Current status of robot-assisted surgery in urology: a multi-national survey of 297 urologic surgeons

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Purpose: *The surgical robot is becoming an important tool for performance of minimally invasive surgical procedures around the world. We surveyed opinions about and utilization of robot-assisted surgery among urologic surgeons from 44 countries.*

Material and methods: *A total of 297 surveys were completed from September to November 2008 by participating urologic surgeons polled at various national and international urologic meetings. The survey evaluated surgeon background, personal experience with minimally invasive surgery, institutional status regarding robotic surgery surgeons' attitudes towards robot-assisted surgery, in general, and prostate, bladder and kidney oncologic procedures, specifically.*

Results: *Two hundred ninety-seven participants completed the survey of which 35% were in training for and 54% in practice of urology. Although 57% of these participants were older than 40, 62% had never sat on a robotic surgical console but 61% believed they would perform robot-assisted surgery. Seventy-eight percent of respondents felt it was required or beneficial to have training in robot-assisted surgery. Only 21% of respondents were currently performing robot-assisted radical prostatectomy. Sixty-one percent of respondents felt robot-assisted radical prostatectomy was the current gold standard or as good as laparoscopic prostatectomy. Only 10% had performed robot-assisted radical cystectomy and 70% of these surgeons have transferred skills from robot-assisted radical prostectomy. Ten percent were performing robot-assisted radical nephrectomies and 30% had transferred skills for laparoscopic partial nephrectomy to robot-assisted partial nephrectomy.*

Conclusion: *Robot-assisted surgery has begun to integrate into the minimally invasive armamentarium for urologic surgery and is applied for more procedures as experience is gained.*

Key Words: urology, laparoscopy, robotics, robot-assisted, robot, residency, education, training, surgical training, minimally invasive surgery

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Introduction

A minimally invasive approach towards urologic procedures over the last decade has caused a paradigm shift and is now incorporated into surgical practice.

Introduction of robot-assisted surgery (RAS), especially for prostatectomy, has shifted the steep learning curve of pelvic laparoscopy and eased this difficult procedure into common practice.[1,2] Residency training programs have started incorporating basic skills sufficient for residents to become comfortable applying robot assistance to their subsequent practice. The current study is the first detailed survey which evaluates the opinion and trends of urologic surgeons specific to robot-assisted surgery.

Materials and methods

An expert panel of robotic surgeons (Khurshid A. Guru MD, James O. Peabody MD and Mani Menon MD) was convened to evaluate opinions regarding various critical aspects of RAS. Review of literature to assess opinions and status of robot-assisted surgery was conducted prior to the panel meeting. Based on recommendations from the panel, the questionnaire was designed with focus on general issues in RAS and specific concerns regarding various procedures currently performed. All sections of the survey were reevaluated by the panel for content and validity.

From October to November 2008, the questionnaire was provided to 305 urologic surgeons (resident physicians in training and practicing urologic surgeons) who volunteered to participate in the survey during national and international academic meetings (two general urologic and one minimally invasive) held in the United States, Europe, and Asia.

An introductory orientation by a research associate, nurse or physician assistant introduced the five sections of the survey. The questionnaire consisted of a total of 58 questions assessing current status of robot-assisted surgery

Statistical analysis

Statistical analysis was performed using Statistical Analysis Software (SAS) version 9.1.3. Categorical variables were expressed as percentages, while continuous variables were expressed as means. All percentages reported were based on the number of responses available.

Results

Demographics

A total of 305 surveys were provided to the participants. Eight participants were excluded from the study because the survey was incomplete in more than one section. Of the participants, 35% were urologic surgeons in training (20% residents and 15% fellows), 54% were practicing urologic surgeons, and 11% were medical students. Among respondents, 57% were older than forty. Participants were from 42 countries across four continents; 53% were from Asia, 24% from Europe, 19% from North America and 4% were from the Middle East, Table 1.

Minimally invasive surgery (laparoscopic or robot-assisted) was being performed at 86% of the respondents practicing institutions, but only 64% received some form of minimally invasive surgery training. Of 185 surgeons, 107 surgeons were formally trained in laparoscopy (mean number of years practicing since training = 4.5) while only 20% of the surgeons were formally trained in robot-assisted surgery (mean number of years since training = 2.8). Of the staff surgeons who were formally trained in laparoscopic surgery, 46% had some exposure to robot-assisted surgical training during their fellowship. 45% of respondents had participated as primary surgeons or as first assistants in less than 50 laparoscopic urologic procedures.

Minimally invasive surgery was incorporated into the urologic training program by endourology (60%), urologic oncology (26%) or both these specialties (14%). Sixty-two percent of the respondents had never sat on a robotic surgical console although 61% believed they would perform robot-assisted surgery during their surgical career. Seventy-eight percent felt it was

TABLE 1. **Demographics**

	No. of respondents (%)
Sex (n = 289)	
Male	286 (99)
Female	3 (1)
Age (n = 295)	
25-30	37 (13)
31-40	89 (30)
41-55	144 (49)
> 55	25 (8)
Level of training (n = 290)	
Medical student and others	32 (11)
Resident	57 (20)
Fellow	45 (15)
Faculty	156 (54)
Years practicing urology (n = 286)	
0-4	65 (23)
4-10	65 (23)
> 10	156 (54)
Continent (n = 291)	
Asia	155 (53)
Europe	69 (24)
Middle East	11 (4)
North America	56 (19)

TABLE 2. **Disposition**

Q1: What is the level of importance of robot-assisted surgical training in your career goals? (n = 283)		
None		12
Minimal		10
Beneficial		45
Required		33
Q2: Would a robot-assisted surgery program: (n = 248)		
Strengthen the department: academically		35
Strengthen the department: financially		3
Strengthen the department: both		49
Strengthen only minimally invasive surgery		13
Q3: What inhibits the development of a robot-assisted surgery program at your institution? (n = 215)		
Need for an institutional robot system	Yes	50
	No	50
Administrative disinterest, lack of support	Yes	38
	No	62
Lack of OR allocation	Yes	13
	No	87
Lack of academic evidence	Yes	8
	No	92

required or beneficial to have robot-assisted surgical training, but 12% saw no benefit to such training. If given an opportunity, 83% would consider robot-assisted surgery training. Given an option to choose of multiple responses regarding robot-assisted training, 71% would pursue a formal minimally invasive surgery fellowship, 18% would be satisfied with proctorship, 13% would either self train or take a sabbatical, and 11% felt satisfied with their training during residency.

Of the respondents without a robot-assisted surgical program at their institution, 50% desired an institutional robotic system but 8% thought robot-assisted surgery lacked scientific justification, Table 2.

Robot-assisted radical prostatectomy

Robot-assisted radical prostatectomy was performed by 21% of surgeons and 36% of the institutions were represented by the respondents. Thirty-one percent of surgeons have been performing robot-assisted radical prostatectomy since 2002 and 31% of the institutions did more than 200 cases per year. With multiple options to choose from 54% of surgeons transferred skills from open to robot-assisted radical prostatectomy, 27% transferred skills from laparoscopic to robot-assisted radical prostatectomy and 22% went from open to laparoscopic to robot-assisted radical prostatectomy.

Sixty-four percent indicated that they or other faculty were still performing open prostatectomy at their institution. Of the participants who responded further, 50%, 23%, and 27% reported that their volume of open cases decreased by 75%, 50%, and 25%, respectively. Only 22% of the respondents indicated that they or other faculty were still performing laparoscopic radical prostatectomy at their institution (mean cases/year = 49) and of the participants who responded further, 20% and 80% claimed that the volume decreased by 75% and 25% respectively.

Forty percent of respondents felt that robot-assisted radical prostatectomy is the current gold standard and 21% considered it to be as good as laparoscopic prostatectomy. Meanwhile, 23% of surgeons felt that it is too early to judge. Only < 1% felt that robot-assisted radical prostatectomy should be discouraged. Seventy-eight percent would consider or recommend robot-assisted radical prostatectomy if they or their family member needed radical prostatectomy while only 13% and 10% would recommend open or laparoscopic radical prostatectomy, respectively, Figure 1.

Robot-assisted radical cystectomy (RARC)

Ninety percent of respondents had never performed a RARC and 84% revealed RARC was not performed by any surgeon at their institution. Ninety percent performing RARC did less than 50 cases per year and only 10% performed 50-100 cases annually. Twenty-nine percent of the surgeons reported that they had started performing RARC since 2005.

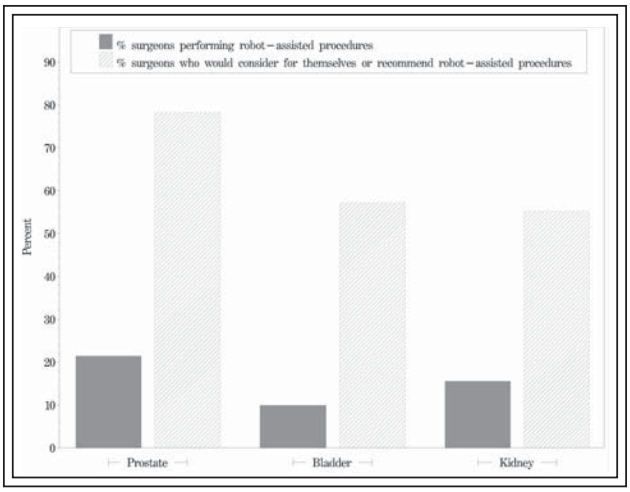

Figure 1. Percentage of respondents performing robot-assisted urologic surgical procedures and percentage of respondents who recommend robot-assisted urologic surgery.

Seventy percent of RARC-performing surgeons transferred skills from robot-assisted radical prostatectomy (RARP) to RARC. Of the surgeons who transferred skills from RARP, 52% had started performing RARC after completing less than 50 cases, 34% after 50-100 cases and only 13% after 101-200 cases. Seventy-nine percent of 38 RARC surgeons were performing open radical cystectomy before embarking on robot-assisted surgery for bladder cancer; in comparison to 21% who were performing conventional laparoscopic cystectomy. Eighty-seven percent of these surgeons felt that less than 100 cases of RARP were needed before starting RARC comfortably and only 13% felt 100 cases of RARP were necessary to be proficient with RARC.

Of the respondents, 40% felt that the greatest advantage of RARC was their recovery of quality of life and only 21% felt cancer control had a significant advantage. Regarding the correct status of RARC, 31% felt that it is too early to judge in term of acceptable oncologic outcomes and 3% concluded that RARC should be discouraged. Fifty-seven percent respondents felt that if they or their family member needed a radical cystectomy, they would undergo or recommend RARC. Thirty-one percent would consider or recommend open and 11% would consider or recommend laparoscopic cystectomy, Figure 2. Of the respondents who performed RARC and pelvic lymph node dissection, 37% replied that urinary diversion should be performed open and 41% felt it should be completed with robot assistance. Fifty percent of the respondents felt access to proximal lymph node dissection would not be difficult with a regular three or four arm robotic system, while 75% respondents concluded that there could be an advantage to using the da Vinci S System.

Robot-assisted radical nephrectomy (RARN)

Eight-four percent of the respondents had never performed RARN and 77% replied that neither they nor other surgeons at their institution had ever performed RARN. Seventy-one percent of surgeons performing RARN had completed less than 50 cases per year, 17% completed 50-100 cases/year and only 12% had performed 100-200 cases/year. Of surgeons performing RARN, 82% transferred operative skills to robot-assisted nephrectomy. Thirty-nine percent transferred operative skill directly from open to RARN, 39% from open to laparoscopic to RARN and 30% from laparoscopic to RARN.

Of the respondents, 75% of surgeons (mean cases/year = 38) indicated they or other faculty were still performing open radical or partial nephrectomy at their institution. Twenty-nine percent, 42%, and 29% surgeons claimed that their radical nephrectomy volume had decreased by 75%, 50%, and 25%, respectively. 67% of surgeons indicated that they or other faculty are still performing laparoscopic radical nephrectomy at their institution while (mean cases/year = 33) 10%, 40% and 50% claimed that their laparoscopic nephrectomy volume decreased by 75%, 50%, and 25%, respectively.

Seventy-nine percent of respondents felt less than 50 cases of robot RARN were needed before one was comfortable with RARN. In comparison, 58% felt less than 50 cases and 35% felt 50-100 cases and were required before one is comfortable with RARN. Totally, 70% of respondents felt quality of life and ease to perform these cases with robot-assistance were the greatest advantages of RARN meanwhile only 26% felt cancer control was an advantage.

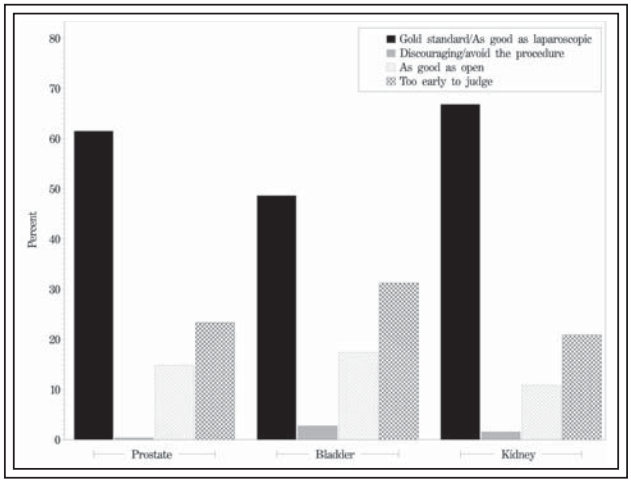

Figure 2. Opinions of respondents on current status of robot-assisted urologic surgical procedures.

Only 34% felt RARN and robot-assisted partial nephrectomy (RAPN) were as good as laparoscopic options while 21% felt it was too early to judge. Fifty-five percent respondents would recommend RARN/RAPN for themselves or their family members, although 35% felt comfortable with laparoscopic nephrectomy and 12% replied that they still would recommend open radical or partial nephrectomy. Seventy-one percent felt ischemic time would not be prolonged with robot assistance. Sixty-two percent felt that the console surgeon depended more on laparoscopic assistance during RARN or RAPN. Selecting multiple options, 51% of respondents felt 3D vision and 39% felt the presence of endowrist may have significant advantages for robot-assisted surgery over laparoscopic surgery in kidney procedures. Fifty-three percent of respondents felt mobility of arms was an issue in reaching the bladder cuff during robot-assisted nephroureterectomy.

Discussion

Advances are occurring rapidly in surgical sciences, especially in the last decade. Robot assistance applied to urologic surgery has been found particularly useful in the pelvis. Donias et al[3] surveyed robotic surgeons in 2002 reported that 90% of cases were performed using the Aesop robotic system and only 30% of surgeons had used the da Vinci Surgical System. Seventy percent of the surgeons who had used the robotic system in 2002 used the robot only to position and hold the laparoscope. In the Society of Gynecologic Oncologists (SGO) survey of 388 gynecologic oncologists published in 2009, more than 50% of cases attempted using a robotic system were completed with the system.[4] During this survey period, only the da Vinci surgical system was used by all surgeons. Despite wide use of the da Vinci system, 50% of surgeons surveyed in this study felt that the limiting step for development of a robot-assisted surgery program at their institution was lack of the ability to purchase a robotic system.

Seventy-two percent of the program directors in the study from 2002 stated that they had no plans of incorporating robotics into their surgical training in the future. Of those who did want to incorporate robotics in training, many cited use of this technology in a laboratory/training setup only. In more recent (2006) survey of urology residents and program directors in the United States, 63% of residents felt that they either would not do robot-assisted surgery or were unsure of its future in surgical application and 57% of the program directors believed robotics was a fad or were unsure of its future.[5] In this study, 78% of respondents felt it was required or beneficial to have robot-assisted surgical training and 83% would consider a robot-assisted surgery fellowship indicating a significant shift in the last 2 years. Sixty-one percent of SGO surgeons performing robot-assisted surgery did not train fellows, and of those surgeons who trained fellows and performed robot-assisted surgery, only 29% allowed fellows to sit at the console.[4] Even though this survey did not study this aspect of surgical training, another survey from 2006 revealed that only 38% of residents believed that they had at least average or acceptable experience with laparoscopy.[5] This, in fact, reflects the learning curve experienced by academic staff surgeons themselves while adapting to this new technology.

One hundred and one urologists who participated in the 5 day mini residency program concluded that their robotic skills testing scores demonstrated greater improvement than did the laparoscopic skills testing scores, which suggests that the transfer of minimally invasive surgical skills may be improved using the robotic interface.[6]

In a survey of 235 Canadian surgical residents (2003), only 18% felt that their minimally invasive training was adequate for practicing advanced minimally invasive surgery.[7] Advanced training in minimally invasive surgery was desirable in this survey and other studies[8] surveyed academic surgical departments in Canada and concluded that formal training, especially fellowship training, was required for them to recruit a minimally invasive surgeon. Eight-eight percent of the chairs from the survey (2008) intended to pursue an MIS agenda over the next 5 years. In the SGO survey, 91% of surgeons performed minimally invasive surgery. Seventy-eight percent of SGO surgeons now believe that maximum emphasis should be laid on laparoscopic training compared to 55% in 2004. Only 24% of these SGO surgeons presently perform robot-assisted surgery, although 66% were planning to perform robot-assisted surgery in the coming year.[4]

Robot-assisted radical prostatectomy has become one of the most commonly performed robot-assisted urologic procedures in the United States and Europe. In a survey from 2006,[5] only 3% believed that laparoscopic or robot-assisted prostatectomy was the gold standard for prostatectomy in comparison to 40% in this study; respondents felt that RARP is either the gold standard or is as good as laparoscopic prostatectomy. Fifty-one percent of residents and 70% of program directors in 2006 believed that RARP looked promising and 64% of overall respondents were planning to do the procedure in 2007. The proportion of acceptance of RARP can

easily be seen with over 78% of surveyed surgeons opting for robot-assisted prostatectomy for themselves or their loved ones.

As expected, advances have been made with application of robot assistance for cystectomy and hysterectomy due to quicker learning and ease of pelvic laparoscopy for radical prostatectomy. A survey of urologic surgeons in 2006 did not evaluate the role and status of minimally invasive surgery for cystectomy.[5] Expanded use of minimally invasive surgery is also observed in the SGO survey. In 2004, the majority (64%) of procedures were diagnostic whereas, in 2007, majority of the indications were staging procedures.[4] During this survey, 10% of surgeons have performed RARC, which suggests progress in adapting robotic assistance to new procedures.

One of the three meetings from which participants were recruited was focused on robot-assisted surgery (30%). Although results of this survey have a greater degree of validity based on the high response rate of greater than 90%, a number of issues may be skewed by participants who have greater interest in learning or who have had greater exposure to minimally invasive surgery. However, only a small percent of the study participants had performed a robot-assisted radical prostatectomy, radical cystectomy or radical nephrectomy (21%, 10% and 16% respectively). Alternately, this level of robot experience could allow a less biased perception and opinions regarding MIS. Despite certain percentage of participants having a high interest in learning about minimally invasive surgery, the participants in this study can be generalized to the international urologic surgeon populations with regards to performance of robotic surgery. Another possible weakness of this study is the international nature of participants and whether or not English is the study participant's first language. This is important because participants who do not have English as their first language may interpret questions differently. Although in theory this may be a concern, members of the expert panel who created the survey considered thoroughly the questions ahead and obvious language concerns were addressed. Another possible limitation is nonvalidated questionnaire which introduces the potential for question bias.

Conclusion

Robot-assisted surgery has begun to integrate into the minimally invasive armamentarium for urologic surgery and is applied for more procedures as experience is gained. □

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EDITORIAL COMMENT

We commend the authors for their efforts at coordinating this international survey. Whereas a mere 3% of residents viewed robotic-assisted laparoscopic prostatectomy as the gold standard in 2006, 40% of all participants herein viewed it as such.1 But as with all survey based studies, these conclusions are limited by biases which the authors readily acknowledge. It would be interesting to see a subanalysis of participant opinion based upon urologic subspecialty, level of practice or regionality. Also, the specific titles of the conferences queried are important, as they provide insight into possible selection biases.

Unfortunately, as only 38% of respondents have operated at the robotic console, participants' perceptions are by and large not those of the urologic robotic surgeon. This may or may not be a strength, as an onlooker's opinion is relatively protected from the bias of personal experience. As such, the conclusions, while thought-provoking, are neither those of the expert surgeon nor the greater urologic community.

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