Role of international tele-education with live surgery for pre-clinical medical students

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Abstract—
Background and Purpose: The number of surgeons in Japan has declined more than 25% in the last 20 years, a critical problem not only limited to this country. Another problem faced in Japan is the limited English communication skills of Japanese students. In an attempt to address these problems, international tele-education involving live surgery for second-year medical students was undertaken in Japan and Korea over a ten-year period. In this study, we aimed to clarify the effect of the class for pre-clinical medical students.

Methods: A 90-minute lecture was given, designed to introduce students to telemedicine as well as devices and instruments for laparoscopic surgery. The class required a connection between Kyushu University Hospital in Japan and Seoul National University Bundang Hospital in Korea. Annual live surgeries were performed each year from 2008 to 2017. Each class comprised a total of 62–90 students per year. After the class, students were given questionnaires for evaluation purposes.

Results: A total of 96% of medical students had a favorable impression of the class over the 10 years. More specifically, 94.6% of students were positive about image quality, and 73.5% of them about sound quality. A total of 88.3% were positive about the class being in English, and 96.1% thought this was important for promoting international exchange and improving their English skills. The percentage of students indicating interest in general surgery was 86.6%, and 94.5% of them were interested in laparoscopic surgery. Finally, three quarters of students had a more favorable impression of surgery after the tele-education class than before.

Conclusion: Our tele-education class is an effective approach for encouraging medical students in the early years of training to become interested in surgery and international exchanges.

I. INTRODUCTION

DEVELOPMENT of information technology (IT) has increased globalization in many fields. Websites can be easily accessed from anywhere in the world, and vast amounts of information can be readily obtained by those who seek it. In particular, recent high-speed Internet technology has enabled high-quality movie images to be sent far afield. This technology has had several dramatic effects on the field of medicine, such as telemedicine, described as clinical health care using an internet connection for coverage to distant areas [1].

The style of medical education has also been changing alongside the development of IT. Two relatively new approaches are e-learning and tele-education. E-learning enables students to learn medicine with stored contents in their own personal computers. It is useful for students to be able to learn anywhere and at any time. Teachers can give advice to the students using text messages, and can create student evaluations using installed software [2]. Tele-education enables students to communicate directly and simultaneously with teachers or other students via different sites connected to videoconference systems. Tele-education is very effective in terms of cost and time saved moving among distant sites, especially where international tele-education occurs. Moreover, videoconference systems enable connections between multiple sites at the same time [3]. However, at many universities most lectures for medical students are still performed using a face-to-face conventional style, because of reasons relating mainly to cost and technical capabilities.

Japan has recently faced the critical problem, familiar to some other countries, of a declining number of surgeons. The number of general surgeons in Japan decreased by 26.6% from 1996 to 2006 [4]. Reasons for the decline are thought to be due to perceptions of great risk and the very busy nature of the field. Oral lectures to medical students cannot convey the attractive points of surgery and do not always lead to understanding of the field. Now, however, students can learn about surgery in detail by watching surgical video clips. They can understand anatomical structures and surgical procedure
precisely through magnified images of real patients and surgeons, especially in minimally invasive surgery. Although students in the earlier years of medical school have little knowledge of medicine, it is thought important to encourage their interests in surgery from this time. Some previous reports also showed that early exposure of medical students to surgery is important to increase the number of surgeons [5] [6].

Japan has a further problem: the challenge of English communication for Japanese students. Japan’s TOEFL iBT scores have been very low for some time, because, to date, English has not been necessary in this island country with little racial diversity [7]. Even in Japan, however, international exchange is becoming increasingly important, and English communication more necessary.

To address these problems, international tele-education with live surgery has been performed by Kyushu University (Japan) and Seoul National University Bundang Hospital (Republic of Korea) for pre-clinical medical students since 2008. It has been considered a valuable approach and is the first of its kind reported in Japan so far.

II. MATERIALS AND METHODS

A. International tele-education class for medical students

This class was organized for second-year medical students in Kyushu University, Fukuoka, Japan. The students, who have little medical knowledge, learn about advanced medical technology and clinical equipment, such as vital monitors, respirators, endoscopies, and computed tomography in the class. A 90-minute lecture is given, designed to introduce them to telemedicine as well as devices and instruments for laparoscopic surgery (Fig 1). The class is performed with a connection between Kyushu University Hospital in Japan and Seoul National University Bundang Hospital in Korea, and live surgeries have taken place annually from 2008 to 2017, with each class having 62 to 90 students participating per year.

In addition to the surgical team, a moderating surgeon in Korea explains about surgical procedures and various instruments in the operation room, such as laparoscopes, insufflators, electrocautery, coagulating shears, automatic suturing devices, image recording systems, and anesthetic machines. Most Japanese students have their first experience of observing surgery, and their first opportunity to communicate with foreign surgeons. They also had the chance to ask the surgical moderator some questions and for discussion with Korean medical students in their clinical class of the operating theater.

B. Technology for videoconference system

Regarding the videoconference system, a digital video transport system (DVTS) was used between 2009 and 2013 to transmit video images [8]. DVTS is free software that can be installed on personal computers. Its images are received from video cameras or surgical instruments through an IEEE1394 interface. High-definition H.323 had been used since 2015 when image quality became satisfactory, and was provided in both hospitals [9][10]. Images transmitted from Korea were shown on the screen in Japan with less than 0.3 sec of time-latency [11]. The sound system consisted of a speaker and multiple microphones with a sound mixer. Technical preparations were undertaken by staff in both hospitals without outsourcing assistance.

C. Feedback about the tele-education class from medical students.

After the class, students were given questionnaires to gauge their impressions about the class, image and sound quality, their opinions about medical teaching in English, interests in general surgery and endoscopic surgery, change of interest in surgery following the class, and their interest in international exchanges (Table 1). Content of the questionnaires varied slightly from year to year. The questionnaires were collected from 64–90 students per class, with a total of 595 students in 8 classes completing questionnaires (no collection of questionnaires in 2008 and 2014). The results were divided into two groups based on the videoconference systems used, the DVTS group (2009–2013) and H.323 group (2015–2017). The data were analyzed by the chi-square test.

D. Patients’ privacy and ethics

This tele-education activity with live surgery was approved by the ethics committee of the Faculty of Medicine, Kyushu University.

Fig. 1. The view of the class
III. RESULTS

A. Students’ impressions of the international tele-education class and technical quality of the tele-education system

The medical students had overwhelmingly positive impressions of the class over the 10-year period (“very good” or “good”: 96.0%) in Fig 2A. Most of the students gave a good evaluation for image quality (“very good” or “good”: 94.6%), while a quarter of them were negative about sound quality (“bad” or “very bad”: 26.5%).

B. The needs of students regarding international exchange, medical teaching in English, and tele-education

Fig 2B shows that most students thought it necessary to promote international exchange (“strongly agree” or “agree”: 96.1%). Medical teaching in English was supported by 88.3% of students, although every class also noted that a highly specialized field like medicine should be learned in the mother tongue for better understanding. Most students were in support of the tele-education class.

C. Interests in general surgery and laparoscopic surgery

Results indicated that 86.6% of the students were interested in general surgery, and 94.5% of them were interested in laparoscopic surgery (“very interested” and “interested”) (Fig 2C). Interestingly, three quarters of students had a more favorable impression of surgery after the tele-education class than before (Fig 2D).

D. Comparison of videoconference systems

Comparison of the two videoconference systems, DVTS (2009–2013) and high-definition H.323 (2015 onwards), revealed no significant differences regarding all analyzed items (Table 2).

IV. DISCUSSION

This study reported on international tele-education with live surgery for medical students in Japan and Korea, and showed that it was favorably accepted over a ten-year period. For most of the medical students it was their first experience to observe live-surgery and attend an international tele-education class. However, they had overwhelmingly good impressions of the class, as well as of the image quality in spite of international live transmission.

The circumstances surrounding the videoconference system have improved greatly over the ten-year period, and tele-education and Internet have advanced in many ways [12]. Several reports on tele-education for surgery have been published [13][14][15][16]. However, there are only a few such reports describing moving surgical images or live surgery [17][18]. This suggests that smooth transmission of moving images is more technically challenging than still images, because a movie consists of 30 images per second. Our department has already organized many telemedicine programs, such as gastrointestinal endoscopy, pediatrics, and cardiology since 2003 [3][8]. Although one challenge of tele-education is its cost, especially the practicality of movie transmission, this was overcome in the present project by building an international teleconference system without any outsourcing. One small concern is the relatively unfavorable evaluation of sound quality (28%) compared with that of image quality (6%). Sound is often sensitive and vulnerable to echo problems. Further improvement of sound control is expected with continuous technological development. The content of a program is of the utmost importance for education. Reporting on remote class surgery, Smith et al. [13] described groups of face-to-face and videoconferencing students showing very high satisfaction, and Stain et al. [14] also found no significant difference in the mean scores for conventional and videoconferencing lectures. Holland et al. [16] reported that a majority of students strongly agreed that participation in videoconferencing of surgical tutorials was valuable. Live surgery is a very favorable experience for most

Table 1. Questionnaires about the class

<table>
<thead>
<tr>
<th>Questions</th>
<th>Answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Impression whole about the class</td>
<td>very good good bad very bad</td>
</tr>
<tr>
<td>2) Impression about tele-education system</td>
<td>very good good bad very bad</td>
</tr>
<tr>
<td>(1) Image quality</td>
<td>very good good bad very bad</td>
</tr>
<tr>
<td>(2) Sound quality</td>
<td>very good good bad very bad</td>
</tr>
<tr>
<td>3) Medical teaching in English</td>
<td>strongly agree agree disagree strongly disagree</td>
</tr>
<tr>
<td>4) To promote international exchanges</td>
<td>strongly agree agree disagree strongly disagree</td>
</tr>
<tr>
<td>5) Interests in general surgery</td>
<td>very interested interested not interested not interested at all</td>
</tr>
<tr>
<td>6) Interests in laparoscopic surgery</td>
<td>very interested interested not interested not interested at all</td>
</tr>
<tr>
<td>7) Change of Interests in surgery after the class</td>
<td>increased no change decreased</td>
</tr>
</tbody>
</table>
medical students, a finding supported by the majority (about 95%, Fig 2A) in the present study. The live demonstration of laparoscopic surgery was shown from an operating theater with interactive communication with moderating doctors. In a conventional way, only a few students can be taken into an operating room at one time. However, live surgery with tele-education can overcome that limitation. Russomano et al. [17] also pointed out the advantages of better access to the operating theater, in addition to lower risk of infection to the patient and demonstration of a new virtual education methodology to students. It was heartening to know that 74% of students reported increased interest in surgery (Fig 2D), and 85% of students were interested in surgery, in spite of the situation in Japan where numbers of young surgeons are decreasing [4].

An important problem still remains in medical training: the English communication skills of Japanese students. The Ministry of Education, Culture, Sports, Science and Technology (MEXT) in Japan aims to improve Japanese students’ level of English based on “the English Education Reform Plan in Response to Globalization” since 2013. However, the number of Japanese students studying abroad has decreased from 82,945 in 2004 to 54,676 in 2015 [19]. In 2016, Japan’s TOEFL iBT score was relatively low in comparison to world averages: 26th of 30 Asian countries, and the lowest of 35 Organization for Economic Co-operation and Development (OECD) countries, the worst in the world in terms of speaking skills [7]. Medical students have no chance to learn medical terms in English because all their lectures are given in Japanese. However, after the classes described in this paper, Japanese students could better understand the importance of English communication skills, and had more interest in international human exchanges.

Our medical teaching project has been effective in kindling an interest in surgery for medical students in their early years of study, as well as exposing them to the benefits of international exchange. A tele-education class is a convenient and useful way to give students the opportunity to learn medicine in English, to observe live surgery performed by
foreign expert surgeons, and to communicate with them medical colleagues in another country without travel.

V. CONCLUSION

Tele-education classes using live surgery are an effective approach to encourage interest in surgery and international exchange in the formative period of medical student training.

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