Original Paper

Urologia Internationalis

Urol Int 2015;95:336–345
DOI: 10.1159/000430502

Received: January 16, 2015
Accepted after revision: April 13, 2015
Published online: July 8, 2015

Acceptance, Prevalence and Indications for Robot-Assisted Laparoscopy – Results of a Survey Among Urologists in Germany, Austria and Switzerland

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Key Words
Austria · da Vinci · Europe · Germany · Indications · Marketing · Prevalence · Surgical procedures · Robot assisted laparoscopy · Robotics · Switzerland · Urology

Abstract
Background: Robotic-assisted laparoscopy (RAL) is being widely accepted in the field of urology as a replacement for conventional laparoscopy (CL). Nevertheless, the process of its integration in clinical routines has been rather spontaneous. ***Objective:*** To determine the prevalence of robotic systems (RS) in urological clinics in Germany, Austria and Switzerland, the acceptance of RAL among urologists as a replacement for CL and its current use for 25 different urological indications. ***Materials and Methods:*** To elucidate the practice patterns of RAL, a survey at hospitals in Germany, Austria and Switzerland was conducted. All surgically active urology departments in Germany (303), Austria (37) and Switzerland (84) received a questionnaire with questions related to the one-year period prior to the survey. ***Results:*** The response rate was 63%. Among the participants, 43% were universities, 45% were tertiary care centres, and 8% were secondary care hospitals. A total of 60 RS (Germany 35, Austria 8, Switzerland 17) were available, and the majority (68%) were operated under public ownership. The perception of RAL and the anticipated superiority of RAL significantly differed between robotic and non-robotic surgeons. For only two urologic indications were more than 50% of the procedures performed using RAL: pyeloplasty (58%) and transperitoneal radical prostatectomy (75%). On average, 35% of robotic surgeons and only 14% of non-robotic surgeons anticipated RAL superiority in some of the 25 indications. ***Conclusions:*** This survey provides a detailed insight into RAL implementation in Germany, Austria and Switzerland. RAL is currently limited to a few urological indications with a small number of high-volume robotic centres. These results might suggest that a saturation of clinics using RS has been achieved but that the existing robotic capacities are being utilized ineffectively. The possible reasons for this finding are discussed, and certain strategies to solve these problems are offered.

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0042–1138/15/0953–0336$39.50/0

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Introduction

Since the introduction of robot-assisted laparoscopy (RAL) into urologic surgery [1–3], its indications and acceptance among surgeons have developed rapidly, supported by the rising numbers of publications and emerging evidence of its functional and oncological equivalence to conventional laparoscopy (CL). Contemporary reviews and meta-analyses have prompted current European guideline recommendations [4] justifying robotic surgery for several indications, such as nephrectomy, partial nephrectomy, pyeloplasty, radical prostatectomy, pelvic lymph-node dissection, sacrocolpopexy and radical cystectomy with urinary diversion. However, high-quality mature data on robotics are still lacking, with most of the results functionally compromised by the surgeons' learning curves and limited long-term results. Nonetheless, recent publications have been able to prove equivalent results for RAL compared to CL for several indications, namely partial nephrectomy [5], pyeloplasty [6] and radical prostatectomy [7–9].

Other than concerns as to RAL outcomes, the economics of operating a robotic system (RS) are currently under debate. Several publications from varying healthcare systems have demonstrated the increased costs of RAL compared to CL approaches and failed to clearly identify any economic advantages of RAL, except for RAL partial nephrectomy and pyeloplasty [10, 11]. Equivalency of expenses could not be proven for either radical prostatectomy or cystectomy in the United States; corresponding data from European countries are limited [12, 13] or pending [14]. As background for any future considerations further, comprehensive data on the availability of RAL, the number of procedures performed using RAL, the accepted indications and the professional attitude towards RAL are required.

To obtain these data for German-speaking countries in Europe, this study was conceived as a collaborative project with the working group 'laparoscopy and robot-assisted surgery' of the German urological society, in cooperation with Austrian, Swiss Urological Associations and the European Society of Urologic Technology.

Materials and Methods

Study Design and Participants

A survey was conducted to assess the use of laparoscopy (published recently in [15]) and RAL in Germany, Austria and Switzerland. A questionnaire (online suppl. Appendix; for all online suppl. material, see www.karger.com/doi/10.1159/000430502) was sent to 303 urology departments in Germany, 37 in Austria and 84 in Switzerland using the address databases of professional societies. Three methods of response were offered: postal mail, fax or web-based questionnaire with personal log-in.

Questionnaire Design

The questionnaire issued in German was developed to be anonymous and self-administered and was initially validated by ten experienced urologists from the authors' university hospitals. The questionnaire was machine-readable and consisted of two parts, capturing general data related to the type and size of institution and number of operating surgeons (including their age) and then assessing the availability of robotic system(s), its implementation in clinical routines, attitudes towards RAL among urologists and concerns about its efficacy. The questionnaire investigated the number of procedures performed by CL and RAL for one year prior to the survey at 25 different urological indications. Additionally, the anticipated superiority of RAL at these specific indications was assessed.

Data Analysis

All questionnaires were scanned, followed by digital character recognition and automated database entries, controlling for the quality of data processing. One of the primary aims was to compare the data obtained from robotic and non-robotic institutions. Descriptive statistical analysis was carried out using Microsoft® Excel® (Redmond, USA).

Results

Response Rate

The questionnaire was returned by 212 (70%) departments in Germany, 28 (76%) in Austria, and 29 (35%) in Switzerland, for an overall response rate of 63%.

Availability/Distribution of Robotic Systems for RAL and Types of Institutions

In 2012, 60 (22.3% of all responding hospitals) robotic systems were available at the participating hospitals (35 in Germany, 8 in Austria and 17 in Switzerland). The majority of the robot-equipped institutions were either university (n = 26; 43%) or tertiary care (n = 27; 45%) clinics, with only 8% (n = 5) identifying as secondary care clinics and two robotic responders from Germany failing to provide the information (fig. 1). As for the ownership of the participating clinics (fig. 2), the majority (n = 41; 68%) of the hospitals were public, with some differences detected among the participating countries.

Size of the Surgical Teams and Age Distribution of the Surgeons at Robotic and Non-Robotic Institutions

The size of the minimally invasive and conventional (open) surgical teams and the age distribution of the

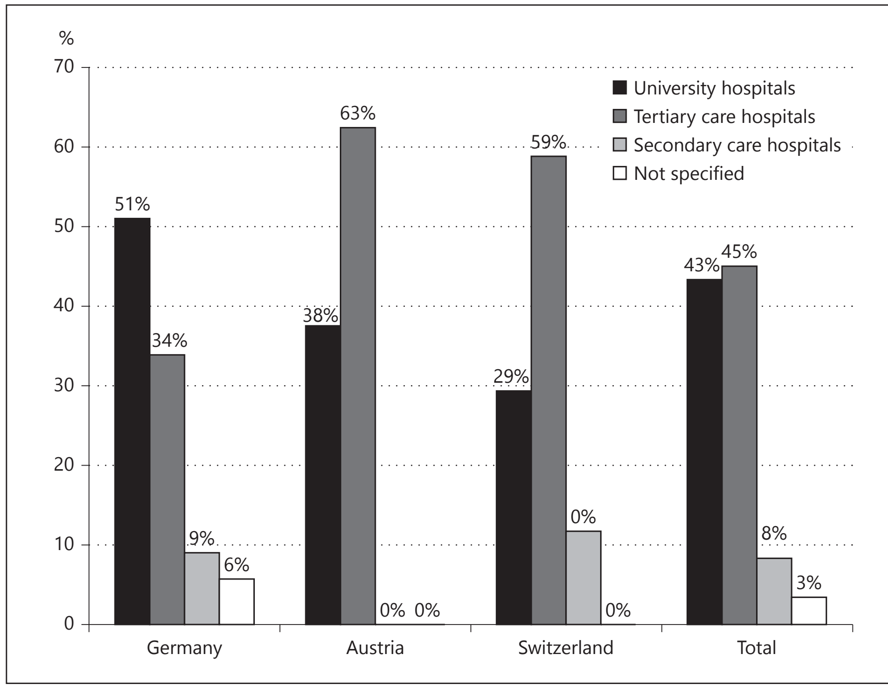

Fig. 1. Care level of robot hospitals. Care level distribution of the participating robot institutions.

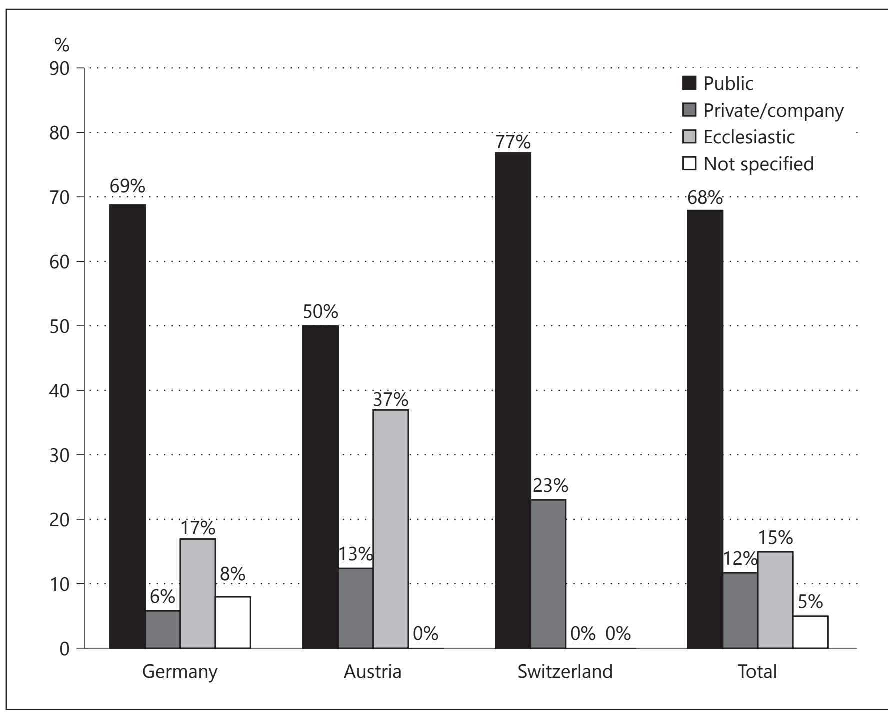

Fig. 2. Ownership of robot clinics. Funding body of the participating robot institutions.

surgeons were analysed. Minimally invasive teams in non-robotic institutions consisted of a mean number of 2.4 surgeons, and conventional teams consisted of 3.6 surgeons (vs. 3.0 and 4.3 for robot-operating institutions, correspondingly). The minimally invasive and conventional surgical teams contained 1.3- and 1.2-fold more members at robotic centres, correspondingly. Only minor differences were observed with regard to the age distribution of the surgeons, with a tendency towards younger minimally invasive surgeons at robotic

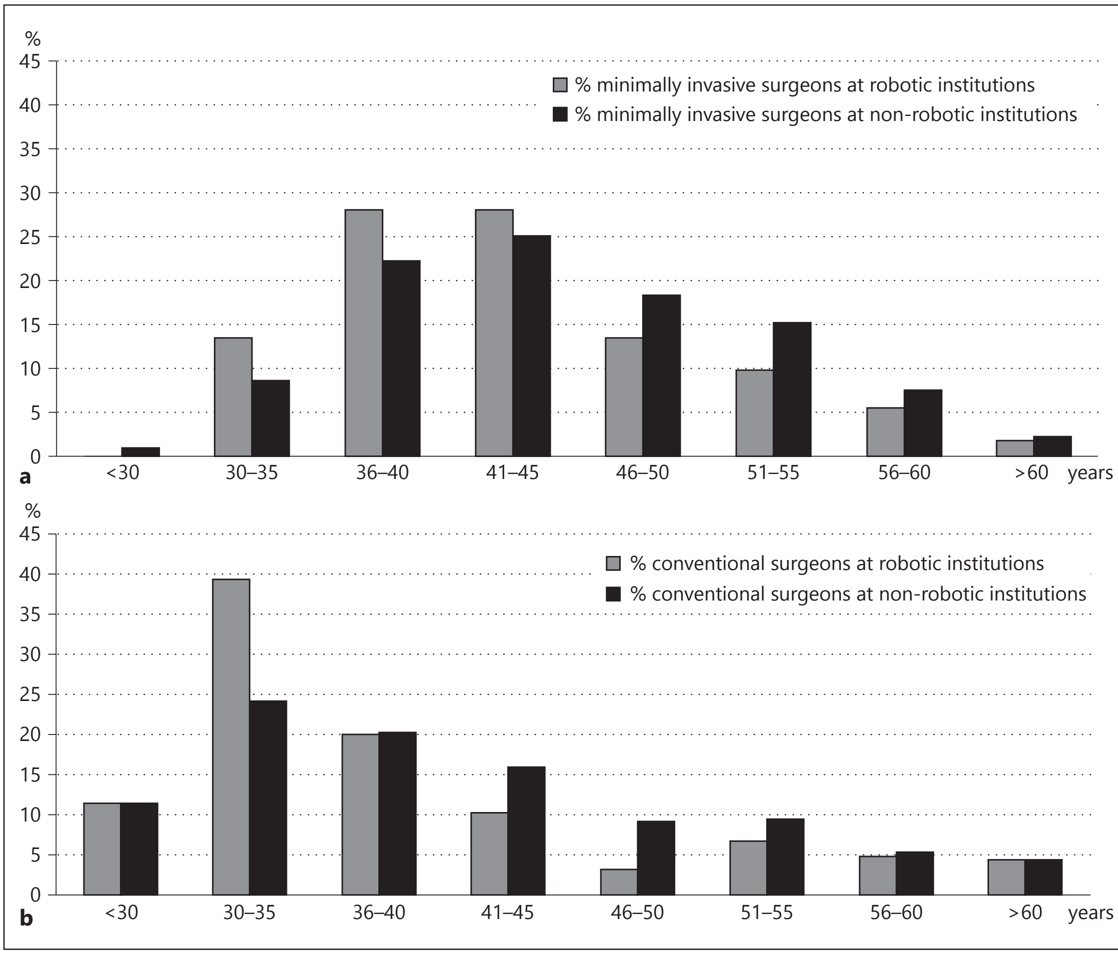

Fig. 3. Age distribution of surgical teams at participating institutions. Age distribution of minimally invasive (**a**) and of conventional (**b**) surgical teams surgical at robotic and non-robotic institutions.

departments (fig. 3a, b). A few participants (conventional surgical teams n = 5, 8.3%; minimally invasive surgical teams n = 7, 11.7%) did not provide information about their teams.

Attitude Towards Robot-Assisted Laparoscopy

Figure 4 represents the individual attitude of the responders towards RAL, focusing on its cost-effectiveness, marketing aspects and perceived influence on urologic surgery. Generally, a substantial proportion of both robotic (75%; surgeons regularly, not sporadically, operating with the use of robotic system) and non-robotic surgeons (98%) considered RAL to be cost-ineffective. Nevertheless, more than 50% of surgeons in each group classified RAL as an 'important marketing tool'. Notably, two times more robotic surgeons believe that RAL will replace CL (60 vs. 33%). A substantial proportion of robotic surgeons expected better functional and oncological results from RAL; on the contrary, these beliefs were relatively faint in the non-robotic group.

Estimated Superiority of RAL for Different Urologic Indications

Interestingly, the response rate to this questionnaire complex varied significantly among robotic (32–65%) and non-robotic surgeons (28–41%). On average, 50% of all robotic participants did not indicate a value for RAL regarding individual indications when asked to locate the perceived superiority of RAL. In general, robotic surgeons were more convinced of the advantages of RAL than non-robotic surgeons (fig. 5). Importantly, among the selected indications, approximately 40% of non-robotic surgeons would prefer to operate using an RS.

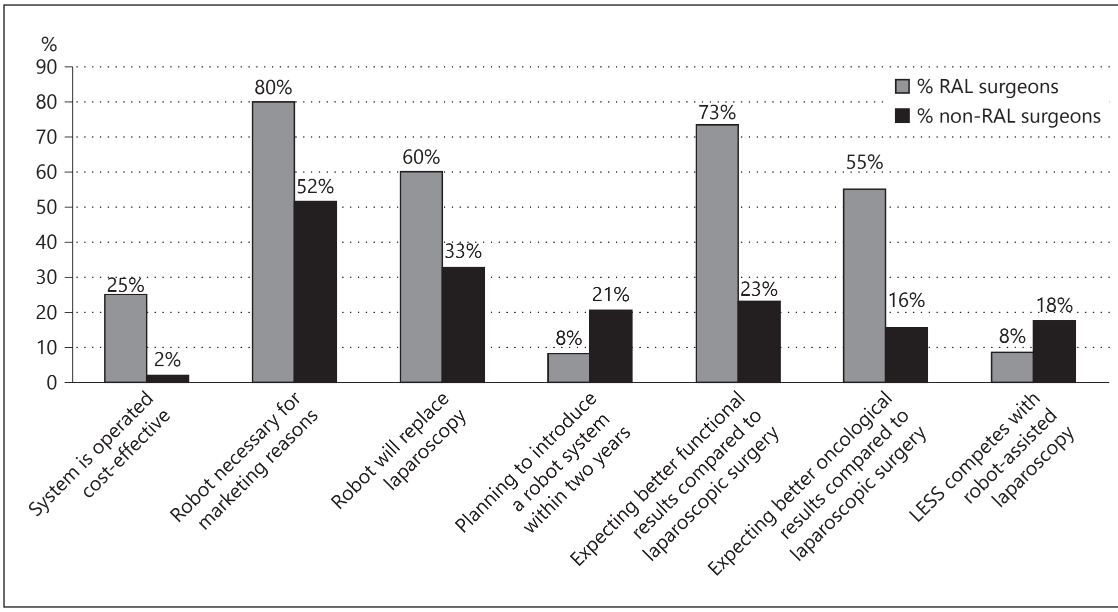

Fig. 4. Attitudes toward robot-assisted laparoscopy. Attitudes towards robot-assisted laparoscopy among robotic and non-robotic surgeons.

Proportion of RAL Procedures for Urological Indications at Robotic Institutions

All robot-equipped institutions were asked to specify the number of procedures (year prior to survey) for 25 indications and the proportion of robot-assisted procedures for each (fig. 6). The average response rate was 89% (range 87–98%).

The proportion of robotic operations for the selected indications varied significantly (the average use was 21%; range 0–75%). For 8 of the 25 indications (fig. 6), the proportion of RAL surgeries exceeded 30%; for two indications (transperitoneal prostatectomy and pyeloplasty), the value exceeded 50%. Intensive implementation of RAL procedures was limited to a few centres and few urologic indications.

Discussion

The presented survey is the first published report on the current patterns of use of urological RAL in German-speaking countries. In contrast to previous articles, which have focused on the description or refinements of robotic techniques [16, 17], robotic standards and equivalence or superiority [6–8, 18, 19], we provide comprehensive data on the availability of RS, their distribution and the use of RAL in urologic surgical routines. Recently published articles have dealt predominately with the economic aspects of RAL under different healthcare systems, indicating any increased direct costs associated with RAL [11–13, 20]. The current survey evaluates the attitudes and patterns of use for RAL. The economics of the robotic system were not within the focus of our study.

This survey had a moderate overall response rate of 63%, with response rates in Germany and Austria above 70% and indicating a sufficient representation of the clinics. Nonetheless, the results gathered for Switzerland are limited by a low response rate of 35% (29 out of 84 recipients) and an above-average proportion of robotic institutions (59%). It remains unclear, why, in comparison to Austria and Germany, Swiss robotic surgeons were attracted to participate in this survey. According to the information provided by Intuitive Surgical® (Sunnyvale, CA 94086–5304, USA), almost all (60/63 systems, 95.2%) robotic centres were responders.

Overall, 60 clinics operated RS. Interestingly, given the 10-fold population of Germany compared to Switzerland, only twice as many more robotic systems are being used in Germany. Although this could be influenced by the wealth and financial aspects of each country, this discrepancy raises some important questions. How many urologic robotic systems are needed per population size per clinically accepted surgical indication? This could be a first step to the optimal and rational saturation of clinics

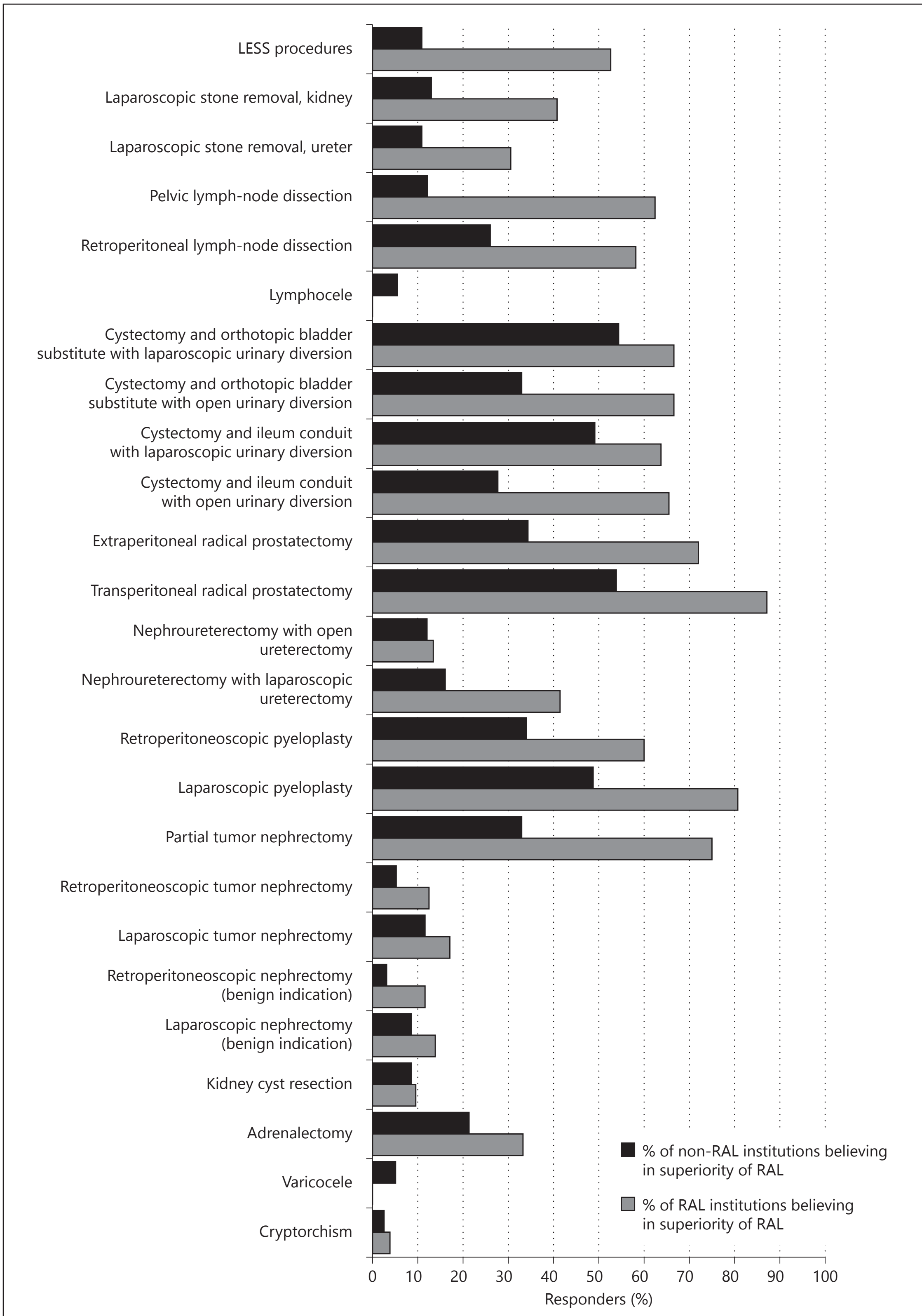

Fig. 5. Estimated superiority of RAL. Estimated superiority of robot-assisted laparoscopy in 25 different urologic indications among robotic and non-robotic institutions.

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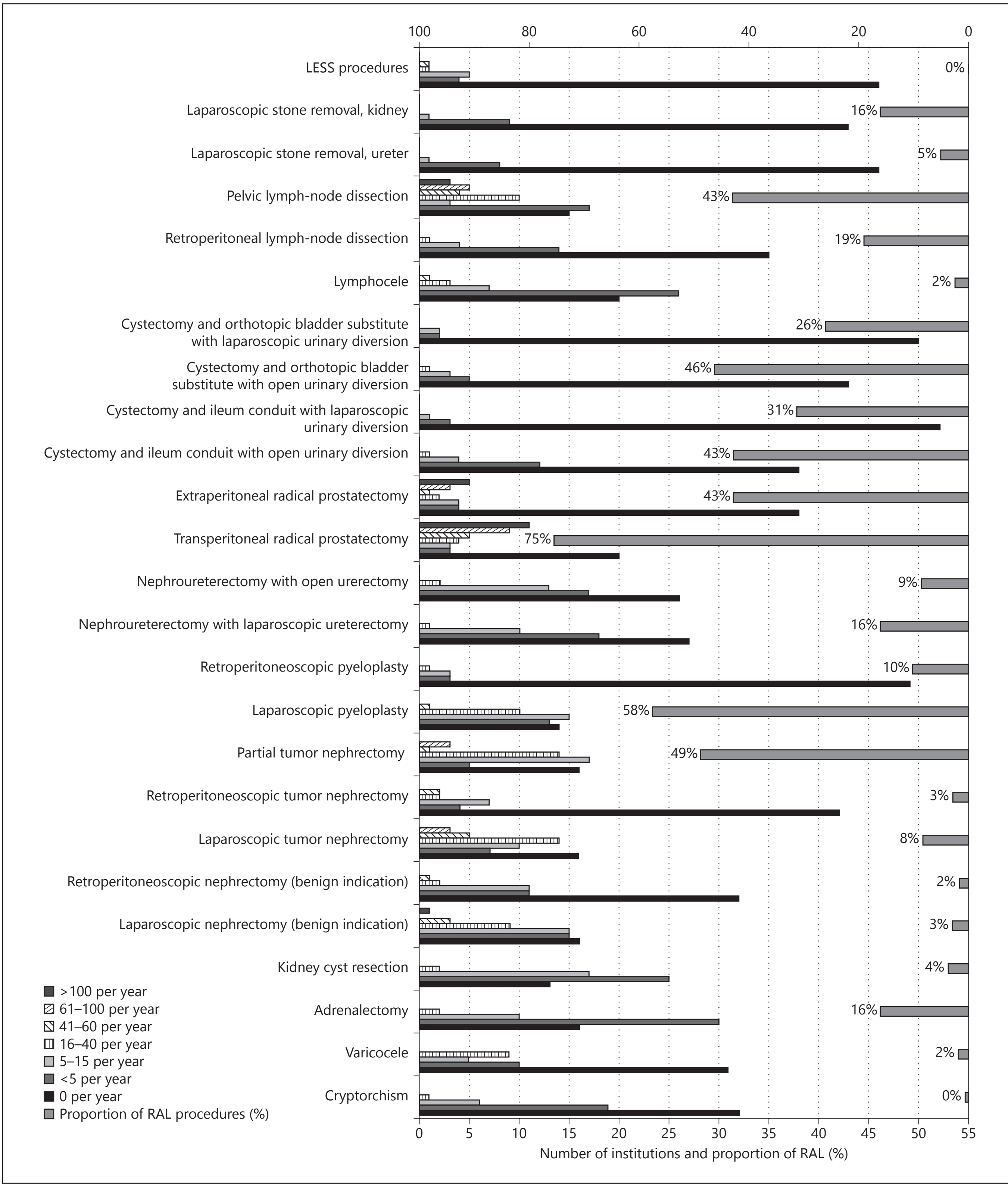

Fig. 6. Number of hospitals, proportion of RAL and number of procedures robotic centers. Number of institutions performing defined procedures at a specific frequency levels in a one-year period. The proportion (%) of robot-assisted laparoscopy for these indications is indicated (grey column).

with RS. One could argue that this is not possible before clear advantages of robotic surgery are proven. Nevertheless, robotic surgical systems are already present.

The survey demonstrated that robotic systems are, as generally anticipated, used at the surgical centres of high care levels, which contain the majority of urologic departments (84% university and tertiary care vs. 16% secondary care hospitals), not counting the 8% being operated at secondary care institutions (fig. 1). This is an important issue to consider and warrants further investigation to determine whether these latter clinics have developed or use an effective economic model for the maintenance.

The ongoing discussion of RAL-associated costs and their insufficient reimbursement in different healthcare system models [11–13, 20] raises the question as to which hospitals can adequately bear these expenditures to benefit from the potential advantages of RAL (e.g. marketing). Our study shows that mostly public authorities agree to address the potential financial or entrepreneurial risks of operating a robotic system, whereas private companies in Germany mostly seem to avoid these risks, possibly due to the diagnosis-related groups (DRG) system-related under-financing of robotic cases.

The implementation of robotic systems in urology is hampered by the restrictive nature of reimbursement regulation. Only a minority of urologists from both robotic and non-robotic institutions believe that RAL is operated cost-effectively. Nevertheless, our survey shows that at least some clinics have been able to develop effective financial models to maintain the high workload of the robotic systems. Still, only a minority of these institutions plan to introduce a new RS into their armamentarium. This finding is understandable among those institutions already using an RS. However, the faint positive reaction from non-robotic institutions allows us to assume that the 'climax' of robotic dissemination has passed. There does remain a prominent agreement within the urological society that such robots are a powerful marketing tool for any institution.

Almost two-thirds of all RAL surgeons believe that robots will replace CL in the future. This dominating opinion represents the driving force behind the development of RAL and its enforced introduction into the urological surgery. This opinion is mostly based on the demonstrated advantages a robotic system gives to an operating surgeon, even when such benefits are subjective and not related to the outcomes.

Robotic surgeons voiced a prominent conviction that RAL provides both better functional and oncological results compared to CL, although current guidelines [4] and recent publications [4–9, 13, 14, 18, 21, 22] were able to show only equivalency. Studies providing answers to these questions with higher evidence levels are pending [14].

As for the age distribution within robotic and non-robotic surgical teams, it could be stated that robotic institutions might offer earlier minimally invasive training compared to non-robotic institutions (fig. 3a, b). To date, education related to the robotics is still an open question. The survey demonstrated, that both open (3.6 vs. 4.3) and minimally invasive (2.4 vs. 3.0) surgical teams at robotic centres consisted of more team members. It remains unclear, if the operation of robot systems requires more staff, if higher care levels of robotic centres cause these team sizes, if robotic centres are more successful in personal recruitment or if robotic clinics can afford intensified surgical education.

One of the important parts of this survey was its evaluation of the anticipated superiority of RAL for 25 different urologic surgical indications. Interestingly, the response rate to these questions was relatively low, compared to other issues, ranging from 32–65% among robotic and from 28–41% among non-robotic institutions (fig. 5). It is obvious that the values given by the robotic surgeons could be significantly biased by their general adherence to robotic technology; the answers from the non-robotic clinics may have been more objective. Many robotic surgeons tend to expect better functional and oncological results. This can hardly be explained only by their attachment to a 'favourite toy'. Thus, for several indications, the perceived superiority of RAL reached 30%, indicating the necessity of deeper evaluations of the reasons behind these opinions held by professionals. Not surprisingly, for some indications, the RAL superiority acceptance reached and surpassed the 50% mark. Cystectomy with intracorporal urinary diversion, transperitoneal radical prostatectomy and pyeloplasty certainly constitute important urological procedures entailing a vast amount of required suturing. No preference of surgical approach in kidney oncology was noted.

The rising number of publications on robot-assisted laparoscopy in urology suggests that this approach plays a crucial role in minimally invasive surgery. However, to date, no reports on the use of RAL in urology are available. This study provides comprehensive insight into the patterns of use for urological RAL in three countries (fig. 6). The proportion of robotic procedures varies widely among urologic indications and centres. Only pyeloplasties and transperitoneal radical prostatectomies are performed in more than half of cases using RAL at participating robotic centres. Moreover, the survey impressively demonstrated that RAL is being performed on a considerable number of patients for only a few indications at a few robotic centres. These findings raise several questions:

- How much and why is RAL limited by its added costs?
- Given the insufficient degree of utilization of the 60 available systems, are they being used predominately for marketing reasons?
- How can a few robotic centres successfully perform high frequencies of RAL without economic drawbacks?

These issues warrant further consideration in additional studies.

Future Directions

Our study leads us to think that the saturation of the medical systems in Germany, Switzerland and Austria with robotic systems under contemporary conditions is probably at its peak. Therefore, the question that arises now is not whether urology should embrace robotic surgery, but how best can we use it. It is more or less clear that robotic surgery has strong applications in several procedures and that its expansion will continue. Another important question is whether the urological community would choose robotics in the face of the similar functional and oncological outcomes. The answer is probably yes because robotic surgeons express a strong attachment to this type of surgery. Neglecting the learning curve of robotic surgery, the main restrictions presumably are the associated costs. Once these problems are overcome, robotics will penetrate the clinical routine. Therefore, certain important steps must be made to solve financial difficulties. First, the economics of robotic surgery should be analysed in the robotic institutions. As a result of this analysis, one or several effective financial models should be developed for further generalization in other robotic centres. Second, the reimbursement system should be optimized with regards to robotic surgery. Third and most important, competitive robotic systems are urgently needed because this is one of the main ways to reduce costs. Fourth, adequate regulation of the indications for robotic surgery is needed.

Some limitations should be outlined for our survey. One of the main limitations is the 63% response rate. This could lead to a distorted reflection of the current patterns of use for CL and RAL. Moreover, the information provided was in part subjective; therefore, individual-related issues could affect the quality of our data.

Drawing a conclusion, the present survey of urologic surgeons in Germany, Austria and Switzerland is the first report on previously unpublished aspects of robot-assisted laparoscopy. The main finding is a relatively pronounced saturation of clinics with robotic systems, which seem to be utilized ineffectively, probably due to the absence of adequate financial regulation. In fact, only a minority of robotic surgeons believe in the cost-effectiveness of RAL. The survey clearly demonstrates that RAL is currently limited to certain important urological indications and that only a small number of high-volume centres have an acceptable workload. The possible reasons behind these findings are discussed, and certain strategies to solve these problems are specified.

Conflicts of Interest

Authors report no conflict of interests.

Financial Disclosure

No funding was received for this study.

Acknowledgments

This study is a collaborative project with the 'Arbeitskreis Laparoskopie und roboterassistierte Chirurgie' of the German Urological Association (DGU), the Austrian Urological Association (ÖGU), the Swiss Urological Association (SGU), and the European Society of Urologic Technology (ESUT).

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