Quality of Communication in Robotic Surgery and Surgical Outcomes

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ABSTRACT

Background and Objectives: Robotic surgery has introduced unique challenges to surgical workflow. The association between quality of communication in robotic-assisted laparoscopic surgery and surgical outcomes was evaluated.

Methods: After each gynecologic robotic surgery, the team members involved in the surgery completed a survey regarding the quality of communication. A composite quality-of-communication score was developed using principal component analysis. A higher composite quality-of-communication score signified poor communication.

Objective parameters, such as operative time and estimated blood loss (EBL), were gathered from the patient's medical record and correlated with the composite quality-of-communication scores.

Results: Forty robotic cases from March through May 2013 were included. Thirty-two participants including surgeons, circulating nurses, and surgical technicians participated in the study. A higher composite quality-of-communication score was associated with greater EBL ($P = .010$) and longer operative time ($P = .045$), after adjustment for body mass index, prior major abdominal surgery, and uterine weight. Specifically, for every 1-SD increase in the perceived lack of communication, there was an additional 51 mL EBL and a 31-min increase in operative time. The most common reasons reported for poor communication in the operating room were noise level (28/36, 78%) and console-to-bedside communication problems (23/36, 64%).

Conclusion: Our study demonstrates a significant association between poor intraoperative team communication and worse surgical outcomes in robotic gynecologic surgery. Employing strategies to decrease extraneous room noise, improve console-to-bedside communication and team training may have a positive impact on communication and related surgical outcomes.

Key Words: Communication, Gynecology, Robotic surgery, Surgical outcomes, Teamwork.

INTRODUCTION

The use of robotic-assisted laparoscopic surgery in minimally invasive gynecology has been rapidly increasing since the da Vinci robotic platform (Intuitive Surgical Inc, Sunnyvale, CA, USA) was approved for this purpose by the Food and Drug Administration in 2005. The rate of robotic hysterectomy is estimated to have increased from as low as 0.5% in 2005 to as high as 22% in 2010.[1] Approximately one half of all minimally invasive hysterectomies are now performed robotically.[2] This technology addresses the ergonomic challenges of traditional laparoscopy by providing a 3-dimensional view, wristed instruments, and diminished tremor for more precise movements, and potentially offers more patients the benefits of laparoscopy, including shorter hospital stays, decreased intraoperative blood loss, faster recovery, and decreased wound infections.[3,4] As robotics represents an increasing percentage of minimally invasive procedures in gynecology, the debate over the relative benefits of robotic vs conventional laparoscopic surgery is driven by questions of cost, safety, credentialing, and medicolegal issues.[5,6]

Robotic surgery presents surgical teams with a radical departure from the operating room (OR) culture of open surgery and even conventional laparoscopy. The large

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footprint of the platform and its complexity changes the demands on the OR team and may adversely affect efficiency. Team members are separated in space and lack face-to-face communication. Teamwork and communication have been highlighted as 2 essential components of OR safety.[7] To date, few studies have investigated the inherent communication challenges in robotic surgery. The purpose of this study was to evaluate the association between the quality of communication and surgical outcomes, specifically operative time, blood loss, and perioperative complications.

MATERIALS AND METHODS

We conducted a prospective questionnaire-based pilot study from March 1 through May 31, 2013, at a university-affiliated tertiary care medical center. Surgeons, circulating nurses, and surgical technicians involved in robotic gynecologic surgery were invited to participate. The anesthesia team was excluded because of frequent personnel turnover during case assignments, precluding adequate study participation. All participants signed an informed consent and were assigned a study identification number by the study administrator to maintain anonymity. Participating attending surgeons had an average experience of 7 years in robotic surgery. Circulating nurses and surgical technicians assigned to those cases were core members of the robotic surgical team. Minimally invasive surgery fellows and obstetrics and gynecology residents were also involved in the study. All robotic gynecologic surgeries for benign indications during the study period were included.

At the end of each surgery, team members completed a survey regarding the quality of communication in the OR. The survey was based on 2 validated questionnaires: the Safety Attitudes Questionnaire and the psychometric testing of interpersonal communication skills questionnaire.[8] We focused on the following aspects: individual communication skills, teamwork, efficiency, and provider satisfaction. In addition, participants were asked to identify the major factors affecting communication during the case: noise level in the OR, console-to-bedside communication problems, lack of nurse availability, lack of instrument availability, lack of participant familiarity with the procedure, other, or none.

Patient data were obtained from the electronic medical records. Baseline information regarding demographics and patients' medical and surgical history were collected. In addition, operative details and outcomes were gathered, including estimated blood loss (EBL), operative time, and perioperative complications. Patient clinical information was correlated with the survey results. The study was approved by the Henry Ford Health System Institutional Review Board.

Statistical analysis was performed using SAS 9.3 (SAS Institute, Inc., Cary, NC, USA). Team members' responses were stratified by role. The 13 survey questions were independently correlated with surgical outcomes using Spearman correlational coefficients. In addition, to assess the overall perception of the quality of communication, we subjected the 13 survey questions to a principal component analysis, creating a composite quality of communication (cQOC) score. The cQOC score was constructed such that *higher* scores indicated *worse* communication. Multivariate linear regression models were used to assess the relationship of cQOC to surgical outcomes.

In the absence of prior similar studies, a sample size could not be determined a priori. We estimated that 40 cases would be needed for the purpose of this study.

RESULTS

A total of 40 robotic surgeries were included. Thirty-two OR team members participated in the study, and 108 surveys were completed. The response rates stratified by participant's role are detailed in **Table 1**. The average response rate was 60% (105/174), with a lower rate in fellows (9/22; 41%) and a higher rate in circulating nurses (34/43, 79%; $P = .025$).

Clinical information regarding the patient and the procedure performed are outlined in **Table 2**. A total of 24 hysterectomies, 11 robotic myomectomies, 3 sacrocolpopexies with or without hysterectomy, 1 advanced endometriosis resection, and 1 trachelectomy were included in the study. Fifty percent of the patients had undergone a laparotomy.

Table 1.
Response Rates Stratified by Professional Category

Medical Staff (n)[a]	Response Rate, n (%)	*P*
Attending (5)	22/41 (54)	.025[b]
Fellow (2)	9/22 (41)	
Resident (11)	15/28 (54)	
Circulator (11)	34/43 (79)	
Scrub (9)	25/40 (63)	
Total (32)	105/174 (60)	

[a]n, total number of participants per professional category.

[b]Significance attributed to the difference in response rate between fellows and circulators only.

Table 2.
Baseline Demographics and Clinical Information

Variable	Mean (SD)
Age (years)	43.10 (9.86)
Body mass index	31.94 (6.05)
Estimated uterine size (weeks)	12.94 (3.59)
Type of robotic surgery, n (%)	
Myomectomy	11 (27.5)
Hysterectomy	24 (60)
Sacrocolpopexy (±hysterectomy)	3 (7.5)
Endometriosis resection	1 (2.5)
Trachelectomy	1 (2.5)
Surgical outcomes (mean ± SD)	
Estimated blood loss (mL)	142.13 (169.77)
Room-in–to–room-out (minutes)	277.78 (92.89)
Room-in to cut (minutes)	45.31 (9.82)
Cut to close (minutes)	214.34 (94.44)
Uterine weight (gram)	386.53 (344.82)

n = 40. SD, standard deviation.

Spearman correlation between individual quality-of-communication survey items and surgical outcomes showed few significant associations. Higher quality-of-communication scores on the item, *Others misunderstood me because they misinterpreted my words or actions*, correlated with a longer room-in–to–room-out time ($P < .01$). Similarly, higher scores on the item, *I asked others to repeat themselves because I didn't understand/hear their message the first time,* correlated with a greater EBL ($P < .05$).

Analysis of the cQOC score showed an association between the quality of communication in the OR and both cut-to-close time and EBL, when controlling for body mass index, prior abdominal surgery, type of procedure, and uterine weight in separate multivariate linear regression models. A higher cQOC score was significantly associated with a greater EBL ($P = .010$) and a longer operative time ($P = .045$). The coefficients presented in **Table 3** demonstrate that for every 1-SD increase in the perceived deficit in quality of communication, there was an additional 51-mL of EBL and a 31-min increase in operative time.

We compared how the different team members judged the quality of communication in the OR, and we found that, for most questions, surgeons rated communication to be worse than did circulating nurses and surgical technicians. For example, surgeons agreed with the statement, *Steps took longer than necessary because I or others had to repeat/clarify what they were saying*, at significantly higher rates than did nurses and surgical technicians (mean 1.4, SD 0.6 vs. 0.8, SD 0.8; $P < .001$). Despite a difference in mean cQOC scores between surgeons vs. circulating nurses and surgical technicians, both groups' responses showed that higher cQOC scores were associated with a longer operative time and a greater EBL.

The most commonly reported factors that negatively affected the quality of communication were the following: the noise level in the OR (28/36; 78%), console microphone/console-to-bedside communication (23/36; 64%); and the lack of familiarity of participants with the procedure (22/36; 61%) (**Table 4**). There was no significant difference between team members' report of factors that negatively affect the quality of communication. There were a total of 5 perioperative complications: 1 cystotomy, 1 conversion to laparotomy, 1 suspected postoperative transient ischemic attack, and 2 readmissions for postoperative abscesses. However, we did not find any associations via logistic regression between cQOC and perioperative complications, ($P > .999$).

DISCUSSION

We present an evaluation of the association between the quality of communication and surgical outcomes in robotic surgery. Our study demonstrated that poor quality of communication is associated with a longer operative time and a higher EBL.

Our survey was based on 2 validated questionnaires including both experienced and inexperienced team members. Our results illustrate the complexity of communication in the robotic OR and demonstrate for the first time the differences encountered in the perception of communication between team members stratified by their role. Robotic surgery has introduced unique and novel challenges to the workflow of a surgical team that have never been experienced before. The surgeon and surgical assistants are physically separated in space. More specifically, surgeons operate while sitting at the surgeon's console, and their field of vision focuses on the 3-dimensional viewer. Several meters away from the surgeon's console, the large robotic patient cart (the platform that attaches to the patient and holds the operating instruments) often obscures the surgeon's view of their assistants at the patient's bedside.

The physical distance and obstacles create an auditory, visual, and physical barrier between team members, po-

Table 3.
Correlation Between Quality of Communication and Surgical Outcomes

	Dependent Variable			
	Cut-to-Close Time	Room-in–to–Room-out	Room in to Cut	EBL
Predictor variable	β^a (*P*)	β (*P*)	β (*P*)	β (*P*)
Quality of communication[b]	**31.03 (.045)**	24.10 (.109)	0.16 (.940)	**51.00 (.010)**

[a]Nonstandardized coefficients of correlation.
[b]Controlled for body mass index, prior major abdominal surgery, and uterine weight.
Bold denotes significant results.

Table 4.
Factors affecting communication

Factor	No n (%)	Yes[a] n (%)
Change of staff	29 (74)	7 (26)
Noise level	8 (22)	28 (78)
Instrument availability	20 (56)	16 (44)
Participants' lack of familiarity with procedure	14 (39)	22 (61)
Microphone	13 (36)	23 (64)
Nurse availability	25 (69)	11 (31)
Physician fatigue	35 (97)	1 (3)
None	23 (64)	13 (36)

[a]At least 1 participant reported the issue as occurring in each case.

tentially hampering efficient communication. Surgical teams have traditionally heavily relied on a multitude of nonverbal communication tools, such as body language and eye contact, to anticipate the next step in the workflow of a given surgery.[9] It is not until surgeons encounter auditory, visual, and physical barriers that they realize how much they have been relying on those cues for efficient communication.

Cao and Taylor[10] reported that the complexity of the robotic setup causes a communications breakdown in the robotics OR and potentially deleterious effects on team function, decision-making, and flow of information. They demonstrated that group tasks were executed with greater efficiency and accuracy in a simulated robotic cholecystectomy in which subjects used scripted speech patterns to communicate with team members. Webster and Cao[11] concluded that facilitated team communication can ease adaptation to new technologies that disrupt customary workflow.

Our data indicate that decreased quality of communication is attributable to modifiable factors: a high level of noise in the OR, problems with console microphone and console-to-bedside communication, and lack of familiarity of participants with the procedure. The high level of noise in the room may result from both the substantial background noise generated by the vision console and team members speaking loudly to communicate across significant distances. The current built-in da Vinci audio system available may not address properly the communication challenges experienced by team members. Engineering solutions to these communication barriers may decrease provider mental load and improve surgical outcomes.

Our data suggest a direct relationship between the team members' experience and quality of communication. When nurses and trainees who are inexperienced in robotic procedures participate in these cases, it may negatively affect team functioning. Adoption of systematic approaches to integrating new team members into the robotic OR may avoid deleterious consequences caused by poor team dynamics.

There is an expanding body of literature on evaluating the effect of these modifiable factors on teamwork, communication, and provider mental load based on the assumption that suboptimal working environment may affect surgical outcome.[12] The current study demonstrated that this assumption has merit. Recognizing the importance of further defining this relationship, Randell and colleagues[13] are undertaking a large-scale study to understand and improve communication and teamwork in robotic surgeries.

Finally, our study showed that, not only did both surgeons and nurses share the same perception regarding teamwork, but surgeons were more critical of team performance. Prior studies evaluating attitudes regarding patient safety in the OR have shown that nurses tend to be more critical than physicians and that physicians have a tendency to have limited insight regarding their team members' perception of performance, safety, and teamwork.[14–16] The finding in our study that surgeons are more critical or concerned than nurses regarding team integration may reflect a loss of sense of control experienced by the robotic surgeon, located distant from the patient and the rest of the team.

The current study has several notable limitations. It was 1 institution's experience and had a small sample size, thus limiting the generalizability of the data. Whereas response rate differed by type of participant and may represent response bias, there were no significant differences in the perception of communication, stratified by role. The study is survey-based and represents correlational data only. Although we cannot determine a cause-and-effect relationship, this study does establish a clear relationship between the complexity of surgery and poor communication in robotic gynecologic surgery and provides a rationale for further comprehensive study. More objective methods of assessing communication effectiveness, such as videotaped analysis, can be employed in addition to subjective assessment in future studies.

CONCLUSION

Our study demonstrated that the diminished quality of communication reported by OR team members is associated with more adverse metrics of patient outcomes. Ambient noise, audio clarity, and team members' inexperience, all contributed to lower communication scores.

Overcoming the communication and teamwork obstacles introduced by robotic surgery may increase patient safety. Future studies are needed to assess interventions for improvement in communication and teamwork in the robotics OR.

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