

Telementoring Between Brazil and the United States: Initial Experience

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ABSTRACT

Background and Purpose: To assess the safety and feasibility of transcontinental telementored and telepresence surgery, we report on two procedures carried out with participation by surgeons in Baltimore in the United States and São Paulo and Recife in Brazil.

Patients and Methods: Over a period of 3 months, a laparoscopic bilateral varicocelectomy and a percutaneous renal access for a percutaneous nephrolithotomy were performed. The mentoring surgeon (LRK) was the same for both procedures. He used a 650-MHz personal computer fitted with a Z360 video COder/DECoder (CODEC) and a Z208 communication board (Zydacron Corp, Manchester, NH) that comprise the core of the telesurgical station. In the first case, a surgical robot, AESOP 3000 (Computer Motion Inc.), was attached to a laparoscope, and the remote surgeon drove the robot via a controller on the remote computer. In the second case, another robot (Percutaneous Access to the Kidney; PAKY) was used for percutaneous needle placement into the renal collecting system.

Results: The two procedures were completed successfully. In the first case, the operative time was 25 minutes, with minimal estimated blood loss. The patient was discharged home the next day. At 3-month follow-up, there was no scrotal pain or varicocele. In the second case, access to the urinary tract was achieved with the first needle pass, and percutaneous nephrolithotomy was uneventful. Blood loss was minimal, and the patient was discharged home on the second postoperative day. At 3-month follow-up, the patient was free of urinary stones and of symptoms.

Conclusions: The first transcontinental telementored and telepresence urologic surgical procedures have been reported previously. The success observed with the novel surgical techniques has motivated great interest. The cases reported here demonstrate that several types of procedures can be mentored safely and effectively with telemedicine technology.

INTRODUCTION

LAPAROSCOPIC UROLOGIC OPERATIONS have gained worldwide acceptance because of their reduced postoperative discomfort, shorter convalescence, better aesthetic results, and lower global surgical costs compared with the open approach.¹⁻⁴ However, more advanced laparoscopic procedures, such as prostatectomy, pyeloplasty, nephrectomy, and adrenalectomy, are associated with a steep learning curve

and a higher risk of complications.^{5,6} Most urologists have had little laparoscopic training during their residencies, and the learning of this evolving technique usually includes postgraduate courses, animal surgery, and observation. Several studies have demonstrated that traditional courses are not sufficient to prepare surgeons to apply laparoscopic techniques to their patients and that the best method of teaching is having the students work with more experienced surgeons.⁷

Telementoring, an advanced form of telemedicine, can be

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used in training programs and in current practice, allowing a nonexpert surgeon to perform a procedure guided by a more-experienced surgeon. The system permits coordinated cooperation between the specialist and the inexperienced surgeon. At a higher level of complexity, the surgeon at a remote site controls one or more robotic manipulators at the operative site in order to perform or assist with the procedure.

In order to assess the safety and feasibility of performing telementored and telepresence operations between Brazil and the United States, we report on two procedures. In one case, an experienced surgeon guided a colleague through a bilateral laparoscopic varicocelectomy. In the second case, radiologically guided needle insertion for percutaneous nephrolithotomy was performed using a robotic arm.

PATIENTS AND METHODS

Patients

A 17-year-old man with chronic bilateral scrotal pain and bilateral grade 3 varicoceles was followed for 2 years. Both testicles were normal, and seminal analyses did not demonstrate any abnormality. However, persistent and disabling scrotal pain was still present, and laparoscopic bilateral varicocelectomy was performed (Table 1).

A 52-year-old man presented with left lumbar pain and hematuria. Intravenous urography and renal ultrasonography showed a 2-cm left renal pelvic stone with moderate pelvic and caliceal dilation. Percutaneous nephrolithotomy was recommended (Table 1).

Technique and equipment

The mentoring surgeon (LRK) was the same for both procedures. He used a 650-MHz personal computer fitted with a Z360 video COder/DECOder (CODEC) and a Z208 communication board (Zydacron Corp, Manchester, NH) that comprise the core of the telesurgical station. The inputs to the workstation included a balanced microphone, video streaming from the endoscope, and video from the external room camera. A teleconferencing camera (Canon, Rochester, NY) and a multidirectional microphone were available for routine communications. The mentor was allowed to make notes and draw over the full-motion video screen as well as to access a menu for control of the light source, laparoscopic insufflator, and camera.

The local site was equipped with a workstation similar to that at the remote site. The inputs included a microphone, video from the laparoscope, and a composite video from the external

room camera. The local site received audio, camera control, telestration data, and a shared video screen from the remote site (Fig. 1).

The data output from the CODEC was fed into the communication board that processed and formatted the information to interface with a data switch controller (SLI, Ijamsville, MD). The data switch controller contained a channel service unit/digital service unit (CSU/DSU) that provided the termination for the integrated services digital network (ISDN) connection. The ISDN is a commercially available high-capacity telephone line, each line carrying 128 kbps. Four ISDN lines were utilized in both cases. This allowed rapid and reliable data transfer between the local and remote workstations.

In the first case, a surgical robot, AESOP 3000 (Computer Motion Inc., Goleta, CA), was fastened to the side of the operating table, and the laparoscope was attached with a magnetic coupling device to the robotic arm. The remote surgeon was capable of driving the robot via a controller on the remote computer. In the second case, another robot, Percutaneous Access to the Kidney (PAKY) that allows fluoroscopic placement of an 18-gauge needle for percutaneous renal access was attached to the operating room table. The system utilizes real-time fluoroscopic images provided by a C-arm to align and monitor needle passage into the renal collecting system. Again, the remote surgeon was capable of controlling the robot from the remote computer.

The Z360 software provides video, audio, and data communication between the two sites. The software, developed at Johns Hopkins laboratory (UROBOTICS), uses two channels provided by the software and allows remote robot control, electrocautery control, and telestration.

RESULTS

Both surgical procedures were completed successfully. Except for set-up of the robotic arms (AESOP and PAKY), no unusual features were noted with either case, and there were no complications. There was a time delay of approximately 700 msec, but communication between the local and remote sites provided excellent image and audio communications.

In the first case, the operating room time was 25 minutes. The estimated blood loss was minimal. No narcotic medication was used in the postoperative period, and the patient was discharged home the next day. Three months after surgery, the patient was without scrotal pain or varicocele.

In the second case, access to the urinary tract was achieved with the first needle pass, and percutaneous nephrolithotomy

TABLE 1. DETAILS OF PROCEDURES

<i>Remote site</i>	<i>Local site</i>	<i>Distance (miles)</i>	<i>Procedure</i>
Mentor's home Baltimore	Hospital Sírío-Libanês São Paulo	5794	Laparoscopic bilateral varicocelectomy
Johns Hopkins Hospital Baltimore	Real Hospital Benef. Português Recife	5454	Percutaneous nephrolithotomy



FIG. 1. Doctor Kavoussi (Baltimore; on monitor) telementoring bilateral varicocelectomy with Dr. R. Netto and his team (São Paulo).

was uneventful. Blood loss was minimal, and the patient was discharged home on the second postoperative day. At 3-month follow-up, the patient was free of urinary stones and of symptoms.

DISCUSSION

The introduction of novel surgical techniques calls for creative methods to provide education for practicing urologists. Training courses are not sufficient in preparing surgeons to perform new procedures on their patients,⁸ and less-experienced surgeons can have a higher incidence of complications.^{9,10} The technology described here can help overcome the steep learning curve, the reluctance of surgeons to perform a new procedure without the presence of a mentor, and the difficulty for experienced surgeons to be physically present to proctor a novice physician.

Both telementored and telepresence urologic operations have previously been reported. These reports demonstrated that these techniques are safe and effective for mentoring several different types of procedures.¹¹⁻¹³ In both procedures performed between Brazil and the United States, operative success was noted. However, some aspects require discussion.

A time delay occurs in any long-distance communication, and even minor delays can result in difficulty in performing coordinated movements.¹⁴ A large amount of bandwidth is required to transmit real-time video and minimize delay. In our two cases, four ISDN lines were utilized, which provided video

images at the rate of 15 frames per second (fps). High-bandwidth telephone lines (T1 line; 1.54 Mbps) can provide images at 30 fps, allowing smoother images with minimal signal delay (<400 msec). Although these high-bandwidth lines would have been desirable, the robotic arms and the electrocautery were used safely with the approximate 700-msec time delay between Brazil and the United States using the ISDN lines.

The use of robotic arms as a surgical tool during telesurgery is in its infancy. Although studies indicate that they can outperform humans in tasks such as camera holding, which results in improved efficiency and shorter laparoscopic operating times,¹⁵ there are only limited experimental and randomized clinical studies to determine efficacy, safety, and cost-effectiveness of this technology in advanced applications.

Moral and legal concerns also remain. Protecting the patient's privacy (as operative information is being transmitted over communication lines), credentialing for the remote surgeons, and allocation of the telesurgery session costs need further discussion. Finally, responsibility for complications is another delicate question to be addressed.

CONCLUSION

Telementoring between Brazil and the United States was feasible, safe, and effective for performing two different procedures. However, several important issues still need to be addressed before these evolving technologies can play a definitive role in laparoscopic urologic practice.

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