Development of a medical education program with abdominal palpation simulators to support the understanding of traditional Japanese (kampo) medicine in beginners

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ABSTRACT

Aim: Traditional Japanese (kampo) medicine has recently been included in the medical education curriculum in Japan; hence, an education program in kampo physical examination for beginners is needed. The aim of the present study was to develop an education program using a simulator of kampo abdominal palpation that would enable beginners to acquire this skill, and to assess the effectiveness and usefulness of the education program.

Methods: First, we conducted a preliminary trial. Fifteen beginners received a lecture about abdominal findings and the associated representative kampo formulas and underwent a simulator palpation test. Following this trial, we created and conducted a 1 day education program as a prospective study. The program included a general lecture on physical examination in kampo medicine, followed by a pre-test assessment involving palpation of the simulators, a specific lecture about abdominal palpation, and finally a post-test assessment. The pre- and post-test accuracy rates were evaluated.

Results: High accuracy rates were obtained in the preliminary trial, but the research protocol did not enable an assessment of the effectiveness or usefulness of the trial. In the subsequent education program, 41 participants had significantly higher accuracy rates after the lecture than before the lecture, in both abdominal findings (from 78.2% to 94.4% on average, \( P < 0.001 \)) and in the associated representative kampo formulas (from 21.8% to 59.7% on average, \( P < 0.001 \)).

Conclusion: An education program using simulators for kampo abdominal palpation can be effective and useful for beginners in kampo medicine.

KEY WORDS: abdominal palpation, kampo medicine, pre-graduate education, simulation-based medical education, simulator

INTRODUCTION

The role of traditional Japanese (kampo) medicine has recently grown in Japanese medical education. The Ministry of Education, Culture, Sports, Science and Technology of Japan (MEXT) revised the Model Core Curriculum (MCC) for Medical Education in Japan in 2016, and competency in kampo medicine was defined as follows: ‘The medical students can describe the characteristics of kampo medicine, and the indication and pharmacology of representative kampo formulas.’ [1]. The document ‘Basic Medical Education: Japanese Specifications, World Federation for Medical Education Global Standards for Quality Improvement’ mentions that ‘the medical school should describe the interface with complementary medicine which would include unorthodox, traditional or alternative practice in the medical education curriculum.’ [2,3]. The current MCC for pharmacy, dental, and nursing education also refer to kampo medicine [4,5]. Therefore, the role of
kampo medicine in pre-graduate health-care education needs to be enhanced.

In modern medical education and clinical clerkship, simulation-based training has gradually assumed an important role. Training using simulators has been proven to improve the clinical examination skills of the trainees: For example, simulation models were developed for cardiac auscultation [6], breast examination [7], and vaginal examination [8]. In Japan, the latest MCC mentioned simulator-based education in clinical clerkships for those physical examination skills that cannot be sufficiently learned in a real clinical environment due to excessive risk and burden on patients [1].

In kampo medicine, specific methods of abdominal examination are one of the fundamental skills needed to diagnose a patient’s systemic physiological state and to determine an appropriate kampo formula. A physician palpates the patient’s abdomen in the supine position with the legs extended and evaluates abdominal strength (elasticity of the abdomen) and the discomfort and resistance associated with pressure exerted on specific abdominal regions. *Fukushokiran*, written at the end of the 18th century, demonstrated the major kampo formulas and the associated abdominal findings (Fig. 1) [9]. This illustrated textbook teaches us how to associate each specific abdominal finding with a kampo formula, and kampo physicians currently practice kampo medicine according to such associations.

Methods of abdominal palpation are difficult to teach, because the palpation pressure is subjective and dependent on the physician’s sensations. During daily training in kampo medicine, healthy volunteers and patients undergo abdominal examination, but abdominal findings depend on the examinees, and even the findings on the same examinee could change after repeated palpations. Furuya reported that some abdominal evaluations were not consistent when different expert kampo doctors palpated the same examinee [10]. Such uncertainty in abdominal findings is an important clinical issue, and the standardization of abdominal examinations is therefore considered of critical importance.

Yakubo et al. developed a simulator of kampo abdominal palpation for standardized education (Fig. 2). It is a manikin replicating the adult male abdomen from the level of the nipples to 30 cm below the umbilicus. Multiple types of simulators were developed for various types of abdominal findings and abdominal strengths [11,12], and 78.6% of kampo educators in medical faculties considered them useful [13]. Medical students with little abdominal palpation experience became aware of its importance through medical education using abdominal simulators [14]. There have been no reports, however, investigating the effectiveness of a lecture program using the abdominal simulators.

The aim of the present study was therefore to develop an education program in which abdominal simulators would be used to enable the students to acquire skills in abdominal palpation and in the association between abdominal findings and kampo formulas. The study also assessed the effectiveness and usefulness of such an education program. We conducted two different trials. First, we conducted a preliminary trial using the simulators. We then created and conducted an education program protocol to assess the ensuing acquisition of abdominal palpation skills.

**METHODS**

**Preliminary trial**

**Subjects**

Participants in the kampo seminar held at Tohoku University Clinical Skills Laboratory in October 2014 were included in this trial. These were health-care workers and medical students interested in kampo medicine.

**Simulators**

For this trial we used seven types of simulators. Two simulators were used to represent different abdominal strengths:
deficiency pattern (weak) and excess pattern (strong). The other five simulators were used to simulate the following pathological abdominal findings: hypochondriac discomfort and resistance (*kyokyo-kuman*), abdominal muscle tension (*fukuchokukin-renkyu*), epigastric discomfort and resistance (*shinka-hiko*), weakness of the lower abdominal region (*shofuku-fujin*), and lower abdominal resistance and fullness (*shofuku-koman*). We gave the seven simulators a number from Sim 1 to Sim 7 in the aforementioned order. All the simulators were made by Nomura Techno (Tokyo, Japan).

**Tests**

We created a multiple-choice test on the abdominal findings and the kampo formulas associated with the simulators (Table 1). Two questions about every simulator were asked, concerning the abdominal findings and the associated representative kampo formula, as documented in the kampo textbooks [15,16]. We assigned the following kampo formulas to each simulator (Sim 1–7), respectively: hochuekkito, daisaikoto, shosaikoto, shokenchuto, hangeshashinto, hachimijiogan, and keishibukuryogan.

For Sim 1 and Sim 2, we presented three abdominal strength choices (1, 3, and 5) and three associated kampo formula options (hochuekkito, shigyakusan, and daisaikoto). For Sim 3–7, questions about the abdominal findings and their associated kampo formulas had five possible response options. After participants palpated each simulator, they responded with their abdominal findings and associated kampo formulas. The actual test form used in this study (English translation) is given in Table 2.

| Simulator | Relevant simulator area | Abdominal sign | Abdominal sign in Japanese | Associated kampo formula |
|-----------|-------------------------|----------------|--------------------------|--------------------------|
| Sim 1     | Strength 1/5 (weak)     | Fukuryoku kyo  | Hochuekkito              |
| Sim 2     | Strength 5/5 (strong)   | Fukuryoku jitsu| Daisaikoto               |
| Sim 3     | Hypochondriac discomfort and resistance | Kyokyo-kuman | Shosaikoto               |
| Sim 4     | Abdominal muscle tension | Fukuchokukin-renkyu | Shokenchuto             |
| Sim 5     | Epigastric discomfort and resistance | Shinka-hiko | Hangeshashinto           |
| Sim 6     | Weakness of the lower abdominal region | Shofuku-fujin | Hachimijiogan           |
| Sim 7     | Lower abdominal resistance and fullness | Shofuku-koman | Keishibukuryogan         |

Participants responded to multiple-choice questions by identifying abdominal signs during palpation of the simulators and the associated kampo formulas.
Participants attended a lecture about abdominal examinations, abdominal findings, and the associated kampo formulas. For example, hypochondriac discomfort and resistance are called kyokyo-kuman. This physical sign is associated with the use of kampo formulas containing specific medicinal crude drugs, such as Bupleurum root or Scutellaria root, whose representative is shosaikoto (Fig. 1).

Afterward, the participants underwent a simulator palpation test. First, they palpated all simulators in order from Sim 1 to Sim 7. Next, they completed the multiple-choice test, during which they were allowed to refer to the lecture documents. This study was approved by the Ethics Review Board of the Tohoku University Graduate School of Medicine (IRB No. 2014-1-742).

Education program: Single-group prospective study

Trainee outcome

For the education program, the outcome was the trainees’ ability to determine the abdominal findings correctly and to recall the representative kampo formulas associated with these findings by palpating the simulators.

Subjects

Participants of the Kampo Medicine Conference held by Medical Students in the Hokkaido and Tohoku Areas at Hirosaki University in September 2015 were included in this study [17]. They belonged to student clubs studying kampo medicine in their universities, but did not have clinical experience in kampo medicine.

Simulators and tests

The same simulators and tests were used as in the preliminary trial.

Protocol

This study was conducted as a 1 day lecture during the Kampo Medicine Conference. At first, participants received a general lecture about kampo physical examination, particularly the four examination methods consisting of visual examination, examination by hearing and smell, question and answer period, and palpation. Next, they completed the simulator palpation tests. The participants palpated all the simulators in order from Sim 1 to Sim 7 and completed the multiple-choice test. Subsequently, all participants received a specific lecture about
abdominal palpation, which consisted of abdominal findings and the associated kampo formulas. Immediately thereafter, the participants again palpated the simulators and repeated the same test as described above. During both tests, they were not allowed to refer to the lecture materials, unlike in the preliminary trial. Finally, they attended a lecture in which the correct answers were demonstrated, and provided feedback about the lecture and the practice sessions.

This study was approved by the Ethics Review Board of the Tohoku University Graduate School of Medicine (IRB No. 2014-1-742).

Statistical analysis
The Wilcoxon signed rank test was used to compare the accuracy rates of the tests completed before and after the specific lecture. \( P < 0.05 \) was considered statistically significant. No adjustment for multiple comparisons was performed.

RESULTS

Preliminary trial
Fifteen participants (10 men and five women; nine medical students, three medical doctors, and three pharmacologists) aged 24.6 ± 11.3 years (mean ± SD) enrolled and completed the study. The accuracy rates of the abdominal findings were 100% (Sim 1, 2, 3, 4), 93% (Sim 5, 6), 87% (Sim 7), and 96% on average. Those of the associated kampo formulas were 100% (Sim 1, 2), 93% (Sim 3, 6), 67% (Sim 4), 87% (Sim 5), 73% (Sim 7), and 88% on average (Fig. 3).

Education program: Prospective study
A total of 51 students (one nursing student and 40 medical students), aged 23.1 ± 4.1 years, were included, and 41 of them (27 men and 14 women) answered the questionnaire. Participant characteristics are listed in Table 3.

The accuracy rates of the abdominal findings and the associated kampo formulas before and after the lecture are represented in Figure 4. Almost all accuracy rates increased after the lecture, although that of Sim 1 was constantly high, reaching 98% both before and after the lecture. The accuracy rates of Sim 3, 5, 6, and 7 after the lecture increased significantly compared with those before the lecture (\( P < 0.01, <0.001, <0.01, \) and \( <0.05, \) respectively). The average accuracy rate was also increased after the lecture, from 78.2% to 94.4% (\( P < 0.001 \)).

All accuracy rates of the associated kampo formulas also significantly increased after the lecture (\( P < 0.001 \)), as did the average accuracy rate, which increased from 21.8% to 59.7% (\( P < 0.001 \)).

Table 3 | Baseline education program participant characteristics (n = 41)

| Variable | n or mean ± SD |
|----------|----------------|
| Sex (M: F) | 27:14 |
| Age (years) | 23.1 ± 4.1 |
| Grade | |
| 1 | 11 |
| 2 | 4 |
| 3 | 15 |
| 4 | 8 |
| 5 | 3 |
| Department | |
| Medical | 40 |
| Nursing | 1 |

Figure 3 | Accuracy of the identification of (a) abdominal findings and (b) associated kampo formulas after the lecture in the preliminary trial.
Table 4 lists the positive, negative, and constructive opinions from the participants in program 2. Some participants mentioned that palpation of the simulators enabled them to acquire abdominal examination skills, which they cannot learn from the textbooks. In contrast, some complained that the time they had to palpate the simulators was too short and the waiting time too long, because of the small number of simulators compared with that of the trainees. Some suggestions were provided on how to use the waiting time, and about the questionnaire.

DISCUSSION

We developed an education program using simulators for kampo abdominal palpation, which proved to be effective and useful. To the best of our knowledge, this is the first report documenting the effectiveness of an education program using the simulators for kampo abdominal palpation. The preliminary trial assessed whether kampo trainees could understand abdominal palpation using simulators. The high accuracy rates suggest that the trial was successful. Measurement of the accuracy rates, however, cannot be considered rigorous, because they palpated the simulators and answered the test while referring to the lecture documents. Also, the effectiveness and usefulness of the simulators could not be assessed from this single test.

Following the trial, we created the protocol of an education program, and conducted it as a prospective study. In this program, referring to the lecture documents was not allowed during the test, to ensure a more rigorous evaluation of the answers. A significant increase was noted in almost all the

Table 4 | Participant opinions about the education program

| Positive opinions |
|-------------------|
| - Using the simulators for abdominal palpation, it was easy to understand the whole lecture. I expect more practical use of the simulators. |
| - It was a good point that I could experience how to palpate the abdomen in kampo medicine. |
| - I could not imagine the abdominal palpation when reading the lecture documents. After I experienced it using the simulators, I could easily understand it. It was impressive how my awareness changed during palpating the simulators. |
| - Palpating the simulators, I obtained the fundamental knowledge about abdominal palpation. I understood the importance of my hand’s feelings for abdominal palpation. |
| - It was a precious experience, because I cannot experience or image it in usual lectures using textbooks about kampo medicine. I think it was useful for future learning. |
| - It was easy to understand abdominal palpation using the simulators. |
| - It was interesting. |

| Negative opinions |
|-------------------|
| - The waiting time was too long to palpate the simulators. |
| - I want more time to palpate the simulators. It was useless due to excessive number of participants. |

| Constructive opinions |
|-----------------------|
| - I think you could prepare some other tasks, documents, or games so that participants could use their waiting time. |
| - An open answer questionnaire would be more useful than multiple-choice test, even if it would require more time. |

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Table 4 | Accuracy of the identification of (a) abdominal findings and (b) associated kampo formulas before and after the lecture in the education program. *P < 0.05; **P < 0.01; ***P < 0.001.
accuracy rates of both abdominal findings and associated kampo formulas, suggesting that the education protocol using the simulators was effective, and enabled students to gain experience in and understand abdominal examination in kampo medicine, as some participants mentioned when providing feedback.

The improvement in accuracy rates was more remarkable in the abnormal abdominal findings (Sim 3, 4, 5, 6, and 7) rather than in abdominal strength (Sim 1 and 2), due to the substantially high accuracy rates of Sim 1 and 2 even at baseline. The accuracy rates in all abnormal abdominal findings increased to approximately 90% after the lecture, indicating that the simulators replicating abnormalities of the abdomen could help trainees to sufficiently understand them.

In the education program, the accuracy rates of the associated kampo formulas significantly increased after the lecture, but were not as high as in the preliminary trial. The association of abdominal findings with the representative associated formulas is an important clinical skill for a kampo physician, but for beginners it would be difficult to recall the names of unfamiliar kampo formulas without referring to educational material. Repeated training would be needed to improve this skill.

This education program would contribute to the standardization of kampo medical education, and develop the competency of MCC for medical education. The simulators for abdominal palpation are suitable tools for kampo medical education. Part-task trainers, designed to replicate abdominal findings only, are adequate simulators [18,19], and can be used in safe, repeatable, evaluable, and tailor-made education programs. The fact that trainees can gain experience in multiple abdominal findings and their associated representative kampo formulas by palpating multiple types of simulators at the same time contributes to their efficiency.

The skill of abdominal palpation should be given more attention in modern medicine. The current International Classification of Diseases 11th Revision (ICD-11) contains traditional medicine conditions, which are commonly used in China, Korea, and Japan [20]. In these three countries traditional medicine is widely used together with Western medicine. Some definitions of traditional medicine patterns refer to the abnormal abdominal findings. Therefore, the skill of abdominal palpation will be invaluable in daily clinical practice.

The simulators are portable and could increase the opportunities to learn abdominal palpation wherever possible. We brought the simulators to Germany to present this study to physicians without any previous knowledge of kampo medicine. After the presentation, some of the attending physicians expressed interest.

This study has some limitations. First, the education program did not include a control group not using the simulators. Future randomized controlled trials will be needed to better assess their efficacy. Second, the imbalance between the small number of simulators and the large number of trainees led to excessive waiting time. Currently, we hold small-group training sessions in kampo medicine for medical students at our university: two to three students at a time are trained in abdominal palpation using the simulators, with no waiting time. Third, real patients sometimes have multiple abnormal abdominal findings, while each of the current simulators can replicate only a single finding. The learners and trainees should always keep in mind the difference between simulators and real patients. Baba et al. recently reported a new abdominal simulator model that included multiple abdominal findings associated with certain kampo formulas, such as tokishakuyakusan and keishibukuryogan [21]. Trainees could use these models to learn more practical abdominal palpation skills. Fourth, the purchase and maintenance of multiple simulators is costly, and savings could be obtained by sharing the simulators between many facilities.

Finally, we did not assess the technique of the examination procedure itself, because the outcome of the beginner trainees was defined as identification of the abdominal patterns and recall of the associated kampo formulae. The order, direction, or strength of the abdominal palpation were also important for clinical practice. We would develop another education program focusing on the skill acquisition of abdominal palpation for trainees in a clinical clerkship.

In conclusion, we developed an education program in kampo abdominal examination using simulators for kampo abdominal palpation. The education program was effective and useful for beginners in kampo practice.

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