Original articles

and Other Interventional Techniques

Results of a randomized trial of HERMES-assisted vs non-HERMES-assisted laparoscopic antireflux surgery

J. D. Luketich, H. C. Fernando, P. O. Buenaventura, N. A. Christie, S. C. Grondin, P. R. Schauer

Minimally Invasive Surgery Center and Division of Thoracic and Foregut Surgery, University of Pittsburgh Medical Center Health System, 200 Lothrop Street Suite C-800, Pittsburgh, PA 15213, USA

Abstract

Background: Speech recognition technology is a recent development in minimally invasive surgery. This study was designed to assess the impact of HERMES on operating room efficiency and user satisfaction.

Methods: Patients undergoing laparoscopic antireflux operations by surgeons experienced in minimally invasive surgery were randomized to HERMES-assisted or standard laparoscopic operations. The variables of interest were circulating nurse's time spent adjusting devices that are voice-controlled by HERMES, number of adjustments to devices requested, and surgeon and nurse satisfaction measured on a scale from 1 (dissatisfied) to 10 (satisfied).

Results: A total of 30 cases were studied. In the non-HERMES cases, nurses were interrupted to make device adjustments an average of 15.3 times per case versus 0.33 times per case in the with-HERMES cases ($p < 0.01$). The interruptions during the non-HERMES cases averaged 4.35 min per case versus 0.16 min per case in the with-HERMES cases ($p = 0.03$). Average satisfaction scores for HERMES operations as opposed to non-HERMES operations were 9.2 versus 5.3 for nurses ($p < 0.01$) and 9.0 versus 5.1 for surgeons ($p < 0.01$).

Conclusions: Physician and nurse acceptance of HERMES was very high because of the smoother interruption-free environment.

Key words: Laparoscopic surgery — Robotics — Voice recognition

Surgery has changed significantly with the introduction of minimally invasive approaches. Industry support and public and physician enthusiasm have helped to drive changes making minimally invasive surgery (MIS) possible for complex procedures such as esophagectomy,

repair of giant paraesophageal hernia, and coronary artery bypass grafting [2–4]. A relatively new addition to the armamentarium of the surgeon performing MIS is the addition of speech recognition technology. Some surgeons may be familiar with the use of speech recognition for a voice-controlled robot arm (AESOP) to control the camera during MIS [1]. Recently, we introduced the HERMES Operating Room Control Center (Computer Motion, Santa Barbara, CA, USA) system into routine use at the University of Pittsburgh. This system uses voice recognition software to network surgical devices (Stryker Endoscopy, Santa Clara, CA USA), allowing the surgeon to control aspects of the operating room environment, with simple verbal commands. These aspects include the camera (white balance, zoom, shutter, and gain), printer (photographs), light source (brightness, on-standby control), insufflation (flow rate and pressure), and the operating room phone. During MIS procedures, the surgeon usually relies on the assistance of the circulating nurse or technician to adjust, set up, and trouble-shoot these devices while performing other duties such as ensuring staple and suture supply in the operating field and coordinating the collection of pathology specimens. Often, all these duties are the responsibility of one person. Giving the surgeons control of some of these duties should improve operating room efficiency.

This study documents changes in operating room efficiency and personnel satisfaction when the HERMES system is used in MIS. Our hypothesis was that using the HERMES system, would save time for the circulating nurse resulting in improved surgeon and nurse satisfaction.

Materials and methods

Study design

Approval to conduct the study was obtained from the University of Pittsburgh Institutional Review Board (IRB 991137). It was important to select a procedure commonly performed, with steps familiar to both

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Correspondence to: J. D. Luketich

the surgeon and the operating room personnel, so that the main difference between patients would be the use of the HERMES system. We elected to perform this randomized study in patients undergoing laparoscopic fundoplication for gastroesophageal reflux disease. Altogether, 30 cases were studied. Half were randomized to group 1 (with HERMES), and half were randomized to group 2 (without HERMES). The variables of interest were as follows: circulating nurse's time spent adjusting each device (camera, light source, insufflator, and phone), the number of device adjustments per case, circulating nurse satisfaction, and surgeon satisfaction. Satisfaction was measured on a scale from 1 (dissatisfied) to 10 (satisfied) for both the surgeon and the nurse. This scale has not been previously validated. We considered the data to be continuous, and t-test analysis was used to compare groups. Surgeons trained in MIS and familiar with the HERMES system performed all cases, and all operating room nurses were familiar with the use of the HERMES system. The system had been used in some cases for several months before the study. However, at the time of the study, not all surgeons would have selected the HERMES system by preference.

Operating room set-up

Before a case, the study coordinator randomized the case to either "with HERMES" or "without HERMES" and communicated this to the circulating nurse. The operating room was set up in the routine fashion for laparoscopic fundoplication, with all of the usual equipment positioned around the operating table. When, however, a case had been randomized to HERMES, the HERMES system was activated, and the primary surgeon wore the HERMES head set.

Data collection

An observer who was not part of the operating team was present in the operating room to record time and motion data and satisfaction data. Each time the surgeon needed a device adjusted, the surgeon would, depending on how the case had been randomized, either use the HERMES system or ask the circulating nurse to make the adjustments. The data collector would immediately record the device and the time it took the circulator to complete the task. The devices included in the study were the camera, light source, insufflator, and phone. All information was collected and entered directly into a laptop computer during each case. At the conclusion of each case, the observer ensured that both the surgeon and circulator completed the satisfaction survey.

Statistical analysis included calculation of the mean number of instrument adjustments, nurse time required for adjustments, and satisfaction scores. Means were compared by t-test analysis.

Results

The study included 30 patients undergoing laparoscopic Nissen fundoplication for GERD. These patients were randomized from March through July 2000: 15 to a "without HERMES" group and 15 to a "with HERMES" group. Table 1 shows that during the "without HERMES" cases, the surgeon asked the nurse to make an average of 15.3 adjustments per case, as compared with 0.33 adjustments ($p < 0.01$) in the HERMES-assisted cases. Table 2 compares nurse time required for device adjustments or assistance for cases with and without HERMES. Significantly less ($p = 0.03$) time was required for the HERMES cases. Satisfaction surveys show that both surgeons and nurse prefer HERMES. The mean satisfaction scores for HERMES versus non-HERMES cases were 9.2 versus 5.3 for the nurses ($p < 0.01$) and 9.0 versus 5.1 for the surgeons ($p < 0.01$).

Table 1. Number of device adjustments requested to nurse

| | Total adjustments required | |
Device	Without HERMES ($n = 15$)	With HERMES ($n = 15$)
Camera	70	0
Light	50	0
Insufflator	82	0
Phone call assistance	27	5
Total	229	5
Average per case	15.3	0.33
p value	<0.01	

Table 2. Amount of nurse-time required to adjust devices

| | Nurse time required (min) | |
Device	Without HERMES ($n = 15$)	With HERMES ($n = 15$)
Camera	10.75	0
Light	5.93	0
Insufflator	11.22	0
Phone call assistance	37.40	2.50
Total	65.30	2.50
Average per case	4.35	0.16
p value	0.03	

Discussion

Most institutions currently perform MIS procedures routinely as part of the daily operating workload. Many are also working with a dwindling pool of operating room personnel. Using voice-activated technology to control the operating environment may improve efficiency and increase operating room personnel productivity. Since this study was completed, we have expanded our use of HERMES to include the operating room lights and positioning of the operating room table, allowing the surgeon even greater control of the environment. Allaf et al. [1] compared a voice interface to a foot pedal control of the AESOP surgical robot and demonstrated that the voice control interface had the advantage of not requiring the surgeon to look away from the operative field. Our study expanded on those findings and applied voice recognition software interfacing to additional operating room devices.

Our study demonstrated that the mean nurse time saved per case was 4.35 min. This savings is statistically but not practically significant. However, satisfaction scores show that both surgeons and nurses prefer the HERMES system. Although the reasons for this may not be apparent from the time-saving data alone, other factors contributing to the overall flow of the operative procedures may have been responsible. One surgeon, at the beginning of the study, was leery about using the HERMES system, but as the study progressed, this surgeon expressed increased satisfaction with the HERMES-assisted cases. Another factor may be phone use. Under standard operating procedures, the surgeon must step away from the surgical field to use the phone. A dedicated phone line is used with the HERMES system, and the operation does not have to be interrupted for phone calls.

This is one of the first randomized studies to investigate voice control of the operating room environment. The HERMES system eliminated an average of 15 physician-directed nursing commands per case. Although the circulating nurse's time was reduced by only 4.35 min, there was a marked increase in operating room personnel satisfaction with this system. Speech recognition technology is a significant development that will be prominent in the operating rooms of the future.

References

1. Allaf ME, Jackman SV, Schulam PG, Cadeddu JA, Lee BR, Moore RG, Kavoussi LR (1998) Voice vs foot pedal interfaces for control of the AESOP robot. Surg Endosc 12: 1415–1418
2. Damiano RJ, Ehrman WJ, Ducko CT, Tabaie HA, Stephenson ER, Kingsley CP, Chambers CE (2000) Initial United States trial of robotically assisted endoscopic coronary artery bypass grafting. J Thorac Cardiovasc Surg 119: 77–82
3. Luketich JD, Raja S, Fernando HC, Campbell W, Christie NA, Buenaventura PO, Keenan RJ, Schauer P (2000) Laparoscopic repair of giant paraesophageal hernia: 100 consecutive cases. Ann Surg 232: 4: 608–618
4. Luketich JD, Schauer PR, Christie NA, Weigel TL, Raja S, Fernando HC, Keenan RJ, Nguyen NT (2000) Minimally invasive esophagectomy. Ann Thorac Surg 2000: 70: 906–912