4	☐5☐6	☐
3. Suitable needle length selection before procedure	☐1☐2	☐3	☐4	☐5☐6	☐
4. Whether needle is placed in the correct acupoint area (simulator model sensor light on)	☐1☐		☐4		☐
5. Whether needle punctured the lung, causing pneumothorax (simulator model alarm light on)	☐1☐2		☐4		☐
6. Whether acupuncture procedure was completed within the set test time	☐1☐2	☐3	☐4	☐5☐6	☐
7. Overall assessment	☐1☐2	☐3	☐4	☐5☐6	☐
				Total score/ average	/

Table 1.
Scoring standard for acupuncture at GB21 using the direct observation of procedural skills (DOPS) tool.

3. Advanced clinical application for GB21 (2 h): the function and anatomical position of the acupoint GB21, its possible complications and their management.

4. Introduction and practice for ASM21 (2 h): the configuration of the ASM21 model and its function. The benefit and improvement in clinical skills when used in combination with ultrasonography. The importance of implantation of simulation in learning.

In this study, GB21 was used as the target acupoint, and ASM21, an acupuncture simulator model of GB21, was developed to help the trainees to easily manage this acupoint (**Figure 3**). The ASM21 model was designed with a sensor that detected whether the needle was placed in the correct position and within a safe depth, and an alarm sounded when the needle reached the lung. As it was constructed with material that is penetrable by ultrasound, the trainees could also measure the safe needle depth when the model was used together with an ultrasound machine.

2.1.2.3 Reliability of the ultrasound acupuncture course

We used the inter-rater reliability and employed Kendall's coefficient of concordance (W) for statistical analysis according to the scores given by the raters, as shown below:

$$W = \frac{R_i^2 - 1\frac{(R_i)^2}{N}}{\frac{1}{12}K^2\left(N^3 - N\right)} \quad (1)$$



Figure 3.
Acupuncture simulator model of GB21 (ASM21) equipped with a sensor detector light alarm.

Where R_i^2 = the total sum of the squares of the scores given by the raters; $(R_i)^2$ = the square of the sum of the scores from each rater; N = number of trainees being evaluated; K = number of raters (experts).

We analyzed the W values of the trainees in the four classes. W values greater than 0.8 indicated good reliability.

2.1.2.4 Validity of the ultrasound acupuncture course

The course validity was calculated using the content validity index (CVI). The CVI method determines the ratio of experts who are in agreement with one another, and allows several raters to independently review the test items and evaluate the performance of the trainees. Briefly, for each test item, a scale of 4 was used for the rater response, responses of 1 and 2 indicating items that are 'invalid', and responses of 3 and 4 indicating 'valid' items. During the analysis, the four ordinal response rankings were then collapsed into two dichotomous categories of responses (score of invalid item = 0; score of valid item = 1), and the CVI of individual items was obtained. The CVI of the overall scale (S-CVI) was then calculated as:

$$S - CVI = \frac{CVI_i}{N} \tag{2}$$

where CVI_i is the sum of individual item CVIs and N is the total number of items. An S-CVI of 0.8 or higher indicated an acceptable validity. This study used IBM SPSS version 25 for quantitative statistical analysis.

2.1.3 Effectiveness assessment

2.1.3.1 Evaluation process

1. Pre-test: the trainees conducted acupuncture at the GB21 acupoint using the ASM21 model without ultrasound, and the frequency of occurrence of pneumothorax (needle puncture of the lung) was recorded on the DOPS form.

2. Pre-test interview: interviews were conducted with the trainees, which focused on acupuncture clinical skills and recorded their thoughts on and difficulties in performing acupuncture at the GB21 acupoint.

3. The trainees attended four classes, totaling an eight-hour course. They were asked to complete a satisfaction survey, and undertook two acupuncture practice sections with ultrasound.

4. Post-test: the trainees performed acupuncture at the GB21 acupoint using the ASM21 model without ultrasound, and the frequency of pneumothorax was recorded.

5. Post-test interview: interviews were conducted with the trainees to record their learning experience and thoughts.

6. Ultrasound acupuncture technical operation procedure: (i) identify GB21 on ASM21; (ii) use ultrasound to measure the distance from the surface to the lung, and use a depth shorter than this measurement as the safe needle depth; (iii) select a needle of appropriate length (the needle body must not exceed the above recorded depth); (iv) use a 28-gauge stainless steel acupuncture needle to perform the procedure; and (v) the test duration was defined from the first use of the needle to when the needle reached GB21 or punctured the lung.

2.1.3.2 Analyses of the results

The pre-test and post-test data were compared. Trainee feedback was also analyzed in order to evaluate the efficacy of the course using the methods described below:

1. Test methods: due to the small number of samples, and the fact that the data were not normally distributed, the Mann-Whitney U test and Fisher's exact test were used to determine whether the trainee skills at GB21 improved after taking the course.

2. Comparison of attendance and performance: the number of times that the needle punctured the lung was compared with the attendance rate by Fisher's exact test.

3. Effect of ultrasound class attendance: the number of times that the needle punctured the lung was compared with the attendance rate at the ultrasound class using Fisher's exact test.

4. Effect of ultrasound skills: the number of times that the needle punctured the lung was compared with the trainee's ultrasound skills using Fisher's exact test.

5. Practice and performance: the relationship between practice and performance was examined by comparing the trainees' practice simulations and the number of times that puncture of the lung occurred using Fisher's exact test.

6. Practice and ultrasound skills: whether the improvement in ultrasound skills was correlated with the number of practice sessions was examined using Fisher's exact test.

2.2 Results

2.2.1 Trainee recruitment

The study recruited 17 trainees, all of whom were residents at the Chinese Medicine Department of our hospital. One of the trainees was not able to attend all the classes and complete the test; therefore, a total of 16 participants, 8 males and 8 females (aged 31.63 $\pm$ 4.46 years), completed the program and were included in

this study. Of them, one was a dual-licensed Chinese and Western medical physician, and the remaining 15 were all licensed Chinese medical practitioners (**Table 2**).

2.2.2 Ultrasound detection acupuncture course

2.2.2.1 Expert advice given during course planning meetings and feedback from trainees

During course planning, several experts suggested that more detailed information about the clinical effects of the advanced application of the GB21 acupoint should be introduced to the trainees, and a half-hour practice session for acupoint selection should be added to the course. As ultrasonography is a relatively unfamiliar technique for Chinese medicine practitioners, in addition to the principles taught in class, the experts also recommended that the trainees be given extra time to practice using the ultrasound machine as per the individual needs of the trainees. The identification of suitable teaching staff for the technique was also important and the process of selection of teaching staff needed to be confirmed.

2.2.3 Reliability and validity analyses

Reliability was determined according to the *W* value of the questionnaires from the raters. A *W* value of 0.821 was obtained, and the inter-rater reliability was between 0.71 and 0.9 ($P < 0.05$), suggesting that the five raters had a high degree of consistency in scoring the performance of the trainees. The results indicated that the ultrasound-guided acupuncture course had an excellent reliability and the design of the teaching materials was appropriate.

The S-CVI values of the five experts were 1, 1, 1, 0.9, and 1, all higher than 0.80, with an overall average of 0.98. This demonstrated that the course had an excellent validity, and that the course design achieved a high standard (**Table 3**).

Based on the results of the course planning meeting, as well as the reliability and validity analyses, the ultrasound-guided acupuncture course was designed to include four modules, which were taught in four different classes: "Introduction and operation of ASM21", "Advanced clinical application of the GB21 acupoint", "Patient safety and safe acupuncture needle depth", and "Principles and application of ultrasonography".

	n	**Percentage (%)**
Gender		
Male	8	50
Female	8	50
Age (years)		
21–30	7	43.75
31–40	8	50
>41	1	6.25
Had Western medical license	1	6.25

Table 2.
Demographic information of the trainees in this study

2.2.4 Assessment of student learning effectiveness

In the pre-test, the trainees had not learned the ultrasound technique, and therefore item 2—"Ultrasound operation skills" was not included for evaluation on the DOPS form. The average DOPS score in the pre-test was 3.0 ± 0.6. After the 16 trainees had attended the four classes, the average post-test score, which included item 2, was 3.8 ± 0.3. The Mann-Whitney U test (two-tailed) showed that the scores differed significantly between pre- and post-test ($P < 0.05$; **Table 4**). Overall, the use of ultrasound effectively helped the trainees to avoid the complication of pneumothorax when performing acupuncture at the GB21 acupoint.

2.2.5 Pre- and post-test interviews

The pre-test interviews indicated that most of the trainees did not have experience in performing acupuncture at the GB21 point prior to taking this course, and were afraid of causing pneumothorax when performing acupuncture at acupoints near to the chest. To assess the satisfaction of the trainees following the course, they were asked to complete a questionnaire after each class. For the four classes, 8, 10, 14, and 12 completed questionnaires were received.

Feedback was also obtained from the trainees during the post-test interviews, and some useful suggestions were collected as a reference to improve the program, as listed below (**Figure 4**).

2.2.6 Correlations between course attendance and post-test results

In this program, the trainees were free to participate in the classes according to their individual schedules. Due to the fact that the working hours and locations of the hospital residents might change, some trainees were unable to attend the entire course. The attendance rate and frequency of practice using the ultrasound instrument are presented in **Table 5**. When a trainee was not able to attend a class, video recordings and slides were provided for self-learning. Of the original 17 trainees recruited to this study, one withdrew; therefore, the data of 16 trainees were included for analysis.

Expert no.	S-CVI value
1	1
2	1
3	1
4	0.9
5	1
Average	0.98

Table 3.
S-CVI values obtained from the five experts as raters in this study.

	Pre-test (n = 16)	Post-test (n = 16)	P-value
Average score	3.0 ± 0.6	3.8 ± 0.3	0.00054*

Table 4.
Comparison of pre- and post-test scores by the Mann-Whitney U test (two-tailed).

Nine trainees attended the "Introduction and operation of ASM21" class (attendance rate = 56%); 12 trainees attended the "Advanced clinical application of GB21" class, but one left early (attendance rate = 69%); 12 participated in the "Patient safety and safe needle depth" class (attendance rate = 75%); and 15 participated in the "Principles and application of ultrasonography" class, but one left early (attendance rate = 88%). The average attendance rate was 75 ± 0.25%. The total number of trainees who practiced using the ultrasound instrument was 12, accounting for 75% of the total number of participants (**Table 5**).

There was no incidence of puncture of the lung during use of the ASM21 model. To test whether attendance at the course was correlated with post-test performance, Fisher's exact test was performed, and showed that P = 1.0, indicating that class attendance had no significant association with the incidence of lung puncture. Additionally, analysis of the relationship between attendance at Class 4 ("Principles and application of ultrasonography") and the incidence of lung puncture also demonstrated that no correlation existed (P = 1.0). Further analysis indicated that acquisition of a good ultrasound technique reduced the incidence of lung puncture ($P < 0.05$), suggesting that acquisition of ultrasound skills helped to prevent

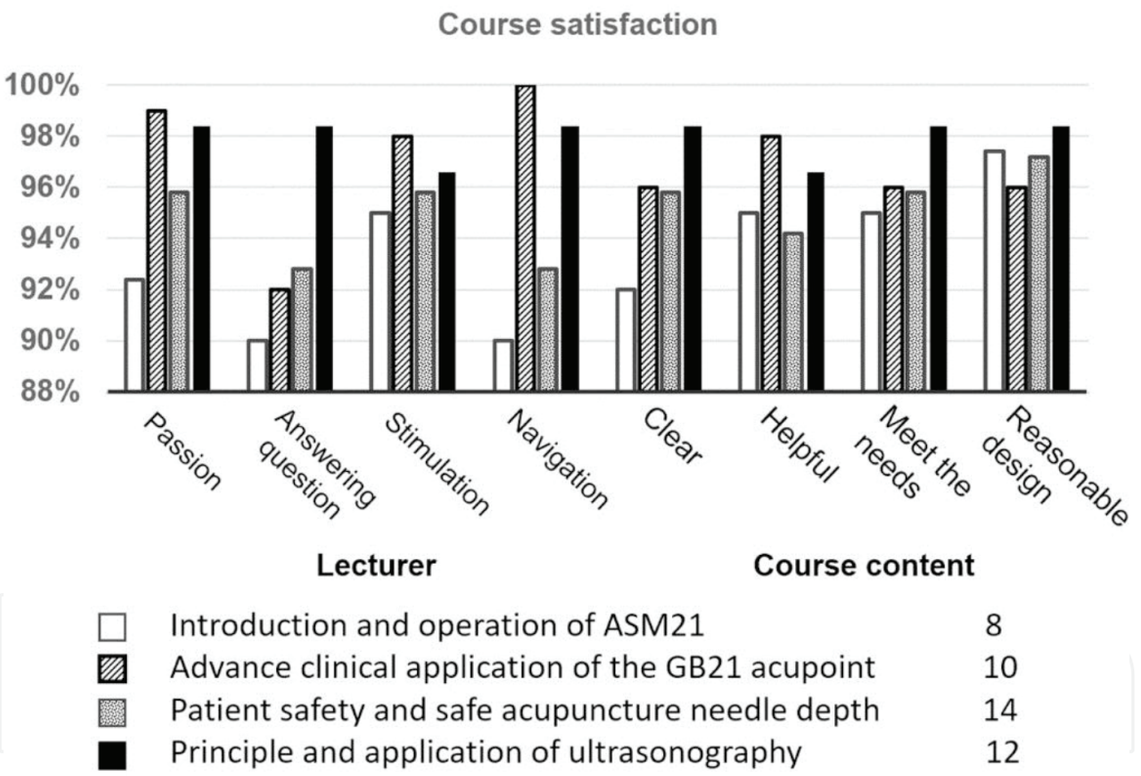


Figure 4.
Course satisfaction survey.

Item	P-value
Attending all classes *vs.* performance	1
Attending ultrasound class *vs.* lung puncture	1
Acquisition of ultrasound skills *vs.* lung puncture	1.6121e−05***
Practice using ultrasound instrument *vs.* lung puncture	1

*Fisher's exact test (*** $P < 0.001$).*

Table 5.
Correlation analyses of trainee course attendance with post-test results.

pneumothorax post-test. Finally, no significant relationship was found between practice using the ultrasound machine and puncture of the lung.

Correlation between practice using the ultrasound instrument and improvement of ultrasound skills.

According to the second item (ultrasound skills) on the DOPS scale (score range = 1–6), the post-test score distribution of the trainees was 3–5. Three trainees had a score of 3 (2 had practiced using the instrument, 1 had not); 12 trainees had a score of 4 (9 had practiced, 3 had not), and one had a score of 5 (who had practiced). Fisher's exact test showed that practice using the ultrasound instrument was not correlated with improvement of ultrasound skills. In the post-test, the depth measurements at acupoint GB21 obtained by seven trainees were 3.0, 3.0, 3.2, 3.3, 3.5, 3.8 and 5.0 cm; the average depth was 3.5 ± 0.7 cm, which was very close to the actual depth of 3.5 cm. The depth measurement of 5.0 cm was much larger than the

Class	Case numbers	Interview key content
General	107010818010	I used to utilize oblique insertion and avoid dangerous acupuncture points. Now, I am glad that ultrasound can assist practitioners in precisely placing acupuncture needles, and reduce the fear of performing acupuncture at difficult points. In order to make this course more meaningful, I suggest having a qualifying examination after the course
Class 1: introduction and operation of ASM21	107010918005	Trainees were curious about using the ASM21 model to practice acupuncture ASM21 allows us the opportunity to practice very well at GB21. As GB21 is not often used clinically, performance in reality is rarely seen. I am looking forward to practicing at this point. Patient safety has always been an important principle in medical ethics
Class 2: advanced clinical application of the GB21 acupoint	107020618004	Trainees had the opportunity to further understand the timing of using GB21, and learn how pneumothorax can occur and its management Training helped us to understand that a needle at the acupuncture point GB21 will reach the pleura at a certain depth (about 2–3 cm), and insertion of the needle to a deeper position will penetrate the lung. Studies from Western medicine also showed that even anesthesia cannot block the pain at this point
Class 3: patient safety and safe acupuncture needle depth	107030818012	Trainees improved their knowledge of the safe needle depth, and learned about pneumothorax complications caused by acupuncture from cases of evidence-based medicine Learning of personal experience from the lecturer about acupuncture-caused pneumothorax was impressed. This highlighted that the needle depth is critical during acupoint selection in clinical practice
Class 4: principles and application of ultrasonography	107040918001 107040918012	Following hands-on operation, the trainees gave positive feedback on the use of ultrasound to detect the safe needle depth for acupuncture The ultrasound device is simple and easy to use, and effectively prevents pneumothorax. It was a novel experience to use ultrasound, especially its application in acupuncture in the clinical setting

Table 6.
Interview records from trainees.

other measurements, and the trainee who made this measurement had not practiced using the ultrasound instrument and had a poor ultrasound skills score. If this outlier value was removed, the average depth was 3.3 ± 0.3 cm.

The average duration of operation of the ultrasound instrument by the trainees was 87 ± 42 s (ranging from 45 s to 2 min and 9 s).

2.2.7 Post-test interview

After attending the course, the trainees expressed that it helped them to reduce their fear of performing acupuncture at the GB21 point, and practice using the ASM21 model helped to improve their self-confidence. Some positive feedback received is presented below:

With the assistance of ultrasound, the depth of the GB21 point can be easily identified. It helps to choose the correct length of needle. By using a proper needle, it prevents causing the problem of puncturing the lung (10704201801001) (**Table 6**).

During the pre-test, I did not know what I was doing as I was full of fear. I never perform acupuncture at the GB21 point, and was therefore very nervous. During the post-test, I felt it was quite an interesting task, as I am more self-confident and can perform it immediately without delay (10704201800901).

When I perform acupuncture at points in the chest, I will double-check by using ultrasound, especially if the patient is elderly, a young woman or a child (10704201801703).

I wish that ultrasound could be more popularized. I will use it in the clinic, especially at those acupuncture points with a high risk of causing an accident. For the common points, I will not use it as it takes time to use it (10704201800203).

2.3 Discussion

UDA is an innovative acupuncture technique. It employs modern ultrasound technology to inject new vitality into this ancient medical system. UDA may reduce the risk of complications at difficult acupoints, such as pneumothorax. It can improve patient safety, and render acupuncture at several important but difficult and less-used acupoints (e.g., Gaohuangshu BL-43, and Back-Shu points) more easily performed by acupuncture practitioners. This will help the advantages of traditional acupuncture to be restored and preserved.

In this study, we developed a program that employed ultrasound technology during training in the use of difficult acupuncture points. In the course described in this study, the focus was the Jianjing point GB21. The course included four 2-h classes: “Introduction and operation of ASM21”, “Advanced clinical application of GB21”, “Patient safety and safe needle depth”, and “Principles and application of ultrasonography”. The design of the course aimed not just to teach trainees to operate the ultrasound instrument and the ASM21 model, but also to educate them about patient safety and the safe needle depth at the GB21 acupoint.

According to the satisfaction survey completed by the trainees who undertook the course, the trainees showed high interest in two of the classes in particular: “Advanced clinical application of GB21” and “Principles and application of ultrasonography”. This might be due to these two classes being directly correlated with clinical application, while the other two classes were related to simulation education and medical quality, which hospital residents are often less interested in. In the post-test interviews, most of the trainees were positive about integrating the ultrasound technique into the teaching of acupuncture. As ultrasound imaging helps

them to clearly identify the position of the lungs, it improved their confidence in performing acupuncture at the GB21 point. Most of the trainees who attended the course expressed that if the hospital could provide an ultrasound instrument at their out-patient clinic, they would be willing to apply the UDA knowledge they had learned from the course in patient practice.

Currently, the largest barrier to Chinese medicine practitioners or acupuncturists using ultrasound is the high cost of the instrument. Even an entry-level new machine will cost more than $10,000 USD. At this moment, with the exception of large hospitals or medical centers, most small clinics are not able to afford to install this instrument at their practice locations. To solve this problem and enable UDA to be widely-used, the purchase of used ultrasound instruments is an option. Alternatively, the development of a low-cost, small-sized simple ultrasound instrument without an imaging function (such as the Butterfly IQ [17], which can easily detect the needle depth), should be considered.

Education in traditional Chinese medicine is still relatively conservative in comparison with modern medical education. Although acupuncture is considered a less invasive therapy, it does require thousands of hours of training to gain the proper skills. However, education in acupuncture still very rarely uses modern teaching aids to assist learning, and especially rarely uses simulation-based learning. These issues are in urgent need of improvement. This study utilized an innovative method that integrated a simulator that mimicked the chest body part and modern ultrasound technology to help trainees to learn how to safely perform acupuncture at the GB21 point. The UDA approach allows greater application of the traditional acupuncture points in therapy, as many of the difficult points are known to be very important, but it is difficult to master the necessary skills. We used UDA in acupuncture education, emphasizing patient safety, which differed from traditional acupuncture education, which mainly focuses on classroom teaching and observational learning [18, 19]. The outcomes of this study indicated that new teaching methods are required for education in acupuncture, as the conventional education system for acupuncture is known to have many problems and needs to be improved [20, 21].

The introduction of a body part model in acupuncture education is very useful for the learner. Body parts or organ sets have been created, and others have developed a 3-D interactive virtual environment, phantoms or integrated platforms to assist learners in acupuncture training [22–25]. However, such types of models or virtual training simulation systems still cannot provide sensations similar to those felt when practicing on the human body. We developed the ASM21 model using material that could be punctured by stainless steel acupuncture needles and that was penetrable by ultrasound. Integrating this material with a sensor detector and a light alarm, the goal was to allow the learners to practice on an object similar to a patient in clinic, and to measure the needle depth by ultrasound. Using a high-quality simulator with a realistic chest model, learners are able to perform sufficient practice before applying UDA in actual patients. Rehabilitation medicine has attempted to incorporate acupuncture as one of its therapy techniques, and has integrated acupuncture with the ultrasound technique [26]. However, that application mainly focuses on soft tissue-related diseases, such as muscle and tendon disorders. Neither patient safety nor the theory of the Meridians has been paid attention to. From a different aspect, in the present study, we used the theory of traditional Chinese medicine and considered patient safety to promote acupuncture modernization.

Although Chinese medicine has a long history, its modernization has followed a difficult path. In the development of the UDA training course, we had a great

appreciation of the obstacles faced. Modern medicine is closely integrated with modern science; modern medicine keeps pace with the development of science-based technology, and new technology is used to develop new products and treatments to improve patient care. However, the majority of Chinese medicine practitioners do not pay attention to new technology. Many researchers have continued to work hard to improve this dilemma [27–29], while more Chinese medicine peers are still needed to join in the modernization. The ASM21 model developed in this study can be further improved to incorporate ultrasound techniques by collaborating with medical engineering manufacturers, which might create a new path for the development of technology for use in the application of Chinese medicine.

The outcomes of our study show promise. However, there were some limitations. First, this study was an educational study conducted in a single group, i.e., hospital residents, and was not a randomized controlled trial. The small sample size was also a limitation.

However, by using qualitative and quantitative analyses to validate the efficacy, the results are still valuable, and can be taken as a useful reference for developing similar courses. The significant improvement in score after the trainees had attended the course indicated a well-designed course, which can help to reduce the risk of pneumothorax, a complication of acupuncture at difficult chest acupoints. Both the attendance rate and practice of the ultrasound technique were independent of the reduction in the incidence of pneumothorax, suggesting that the use of ultrasound is key to reducing the incidence of this complication. As the operation of the ultrasound instrument is simple, no special repeat practice is required, which is a significant advantage of UDA that should be promoted in the future. The trainees only need to learn to measure the safe depth of the needle, rather than being familiar with diagnostic sonography. Based on the outcomes and the feedback obtained from the trainees, the course could be shortened by focusing on the operation of the ultrasound instrument and practice using the simulator. In terms of satisfaction, the post-test interviews demonstrated that the trainees gave the highest ratings for the course, indicating that the course design was successful.

In conclusion, a course design for acupuncture training needs to include practice using a simulator, which can greatly enhance the interest and motivation of the trainees. In the interviews, several trainees suggested that acupuncture clinical instructors should receive UDA training, which showed that they were not satisfied with the conventional educational approach. Some trainees also had different opinions to those of the lecturers for the classes, suggesting that the new generation no longer fully accepts the arrangements of traditional education. In order to achieve the goal of a high level of education, it is necessary to implement more communication between teachers and students in the current medical education setting.

3. Conclusion

3.1 UDA

UDA, by introducing ultrasound into acupuncture practice, will be a revolution technique for traditional acupuncture. UDA can not only reduce the risk of severe advertise effect when needing dangerous points, but also increase the usage of some important points traditionally, such as GB21 and BL43. We proposed the standard operating procedure for UDA and developed a course for UDA training. A video demonstration could be found at the web www.Dr-Hou.com. We truly hope that UDA would be widely accepted and performed popularly everywhere in acupuncture practice.

3.2 Future work

In order to prompt UDA further, a specific and affordable ultrasound devise is urgent needed. All the ultrasound devises available are too complicated and expensive for acupuncturists. We are currently in cooperation with medical engineers to develop a UDA special ultrasound. This ultrasound devise for safety depth (USD) will be a handy and useful devise specially designed to measure the safe needling distance of dangerous points. We believe that only by introducing and developing new ideas and practices can renew and update acupuncture. Thus an energetic and a fresh acupuncture can be presented to the world.

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Conflict of interest

There is no financial relationship to disclose.

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References

[1] Hsu ES, Wu I, Lai B. Acupuncture. In: Essentials of Pain Medicine. Fourth Edition. 2018:545-550

[2] Organization WH. Acupuncture: Review and Analysis of Reports on Controlled Clinical Trials. Geneva: World Health Organization Available at: http://wwwiamaedu/OtherArticles/acupuncture_WHO_full_reportpdf; 2002 [Accessed Jan, 1 2018. 2016;31]

[3] Witt CM, Reinhold T, Brinkhaus B, Roll S, Jena S, Willich SN. Acupuncture in patients with dysmenorrhea: A randomized study on clinical effectiveness and cost-effectiveness in usual care. American Journal of Obstetrics and Gynecology. 2008; **198**(2):166. e1-166. e8

[4] White A. A cumulative review of the range and incidence of significant adverse events associated with acupuncture. Acupuncture in Medicine. 2004;**22**(3):122-133

[5] Melchart D, Weidenhammer W, Streng A, Reitmayr S, Hoppe A, Ernst E, et al. Prospective investigation of adverse effects of acupuncture in 97 733 patients. Archives of Internal Medicine. 2004;**164**(1):104-105

[6] Ernst G, Strzyz H, Hagmeister H. Incidence of adverse effects during acupuncture therapy—A multicentre survey. Complementary Therapies in Medicine. 2003;**11**(2):93-97

[7] Shinbara H, Ogasawara C, Hayama S, Hino K, Taniguchi H, Sumiya E. A survey of adverse events at acupuncture and moxibustion clinics in Japan. Journal of the American Medical Association. 2012;**2**:31-40

[8] Chou P-C, Huang Y-C, Hsueh C-J, Lin J-G, Chu H-Y. Retrospective study using MRI to measure depths of acupuncture points in neck and shoulder region. BMJ Open. 2015;**5**(7): e007819

[9] Lin J-G, Chou P-C, Chu H-Y. An exploration of the needling depth in acupuncture: The safe needling depth and the needling depth of clinical efficacy. Evidence-Based Complementary and Alternative Medicine. 2013:1-21

[10] Chou P-C, Chu H-Y, Lin J-G. Safe needling depth of acupuncture points. The Journal of Alternative and Complementary Medicine. 2011;**17**(3): 199-206

[11] Chen H-N, Lin J-G, Ying L-C, Huang C-C, Lin C-H. The therapeutic depth of abdominal acupuncture points approaches the safe depth in overweight and in older children. The Journal of Alternative and Complementary Medicine. 2009;**15**(9):1033-1037

[12] Chen H-N, Lin J-G, Yang AD, Chang S-K. Safe depth of abdominal acupoints in pediatric patients. Complementary Therapies in Medicine. 2008;**16**(6):331-335

[13] Dattola A, Alberti A, Giannetto G, Di DM, Basile G. Echo-guided percutaneous drainage of abscesses and abdominal fluid collections. Annali Italiani di Chirurgia. 1999;**70**(2):161-167

[14] Dammert P, Pratter M, Boujaoude Z. Safety of ultrasound-guided small-bore chest tube insertion in patients on clopidogrel. Journal of Bronchology & Interventional Pulmonology. 2013; **20**(1):16-20

[15] Ajayi G. Ultrasonography-guided amniocentesis in singleton pregnancies: A review of the first 1,000 cases. Clinical and Experimental Obstetrics & Gynecology. 2011;**38**(4):405

[16] Wilkinson JR, Crossley JG, Wragg A, Mills P, Cowan G, Wade W. Implementing workplace-based assessment across the medical specialties in the United Kingdom. Medical Education. 2008;**42**(4):364-373

[17] ButterflyIQ. Meet IQ. Available from: https://www.butterflynetwork.com/

[18] Yeh GY, Ryan MA, Phillips RS, Audette JF. Doctor training and practice of acupuncture: Results of a survey. Journal of Evaluation in Clinical Practice. 2008;**14**(3):439-445

[19] Janz S, Adams J. Acupuncture education standards in Australia: A critical review. Australian Journal of Acupuncture and Chinese Medicine. 2011;**6**(1):3

[20] Flaws B. American acupuncture education: Has a wrong turn been taken? American Journal of Acupuncture. 1991; **19**(1):63-71

[21] Ijaz N, Boon H, Muzzin L, Welsh S. State risk discourse and the regulatory preservation of traditional medicine knowledge: The case of acupuncture in Ontario, Canada. Social Science & Medicine. 2016;**170**:97-105

[22] Heng P-A, Wong T-T, Yang R, Chui Y-P, Xie Y-M, Leung K-S, et al. Intelligent inferencing and haptic simulation for Chinese acupuncture learning and training. IEEE Transactions on Information Technology in Biomedicine. 2006;**10**(1):28-41

[23] Leung K-M, Heng P-A, Sun H, Wong T-T. A haptic needle manipulation simulator for Chinese acupuncture. Studies in Health Technology and Informatics. 2003: 187-189

[24] Lee I-S, Lee T, Shin W-C, Wallraven C, Lee H, Park H-J, et al. Haptic simulation for acupuncture needle manipulation. The Journal of Alternative and Complementary Medicine. 2014;**20**(8):654-660

[25] Si W, Yuan Z-Y, Mao R, Zhao J, Liao X, Duan Z. Modeling and realization of virtual acupuncture training simulation system. JDCTA. 2010;**4**(8):126-136

[26] Litscher G. Modernization of traditional acupuncture using multimodal computer-based high-tech methods—Recent results of blue laser and teleacupuncture from the medical University of Graz. Journal of Acupuncture and Meridian Studies. 2009;**2**(3):202-209

[27] Litscher G, Huang T, Wang L, Zhang W. Violet laser acupuncture—Part 1: Effects on brain circulation. Journal of Acupuncture and Meridian Studies. 2010;**3**(4):255-259

[28] Wu J, Hu Y, Zhu Y, Yin P, Litscher G, Xu S. Systematic review of adverse effects: A further step towards modernization of acupuncture in China. Evidence-Based Complementary and Alternative Medicine. 2015:1-19

[29] Castro JA. Integrating acupuncture in the physical medicine and rehabilitation setting. Critical Reviews™ in Physical and Rehabilitation Medicine. 2005;**17**(4):301-316