ORIGINAL ARTICLE Print ISSN 2234-2400 / On-line ISSN 2234-2443
Clin Endosc 2012;45:73-77 http://dx.doi.org/10.5946/ce.2012.45.1.73

Open Access

International Live Endoscopic Multichannel Demonstration Using Superfast Broadband Internet Connections

Sang Pyo Lee[1], Hang Lak Lee[1], Joon Soo Hahm[1], Ho Soon Choi[1], Inwhee Joe[2] and Shuji Shimizu[3]

[1]Department of Internal Medicine, Hanyang University Medical Center, [2]Department of Computer Sciences and Engineering, Hanyang University College of Engineering, Seoul, Korea, [3]Department of Endoscopic Diagnostics and Therapeutics, Kyushu University Faculty of Medicine, Fukuoka, Japan

See commentary on page 1

Background/Aims: Telemedicine is a convenient and efficient tool for remote education in various fields. The telemedicine system can also be used to educate doctors and medical students. The aim of our study was to establish the effectiveness of the telemedical system for use in a live endoscopic multichannel demonstration conference and to test the effectiveness and usefulness of a multicenter-based live endoscopic demonstration through live, interactive, high resolution video transmission using advanced networks and the digital video transport system (DVTS).

Methods: This study is a prospective multicenter pilot study. A live demonstration of an endoscopic submucosal dissection (ESD) and an endoscopic retrograde cholangiopancreatography (ERCP) using advanced network technology was performed.

Results: The DVTS successfully transmitted uncompressed, high-resolution, digital lectures with endoscopy video during a multichannel endoscopic live demonstration of ESD and ERCP over multiple advanced networks. The overall satisfaction rating when the endoscopic lecture demonstration was performed by combining DVTS was generally good.

Conclusions: We believe that a multicenter-based live endoscopic demonstration is a very effective conferencing method when using advanced networks and DVTS.

Key Words: Telemedicine; Internet; International educational exchange

INTRODUCTION

Advances in internet technology have greatly contributed to practically every aspect of our lives and also to the computerization and automation of medicine. In recent years, increasing attention has been given to the development and practice of telemedicine.[1] Telemedicine is a convenient and efficient tool for remote education in a variety of fields. Recently, robust research efforts have yielded some great achievements regarding telemedical care between domestic hospitals.[2] The telemedicine system can also be used to educate doctors and medical students.[3-8]

We established a large broadband network and have shared medical knowledge between Asian-Pacific countries using a high speed network. We have also conducted regular telemedicine conferences with Japan, Taiwan, and the USA. In addition, we have also performed a live endoscopic submucosal dissection (ESD) procedure conference under the auspices of the Korean Society of Gastrointestinal Endoscopy through telemedicine, as well as a live endoscopic retrograde cholangiopancreatography (ERCP) procedure.

The purposes of this research were to attempt a domestic and international remote medical live conference using the digital video transport system (DVTS) over a high speed network and to establish a new vision of live teleconferencing through high-quality image processing technology.

Received: August 5, 2011 **Revised:** October 27, 2011
Accepted: December 29, 2011

Correspondence: Joon Soo Hahm
Department of Internal Medicine, Hanyang University Medical Center, 22 Wangsimni-ro, Seongdong-gu, Seoul 133-791, Korea
Tel: +82-2-2290-8341, **Fax:** +82-2-2298-9183, **E-mail:** hamjs@hanyang.ac.kr

MATERIALS AND METHODS

Participants and study design

We conducted a prospective, multicenter, pilot study. Endoscopy units at multiple sites participated in our study.

Design of system

A teleconference system with bidirectional transmission over the network was set up via the Internet protocol, where the DVTS was applied to send and receive the signals (Fig. 1). This system also allows internet video production for a broad range of organizations since it is available as hardware or as software that can be downloaded and installed on a personal computer (http://www.sfc.wide.ad.jp/DVTS/) that runs on either Windows or Mac OS X. The digital video (DV) camera or the video output from the medical device used during the procedure is connected to the PC via an IEEE 1394 interface that can be connected to the broadband Internet (Fig 2). Audio and video images are transmitted through this connection.

The real-time demonstration of endoscopic procedures was accomplished by connecting the endoscopic room to the conference room via two DVTS data streams. One stream transmitted the endoscopic images for preserving the quality of images, and the second one transmitted other images including the endoscopic room, preoperative images, or the staff in the conference room. Then we transmitted both streams of DVTS to the hospital linked to us. The endoscopic surgical images were obtained at the interface of the surgical instruments and changed to the Internet protocol packets by the DVTS hardware. In the meantime, all the images of the endoscopic room, hand manipulations by the endoscopist, radiology, and the conference room were collected by a DV camera connected to the hardware DVTS via an IEEE 1394 interface. Security software (C4-VPN; Focus Systems Co., Tokyo, Japan) was also used

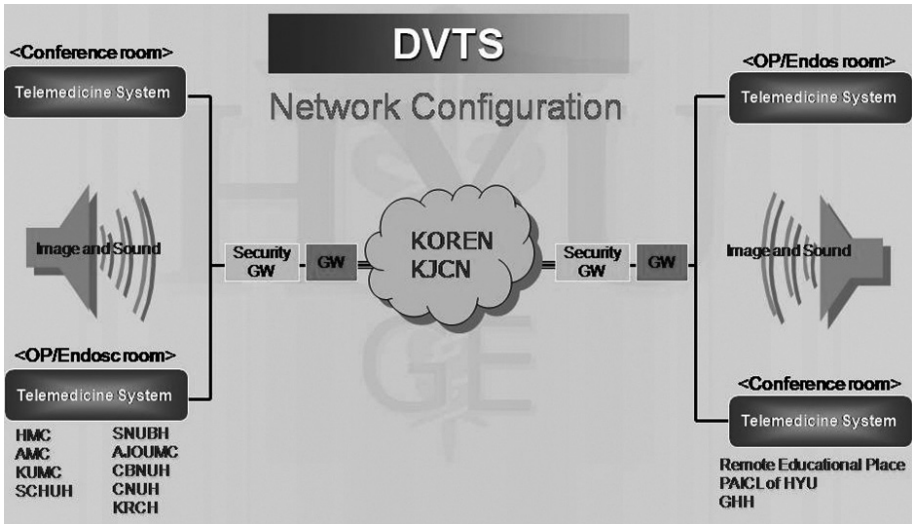

Fig. 1. Schematic digital video transport system (DVTS) network configuration between location (A) where the endoscopic live procedure is being demonstrated, and location (B) where the trainee watches the demonstration. GW, gateway; KJCN, Korea-Japan Cable Network; HMC, Hanyang University Medical Center; AMC, Asan Medical Center; KUMC, Korea University Medical Center; SCHUH, Soonchunhyang University Hospital; SNUBH, Seoul National University Bundang Hospital; AJOUMC, Ajou University Medical Center; CBNUH, Chungbuk National University Hospital; CNUH, Chungnam National University Hospital; KRCH, Kyoto Red Cross Hospital; PAICL of HYU, Paiknam Academic Informatino Center & Library of Hanyang University; GHH, Grand Hilton Hotel.

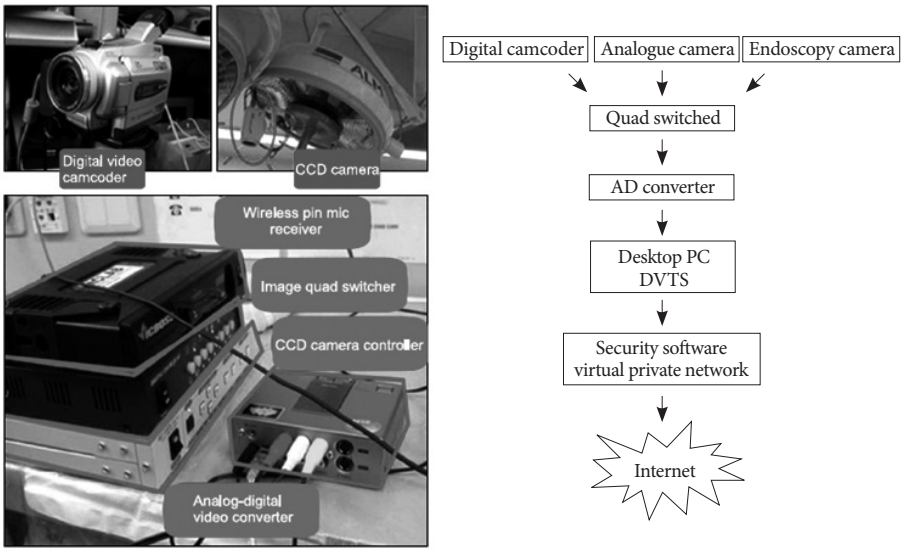

Fig. 2. Digital video transport system (DVTS) terminal system organization between location (A) where the endoscopic live procedure is being demonstrated, and location (B) where the trainee watches the demonstration. AD, analogue digital; CCD, Charge Coupled Divice Camera.

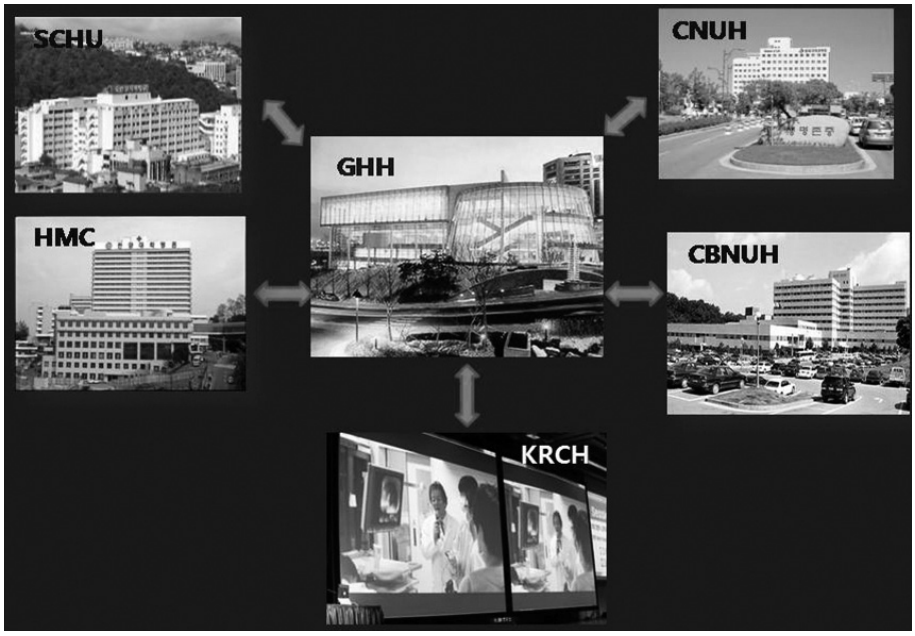

Fig. 3. Multichannel hospital sites of the live endoscopic submucosal dissection (ESD) in 2008. A thousand Korean endoscopists gathered inside the Grand Hilton Hotel (GHH). ESD procedures that were being performed at Hanyang University Medical Center (HMC), Chungbuk National University Hospital (CBNUH), Chunbuk National University Hospital (CNUH), Soonchunhyang University Hospital (SCHU), and Kyoto Red Cross Hospital (KRCH) in Japan were transmitted to the GHH in Seoul, Korea.

Fig. 4. Conference room for trainees. Many trainees are able to observe the endoscopic submucosal dissection (ESD) and listen to the lecture. These trainees and the senior person present in the conference room discuss ESD skills and knowledge with the doctors who are performing the remote ESD live demonstration.

throughout the real-time transmission for the protection of patients' privacy. After an endoscopic live demonstration using DVTS, participants were asked questions regarding the degrees of satisfaction about the image and sound quality of the presentation. We aimed to determine the teaching efficacy of this system using the DVTS transmission system of high resolution images and video over advanced networks.

RESULTS

Multi-station ESD live demonstration

We performed a live ESD procedure in accordance with the auspices of the Korean Society of Gastrointestinal Endoscopy (KSGE) through telemedicine. Our KSGE annually holds a live ESD conference using a satellite communication system. On August 30, 2008, the KSGE held a live ESD telemedicine conference at the Grand Hilton Hotel (GHH) in Seoul, Korea, in which approximately 1,000 Korean endoscopists participated. ESD live demonstrations were consisted of total four sessions from 9:00 AM to 4:00 PM. ESD procedures that were being performed at Hanyang University Medical Center (HMC), Chungbuk National University Hospital (CBNUH), Chungnam National University Hospital (CNUH) and Soonchunhyang University Hospital (SCHU) in Seoul and Kyoto Red Cross Hospital in Japan were transmitted to the GHH in Seoul (Figs. 3, 4). After an endoscopic live demonstration, a questionnaire that was composed of questions regarding the satisfaction with image and sound qualities were administered to the participating attendees. The proportion of people who said that they were satisfied with the endoscopic lecture demonstration was amounted to 91%.

Multi-station ERCP live demonstration

On February 21, 2009, live ERCP telemedicine demonstrations were successfully performed. Approximately 1,000 Korean endoscopists gathered at the Hanyang University Paiknam Academic Information Center (HUPAIC) in Seoul (Figs. 5, 6). ERCP live demonstrations were consisted of total five sessions from 9:00 AM to 5:00 PM. ERCP procedures performed at HMC, Asan Medical Center (AMC), Korea University Hospital (KUH), Seoul National University Bundang Hospital (SNUBH), Ajou University Hospital (AJUH), CBNUH, CNUH and SCHU were transmitted to the HUPAIC. Various live diagnostic and/or therapeutic ERCP and EUS procedures were performed and transmitted.

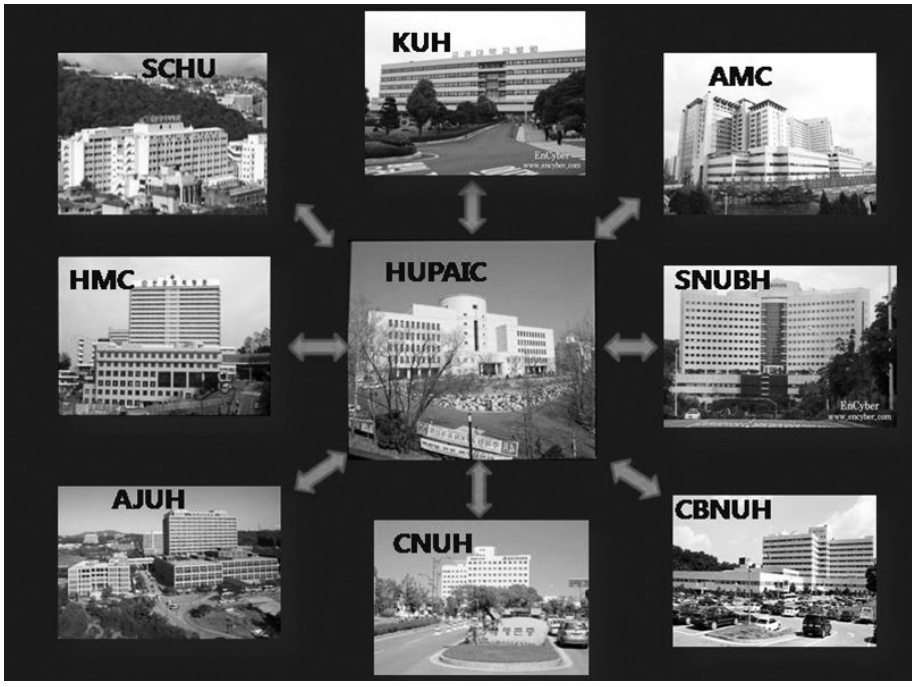

Fig. 5. Multichannel hospital sites in endoscopic retrograde cholangiopancreatography (ERCP) live 2009. A thousand Korean endoscopists gathered inside the Hanyang University Paiknam Academic Informative Center (HUPAIC) located in Seoul, Korea. ERCP procedures performed at Hanyang University Medical Center (HMC), Asan Medical Center (AMC), Korea University Hospital (KUH), Seoul National University Budang Hospital (SNUBH), Ajou University Hospital (AJUH), Chungbuk National University Hospital (CBNUH), Chunbuk National University Hospital (CNUH), and Soonchunhyang University Hospital (SCHU) were transmitted to the HUPAIC.

Fig. 6. Main center of the live endoscopic retrograde cholangiopancreatography (ERCP) in 2009. Many trainees are able to observe the ERCP and listen to the lecture. These trainees and the senior person present in the conference room discuss ERCP skills and knowledge with the doctors who are performing the remote ERCP live demonstration.

DISCUSSION

Telemedicine has opened the door to a wide range of learning experiences, one of which is the capability for simultaneous feedback between doctors and students at various remote locations. The merits of telemedicine are as follows. First, it is possible to conduct a medical practice and to administer medical advice from a remote location, regardless of any spatial limitations. Second, the availability of diagnostic tests at a remote hospital eliminates the need for expensive machines, and the inter-institutional sharing of patient records also becomes possible. Third, teleconferencing enables doctors to share medical knowledge at a low cost and allows medical students to receive education from distant locations.[1-4]

The telemedicine system using a high speed network can be used for a whole variety of medical reasons, including surgery, endoscopy, medical informatics, pathology, interventional radiology, medical e-lectures and tele-consultations. This telemedicine system has three major characteristics. One is that it utilizes a broadband system, which can be easily used anywhere

and works with most equipment. The second characteristic of the telemedicine system is that it enables free international communications. The third is that it is a high quality system. Although this telemedicine system has many advantages, there are some requirements that are needed to be organized systematically for a more advanced telemedicine project to be successfully conducted. Namely, medical staffs could not succeed this project by themselves. A competent engineering staff is also needed to support the medical staff at each of the locations. Proper governmental support is also required.

We believe that the telecommunication system will have a substantial impact on telemedicine because it will allow distant healthcare providers to share high-quality moving medical imagery equal to that produced by the original equipment. The goal of this system is to exchange medical information that is of original quality beyond geographic borders using this easy and economical system and to provide every patient with better healthcare through medical standardization.

We performed a live ESD procedure telemedicine conference under the auspices of the KSGE, which holds annual live ESD conferences using DVTS. There are many advantages of using this system. First, many endoscopists can perform procedures at their own hospitals and patients can receive a procedure without having to be transferred to another hospital. Second, large audiences in several remote locations can watch the various procedures that are being performed at other domestic or international hospitals. DVTS was shown to be a promising tool for use in remote medicine as there are a various number of ways in which this tool can be utilized, and this network will aid in the development of diverse medical services and technologies.

In the future, we plan to conduct a regularly scheduled multistation ESD live demonstration of the KSGE and diagnostic and therapeutic EUS live demonstrations. We are also planning to create a tele-consultation program for local and distant hospitals.

Conflicts of Interest

The authors have no financial conflicts of interest.

Acknowledgments

This work was supported by the research fund of Hanyang University (HY-2010-N).

REFERENCES

1. Harris BA Jr. Telemedicine: a glance into the future. Mayo Clin Proc 1994;69:1212-1214.
2. Broderick TJ, Harnett BM, Doarn CR, Rodas EB, Merrell RC. Real-time Internet connections: implications for surgical decision making in laparoscopy. Ann Surg 2001;234:165-171.
3. Hahm JS, Lee HL, Choi HS, Shimizu S. Telemedicine system using a high-speed network: past, present, and future. Gut Liver 2009;3:247-251.
4. Hahm JS, Lee HL, Kim SI, et al. A remote educational system in medicine using digital video. Hepatogastroenterology 2007;54:373-376.
5. Hahm JS, Shimizu S, Nakashima N, et al. Telemedicine with digital video transport system. Korean J Gastroenterol 2004;43:370-375.
6. Heatley DJ, Bell GD. Telemedicine in gastrointestinal endoscopy. Endoscopy 2003;35:624-626.
7. Kaltenbach T, Muto M, Soetikno R, et al. Teleteaching endoscopy: the feasibility of real-time, uncompressed video transmission by using advanced-network technologies. Gastrointest Endosc 2009;70:1013-1017.
8. Shimizu S, Nakashima N, Okamura K, et al. International transmission of uncompressed endoscopic surgery images via superfast broadband Internet connections. Surg Endosc 2006;20:167-170.