Telesurgery in medical school and teaching hospital

Telecirurgia no curso médico e hospital escola

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ABSTRACT

Purpose: Telesurgery has been advertised for increasing efficiency, extending the scope of surgical practice, improving surgery outcomes, and reducing costs in the healthcare system. The aim of this article is to describe the some important aspects of telesurgery in medical schools, including the telecommunication requirements, the impact from lack of haptic feedback, surgeons adaptation, ethical and medicolegal issues. **Methods:** A review was done in Pubmed and ScieLo electronic platform, and a total of 20 representative articles were identified and are the basis of this review. **Results:** In this review we described the basic terms about telemedicine and telesurgery. We also described the guides for the establishment of telesurgical networks connecting various hospitals and centers in the world, allowing for rapid and safe dissemination of new surgical techniques. Telemedicine has been used to read image exams, interpret tests, consultation, conventional, laparoscopic and telerobotic surgery, manage diabetes, and manage postoperative follow up from remote sites. Reductions in time lost from work, transportation costs, more efficiency for the health care providers, and reducing medical costs all have been suggested as benefits of telemedicine. **Conclusion:** Despite the information published about telemedicine and telesurgery, this technology has been shown to be highly important in medical schools in rural hospitals, and war settings, with unequivocal benefits. Properly structured investigations will be needed to determine the role of telesurgery in the future.

Key words: Remote telepresence surgery.Telerobotic surgery. Telesurgical networks. Telemedicine.

RESUMO

Objetivo: A telecirurgia foi desenvolvida para aumentar a eficiência, alargando o âmbito de prática cirúrgica, melhorando os resultados da cirurgia e reduzindo os custos no sistema de saúde. O objetivo deste artigo é descrever os aspectos importantes da telecirurgia em escolas médicas, incluindo os requisitos de telecomunicações, o impacto do método, adaptação cirurgiões, questões éticas e médico-legais. **Métodos:** Foi feita uma revisão nas plataformas eletrônicas Pubmed e SciELO, e um total de 20 artigos representativos foram identificados, sendo a base desta revisão. **Resultados:** Nesta revisão foram descritos os termos básicos da telemedicina e telecirurgia. Descrevemos as bases para o estabelecimento de redes de conexão entre hospitais e centros médicos interligando ambientes e cenários telecirúrgicos, permitindo a difusão rápida e segura de novas técnicas cirúrgicas. A telemedicina tem sido usada para visualizar exames de imagem, interpretar exames, consulta, cirurgia convencional, laparoscópica e telerobótica, controlar diabetes, e gerenciar seguimento pós-operatório em sites remotos. Redução do tempo de tratamento, otimização de custos de transporte, mais eficiência para os prestadores de cuidados de saúde, e redução custos com cuidados médicos, todos têm sido sugeridos como benefícios da telemedicina. **Conclusão:** Apesar da limitação de informações publicadas sobre telemedicina e telecirurgia, esta tecnologia tem-se mostrado muito importante nas escolas médicas, em hospitais rurais, em cenários de guerras, com benefícios inequívocos. Investigações devidamente estruturadas são necessárias para determinar o papel da telecirurgia no futuro.

Descritores: Cirurgia telerobótica. Cirurgia remota por telepresença. Redes telecirúrgicas. Telemedicina.

INTRODUCTION

Telemedicine is the exchange of medical information between distant locations via electronic communications aimed at the health and education of patients or healthcare staff. Extends the patient care, including consultation, diagnosis and treatment. It was used in the 70s by Thomas Bird[1], where doctors examined distant patients by telecommunication, through the connection between the Massachusetts General Hospital in Boston and Logan Airport, serving employees and patients. Telemedicine encompasses: teleconsultation, teletutory and telesurgery.

Teleconsultation is the examination of patients by clinical specialists using communication technologies, through static and dynamic images, sounds or both simultaneously. Teletutory includes the ability to guide, direct and interact with other health professional on different degrees of complexity, through a real-time transmission of medical procedures viewing of target areas of the patient where some medical procedure is to be performed, operating robotic instruments. Telesurgery is performance of a surgical procedure by a surgeon at a distance, using telecommunication technologies and robotics. The first transatlantic telesurgery was

done in 2001, in which the surgeon Marescaux performed a cholecystectomy in a patient located in Strasbourg, France[2]. In Brazil, the first telesurgery occurred in 2000, in which the surgeon Louis Kavousse, from Johns Hopkins, in Baltimore, held a varicocelectomy in a patient in the Syrian-Lebanese Hospital in São Paulo, Brazil[3].

The U.S. Army encouraged the development of telesurgery in the world as a result of the effort in the advancement of medical care in areas of difficult access or involved in wars, where specialized surgical service is not feasible. In the military context there is interest in the advancement of research and testing to extend health care to war field[4].

For 30 years, the National Aeronautics and Space Administration (NASA) began exploration of remotely controlled robotic technology for the medical care of its astronauts in orbit through experiments performed in the absence of gravity[5], such as the NASA Extreme Environment Mission Operations (NEEMO) [6].

Anvari et. al. (2007) performed 22 laparoscopic telesurgeries, the biggest and most expensive experiment in the area so far. In this study they created a surgical service between two hospitals separated by 400Km in Ontario, Canada[7].

Teleoperative systems consist of three parts: Robotic Arms (Slave sub-system); a controller system (Master sub-system) and a sensor system (reception of audio-visual data). These connected systems ensure the surgeon the ability to remote control the robotic arms and audio-visual feedback of the surgical field. The data transmission depends on the used technology: Digital VideoTransporting System (DVTS) Research and Education Network (REN), Integrated Service Digital Network (ISDN), Digital SubscriberLine (DSL), among others. The remote contact for educational purposes requires no sophisticated transmission systems as compared to what is required in the performance of surgeons distant from where is occurring the operative procedure. It is necessary to get real-time images with the lowest possible delay[8].

The cost to set up a room with a telelearning system can be reduced using simple technologies that do not compromise the quality or efficiency of the project. This was demonstrated by a work performed between Mexico and USA[9], in which students and surgeons in both countries interacted during surgeries through innovative connection by Skype ®. This model allowed the participation of students regardless of space limitations in the operating room, as well as reduced the risk of contamination and acidents[9].

Applicability of different technologies in telesurgery

The usefulness of the available technologies depends on the type of action we plan to use. In this context, multi-slave Da Vinci HD is ideal for teletutory using the tele-extraction, in which the surgeon makes digital drawings on a monitor and transmits the superimposed image of the operation room elsewhere. Challacombe et al. (2005) proved that teletutory reduced the learning curve for donor nephrectomy for renal transplantation, performed with the aid of a remote specialist[10]. Moreover, the Authomated Endoscopic System for Optimal Positioning (AESOP) allows the surgeon

to handle the video laparoscope and electrocautery for hemostasis and dieresis. The multi-slave systems include mechanical devices whose arms reproduce remotely precise movements of the surgeon who manipulate it[9].

In teleconsultation, a system capable of transmitting audiovisual data is sufficient to interaction between physician and patient, avoiding delays in diagnosis due to geographical distance difficulties, or lack of specialized experts. Despite the advantages of this technology, Al-Qirim et al. (2007) noted difficulties in teleconsultation in dermatology and psychiatry. Given the changes in the quality of image, dermatologists prefer to use it in follow up rather than a diagnostic tool. Psychiatrists said that the perception was impaired by behavioral audiovisual transmission[11]. However, this study demonstrated a lack of interest of the physicians in using the technology, coupled with limited experience and deficient technical support.

Specialties that can benefit

Specialties that rely on visual factor as dermatology, radiology and surgery benefit from telemedicine. Studies of Magann et al. in gynecology and obstetrics, refer to the transmission of images from ultrasound, colposcopy, fetal echocardiography, surgery, and gestational diabetes control, reducing the number of cases of macrossomy and cesarean, and safe postpartum follow up[12].

Telesurgery ethical issues

The harmonious relationship between doctor and patient facilitates patient adherence to treatment. As part of telesurgery, personal contact is compromised due to transmission limitations, requiring a joint effort in developing appropriate behavior and mutual trust.

According to Tronto (1998), interaction in care can be divided into: Caring-about, recognizing that someone needs care; Taking-care-of, the surgeon's responsibility to meet the needs of the individual; Care-giving, materialization of concrete actions on patient care and Care-receiving, evidence of favorable result from the surgical procedure[13]. Adapting this model to the doctor-patient relationship, we observe the process of decision making (Caring-about); Medical Intervention (linked to the 2nd and 3rd phases of Tronto) and the result (Care-receiving)[14].

In literature review, Wynsberghe et al. (2008), questioned whether the procedure execution by the telesurgeon undermines the sense of responsibility of the physician on site about the welfare of the patient. For this, it was suggested that there be a division of responsibilities in which the professional would be responsible for the issues inherent to the procedure (medical intervention phase), while the local surgeon would take care of the other stages of care (pre and postoperative) including authority to refuse the surgery if needed[15]. However, this model is not without bias. The lack of experience of the surgeon about telesurgical parameters may

compromise the correct judgment about the conditions to perform the operation. Furthermore, there are restrictions on the role of telesurgeon in the patient care.

It is important to say that, depending on the surgical procedure, the doctor-patient relationship may change. In urgent or emergency situations in a military context, aerospace or extreme environments, unlike elective procedures, priority is given to the surgery rather than the patient-surgeon relationship.

The telesurgery faces basic ethical difficulties. For example, responsibilities about payment of providers are not yet established, and this service is subject to discrepancies of different health systems. Arriaga et al. (2010) related in a study of victims of Hurricane Katrina, that doctors received payments from private health insurers by contracts previously established[16].

With regard to the medico-legal issues, this practice lacks universal law, since some doubts persist about the protection of doctors, patients, telecommunications network provider of robotic systems and the entire care team involved. In general, the solution to alleviating the ethical problems is "standardization" related to payments or the legislation on which it relies to address problems that may arise. For telesurgery develop and benefit regions deprived of specialized services, it is imperative to establish national and international rules[16].

Advantages resulting from telesurgery

The telesurgery extends medical assistance, bringing benefits to doctors, patients and the health system. Among the main advantages are: support for surgical cases in remote locations that do not have specialists, reduction costs and time in transfer of patients to referral centers; the use of technology within a single health center; possibility of telesurgeon assist the perioperative patient at distance; performing advanced operations remotely; teaching tool in training surgeons.

The surgeries in countries at war, victims of natural disasters or humanitarian crises has always been an obstacle to the appropriate surgical care and quality. Accordingly, telesurgery allows contact local surgical team who work with surgeons using advanced technology[4]. Doctors who work far from major centers, can benefit from teletutory or telecare, running more complex activities with the help of experienced professionals of tertiary services, improving health care to patients. Rifat Latifi et. al. (2009) observed that telesurgery proved a viable alternative when performed between rural hospitals and a level one trauma center located in the urban area, serving patients of general surgery and traumatology and reducing significantly the cost of transfers[17].

Generally, the trauma center is located in urban areas, which requires the use of air or road transport patients who need specialized care. The creation of a teletrauma program where a surgeon specializing in trauma guided surgeons from rural areas, helped initial treatment and recovery of traumatized patients, improving outcomes and reducing healthcare costs[17].

Hjelm et. al. (2002) used a telecommunication system in the teaching Prince of Wales Hospital - Hong Kong, allowing healthcare professionals to access and

connect to the medical school, which allowed the use of audiovisual media in a restricted area, improvements in health and medical education[18].

Lavrentiev et al (2008). reported the contribution of telecare in deploying telemedicine and surgical clinic in a prison in the state of Virginia, United States. The telesurgery promoted surgeon access, low cost and quality care through the use of videoconferencing and recording of data, replacing the conventional transport patients for pre and post-operative consultations. Thus, the researchers concluded that telemedicine is effective in health care in this specific group of patients[19].

The telesurgery is used in training surgical residents and undergraduates. Panait et al. (2006) monitored and evaluated the learning laparoscopic twenty medical students with no previous laparoscopic experience using virtual reality surgical simulator (Lapsim), with the help of a mentor and a local telementor. It was evident that the integration of instructional media with tele-education was as effective as classroom learning in the development of surgical skills, reaffirming the importance of remote telesurgery and teletutory in medical education[20].

Technical issues inherent to telesurgery

The cost of seting up a telemedicine system is relatively low. The existence of a simple conventional internet connection may be useful in respect to teletutory and teleconsultation in surgery. There are many telecommunication systems that can be installed in healthcare facilities, varying the type of media that is transmitted to the needs of surgeons and servies4. In dermatology and plastic surgery, the visual data must have the best possible resolution without corrupting the transmission of static or dynamic image with excelent quality. In radiology, imaging tests must be passed in all its details, preserving the sharpness via telemedicine8.

As more data is transmitted, the greater the demand for broadband connection for a quality service. Thus, the needs of the type of assistance provided via telemedicine determine the connection type, transmission and quality of data shared electronically, seeking a better use, service and resolvable reduction of cost3,12,14.

In telesurgery, the cost of buying, deploying and maintaining technological equipments necessary for the reception and transmission of operative data, are high since it should work without any delay or compromise in response between the master and slave subsystems, ensuring execution telesurgery similar to the vive in person convencional surgery[9,16].

The maintenance of computer systems should be performed periodically in order to prolong the use and avoid damage to the telesurgical service. Moreover, the presence of specialized technicians to operate the system is needed, especially in hospitals with limited financial resources. The more complex the telesurgical system, the greater the need for trained personnel for adequate operation and maintenance[8].

CONCLUSION

The present review describes the feasibility and safety of robot-assisted telepresence surgery in delivering surgeries in smaller communities and in the war setting, and in improving the training of advanced surgical skills among residents in teaching hospitals and surgeons practicing in these locations. As future developments in technology result in user-friendly robotic systems that are easier to transport and set up, they may even provide lifesaving emergency surgical care in remote localities in the absence of a local surgeon or physician.

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