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Surgical Preferences and Fears: Misconceptions about Robotic-Assisted Surgery

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Keywords

Robotic-assisted surgery · Public knowledge · Surgical preference · Technology

Abstract

Introduction and Objective: Robotic-assisted surgery (RAS) is widely adopted across surgical fields, notably urology, but patient knowledge remains limited, often shaped by misconceptions. Previous research indicates factors like age, profession, and technology use influence RAS perceptions. This study investigates public knowledge, preferences, and misconceptions about RAS within a German cohort. ***Methods:*** A cross-sectional survey at a university hospital's open house gathered responses from 339 participants prior to an RAS exhibition. The questionnaire assessed demographics, surgical preferences, and RAS knowledge. Statistical analyses, including *t* tests, chi-squared tests, ANOVA, and multivariate logistic regression, identified key associations. ***Results:*** A total of 71% (234) of participants favored RAS over conventional surgery, yet misconceptions persisted in 38% (122), particularly among pensioners (48% (46), $p < 0.01$). Misconceptions were linked to a preference for conventional surgery (43% (52) vs. 19% (36), $p < 0.01$). Surgical preference emerged as a significant predictor of misconception. Concerns included surgeon skill (41%, 141) and machine malfunction (39%, 132), with younger participants fearing human error and older individuals fearing technical failure ($p < 0.01$). ***Conclusion:*** This local study reveals strong public support for RAS but underscores prevalent misconceptions, especially among older adults, suggesting that addressing misconceptions could foster acceptance and informed decision-making.

Introduction

The growing integration of robotic-assisted surgery (RAS) [1, 2] into modern medical practice has sparked varying levels of awareness and perception among different populations. Understanding perceptions, preferences and opinions in modern-day patients is important especially in urology, where robotically assisted radical prostatectomies have become one of the most standardized and widespread applications in robotic surgery [3]. Across specialties, RAS is intensely propagated as a minimally invasive method with shorter hospital stays, lower transfusion and readmission rates [4–8], partly resulting in an improvement of overall economic burden

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[8]. The availability of robotic systems has also been shown to influence patient choice of hospital [9] for planned prostatectomies. However, an informational imbalance favoring robotic procedures has been described [10–12], potentially influencing patient perceptions.

Little is known on the informative behavior of patients or the general public's knowledge on RAS in western countries. In the USA, 56% of female patients undergoing pelvic surgery have never heard of RAS and only 6% prefer robotic over conventional surgery, with those preferring RAS being unaware of its advantages [13]. In line with 60% of the European population informing themselves online on health issues [14], those who were informed on RAS retrieved their information online [13]. UK patients showed to be rather uninformed about RAS, fearing an increased risk, a decreased precision and technical failure due to robotic assistance [15]. A recent cross-sectional study conducted in Saudi Arabia, where RAS is rather slowly adapted revealed that patients' awareness of RAS is influenced by several factors, including sex, education, income, and technology usage [16]. While many are aware of RAS, concerns about robotic malfunction and surgical errors remain prevalent, particularly among less tech-savvy and older populations [16]. Even among Saudi-Arabian surgeons, 27% are unaware of the purely tele-manipulatory character of RAS [17].

This study aims to further investigate the knowledge among the public by exploring attitudes, preferences, and misconceptions surrounding RAS within the German population, where RAS implementation is on a profound international level [16, 18]. Our study builds on the previous findings, examining knowledge toward RAS in a different context.

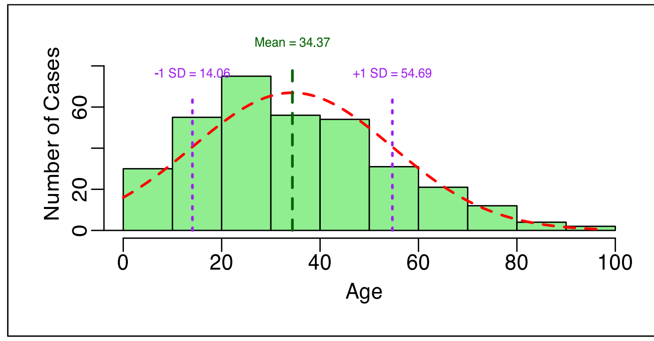

Fig. 1. Age distribution with Gaussian curve. Showing a histogram of the age distribution within the collective with a Gaussian curve (red dotted) overlay. SD, standard deviation.

Methods

In this single-center descriptive study, paper-based questionnaires were handed out to visitors of an open house event of the urologic department of a German university hospital. Open house was embedded in a city-wide event propagating science to the general public. Participants were handed out questionnaires before entering an exhibition on RAS to test their preexisting knowledge. The study was conducted in ethic compliance with the Declaration of Helsinki. An ethics approval was not required due to local law as no personal data were processed. Patients were informed about the usage of data for scientific analyses (see online suppl. mat. 2; for all online suppl. material, see https://doi.org/10.1159/000544773) and gave implied informed consent by participation. The questionnaire (see online suppl. mat. 1) was in German language and leaned on questions used in previous studies [16].

The first section of the questionnaire covered biographic questions on age, gender, profession, and daily usage of computer technologies. The second section contained 8 questions on knowledge, preference, and beliefs on RAS. Preference for robotic or conventional surgery was asked directly. Convictions were determined asking for advantages and disadvantages of RAS. Knowledge was tested by presenting false answers among correct ones (e.g., robotic assistance means the robot is programmed and performs the surgery).

Items were mostly single-choice questions. Answers to multiple choice questions were transformed into dummy variables for analysis.

A variable "Misconception of robotic surgery" was created to identify participants who demonstrated a misunderstanding of robotic surgery. Participants were coded as misconceiving if they thought robots were programmed and performed the surgery by themselves, robots operated automatically, and the surgeon is present for security reasons only or robotic surgery was mostly used for conventional open surgery or "Laser-surgery," if they feared the robot would perform a wrong surgery, or if they believed "R2D2" and "Uronaut" to be robotic systems applied in urology. Participants were coded as misconceiving if one of these conditions applied and excluded as missing value if any of the relevant variables contained missing values.

t tests, chi-squared tests and analyses of variance (ANOVA) were used for statistical analysis. A multivariate logistic regression analysis was additionally

Table 1. Sample summary

Variable	Statistics
Age (M, SD)	M = 34.76±19.01
Sex (n = 339)	
Female	198 (58%)
Male	141 (41%)
Profession (n = 339)	
Health care	92 (27%)
Technologies	43 (13%)
Other	99 (29%)
Pensioner	105 (31%)
Usage of Computer Technologies per day (n = 339)	
0 h	10 (3%)
1–2 h	81 (24%)
3–6 h	150 (44%)
>6 h	98 (29%)
Devices used daily (multiple choice)	
Smartphone	
No	28 (8%)
Yes	313 (92%)
Computer	
No	105 (31%)
Yes	236 (69%)
Gaming console	
No	308 (90%)
Yes	33 (10%)
Surgical preference (n = 330)	
Robotic	234 (71%)
Conventional	96 (29%)

conducted with age >60, profession and surgical preference to check for independent influence of factors on misconception. Statistical analysis was performed using R Studio (Version 2024.09.0 + 375) [19].

Results

A total of 339 participants filled out questionnaires in this first German single-center study on robotic knowledge among the public differentiating their beliefs, preferences, and knowledge toward RAS.

Descriptive Statistics

Age was normally distributed (see Fig. 1; Shapiro-Wilk-Test: $p < 0.01$) with a mean of 34.8 ± 19.0 (6; 94) years. Sex was not fully balanced among participants (58% female vs. 41% male). With 105 participants (31%), pensioners depict the largest designated professional group, followed by health care professionals (n = 92, 27%), ranking second. The largest share of participants (44%) used computer technologies 3–6 h a day (see Table 1 for descriptive statistics).

Table 2. Comparison of characteristics between participants preferring robotic or conventional surgery

Variable	Robotic (N = 234)	Conventional (N = 96)	p value
Age (n = 330)	37.46±18.34	27.38±18.34	**<0.01**[a]
Sex (n = 330)			
Female	54% (126)	72% (69)	**<0.01**[b]
Male	46% (108)	28% (27)	
Profession (n = 328)			
Health care	33% (77)	14% (13)	
Technologies	14% (32)	9% (9)	**<0.01**[b]
Other fields	27% (64)	33% (32)	
Pensioners	25% (59)	44% (42)	
Usage of computer technologies (n = 328)			
0 h/d	2% (5)	4% (4)	
1–2 h/d	21% (50)	26% (25)	0.51[b]
3–6 h/d	45% (106)	43% (41)	
>6 h/d	31% (72)	26% (25)	

[a]t test p value. [b]Chi-squared test p value, bold p values mark significant findings with a level of significance of $p < 0.05$.

Preference for Robotic Surgery

The vast majority of participants preferred RAS over conventional surgery (71% vs. 29%, see Table 1). The comparison by surgical preference is summarized in Table 2. Those preferring conventional surgery are younger on average (37.5 vs. 27.4 years, $p < 0.01$). Of those favoring conventional surgery, the majority is female (72% vs. 28%, $p < 0.01$). Healthcare and technology professionals show a clearer preference for RAS than other professionals (Pro Robotic: health care 85%, technologies 78%, others 66%, pensioners 58%, $p < 0.01$). Usage of computer technologies did not significantly influence surgical preferences (p = 0.51).

Prevalence and Distribution of Misconceptions

A total of 21 participants were excluded due to missing values. A total of 122 (38%) participants are subject to misconceptions on RAS. Differences between misconceiving and non-misconceiving participants are depicted in Table 3. Of all professions, misconception is most prevalent among pensioners (percentage of misconception within professional group: pensioners 48%, health care 24%, technologies 43%, other fields 39% (36), $p < 0.01$). Interestingly, those holding unrealistic views about RAS

Table 3. Comparison of characteristics between participants with misconceptions and those correctly informed on robotic surgery

Variable	Misconception (N = 122)	No misconception (N = 196)	p value
Age (n = 318)	31.50±18.48	36.75±18.26	**0.01**[a]
Sex (n = 318)			
Female	58% (71)	59% (114)	0.95[b]
Male	42% (51)	41% (82)	
Profession (n = 318)			
Health care	18% (22)	34% (67)	
Technologies	15% (18)	12% (23)	<**0.01**[b]
Other fields	30% (36)	29% (57)	
Pensioners	38% (46)	25% (49)	
Usage of computer technologies (n = 318)			
0 h/d	3% (3)	3% (6)	
1–2 h/d	22% (27)	24% (46)	0.97[b]
3–6 h/d	45% (55)	45% (88)	
>6 h/d	30% (37)	29% (56)	
Devices used daily (multiple choice)			
Smartphone	94% (116)	91% (179)	0.37[b]
Computer	65% (80)	73% (144)	0.16[b]
Gaming console	11% (14)	9% (17)	0.54[b]
Surgical preference (n = 312)			
Robotic	57% (70)	81% (154)	<**0.01**[b]
Conventional	43% (52)	19% (36)	

[a] *t* test *p* value. [b] Chi-squared test *p* value, bold *p* values mark significant findings with a level of significance of $p < 0.05$.

are younger on average than individuals with a more accurate understanding (31.5 vs. 36.8 years, $p = 0.01$).

A strong association exists between misconceptions and surgical preferences. Within the group of those unaffected from misconceptions about RAS, 154 (81%) prefer a robotic surgery, while only 70 (57%) of those subject to misconceptions willing to undergo RAS ($p < 0.01$). Within those preferring conventional treatment, the majority (59% (52) vs. preference for RAS 31% (70) have misconceptions on RAS.

In a multivariate analysis of influences on misconception, only preference for conventional surgery ($p < 0.01$, OR 0.41) remained a significant predictor of misconception. Age >60 ($p = 0.12$; OR 0.75) and different professions ($p = 0.52$ to $p = 0.78$; OR 0.35 to OR 0.67) showed no significant association with misconception.

Fears and Convictions on RAS

The most widespread concern about RAS is a possible lack of surgeon skill in 141 (41%) participants when using robotic systems. This is followed by fears of machine malfunction in 132 (39%) participants. The implausible fear of the wrong surgery being performed is apparent in 51 (15%) participants.

Older individuals tend to be more concerned about machine dysfunction, while younger individuals fear human error more (see Fig. 2, p_{ANOVA} <0.01). Within participants above 18 years, no significant associations of fear category and age are found ($p_{\text{ANOVA}} = 0.08$). Distribution of fear among professions shows no significant differences either ($p = 0.06$).

Convictions on RAS (Fig. 3) show the majority of participants believing in RAS to be more accurate (82% (277/339)), whereas pain reduction (28% (94/339)) and faster treatment (38% (130/339), was only seen by a minor share. A small portion believed RAS to be more prone to errors than conventional surgery (7% (23/339)), while 45% (152/339) thought RAS has fewer complications. More participants saw RAS as a faster (38% (130/339), rather than a slower (6% (21/339) method.

Discussion

For the first time, this study shows knowledge, convictions and fears of the German public on RAS, allowing for a more individualized patient information ahead of surgery. In contrast to previous findings in the Middle

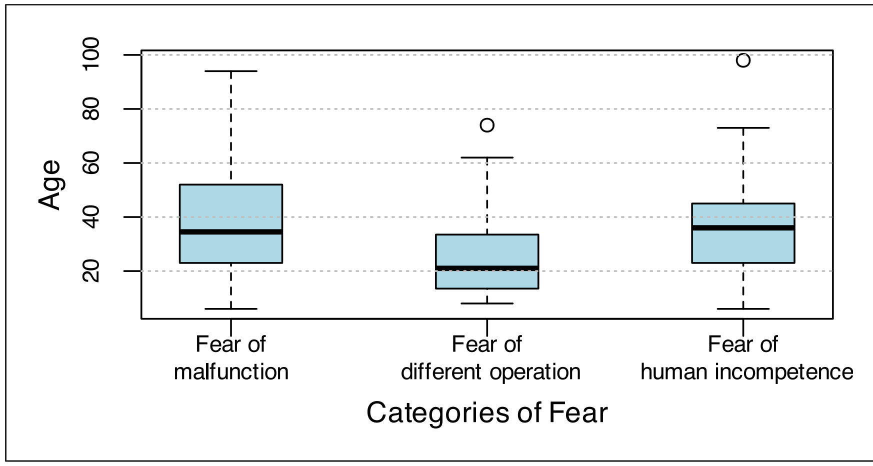

Fig. 2. Age by categories of fear. Boxplot chart of the distribution of fears among age, based on Question 5.

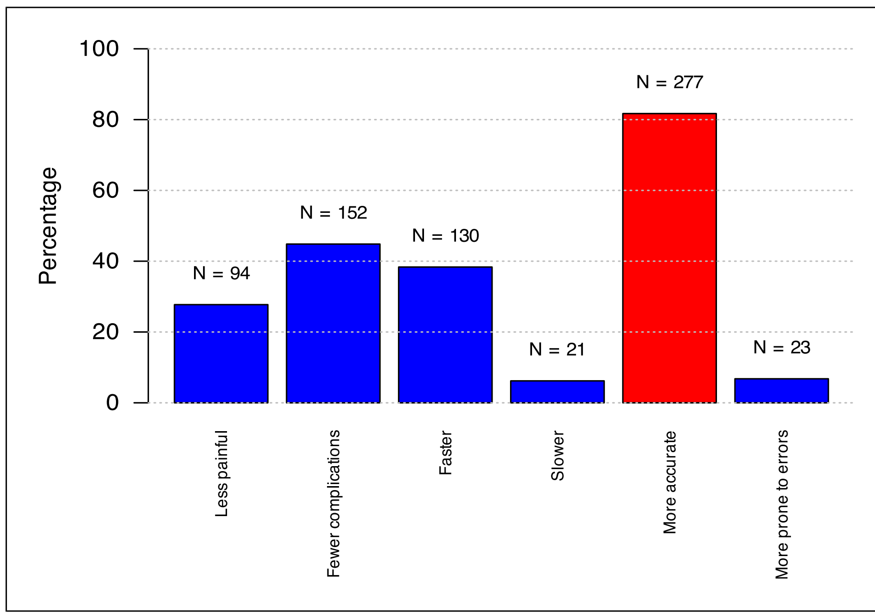

Fig. 3. Convictions on RAS. Showing percentage of participants agreeing to statement on robotic-assisted surgery in comparison to conventional surgery. Based on multiple choice question 6. Red bars exceed 50% participants.

East [16] and US women [13], 71% of participants and 65% of women favor RAS over conventional surgery. Even though 72% of those preferring conventional treatment are female, 65% of females still favor robotic surgery. This clearly differs from previous data, where only 43% of women, but the majority of men, preferred RAS [16]. It was reproducible that with 78% (32) more tech-professionals prefer robotic surgery when compared to other professionals (67% (64), $p < 0.01$). Having a greater understanding of medical technology also health care professionals understandably show a clear preference for RAS (85% (13)). However, little public data exist on attitude toward technology by profession. The high 74.8% rate of females among health care professionals in Germany [20] is also observed in our cohort (72%) and may influence analysis on sex and preferences.

Interestingly, older patients, in which previous data described a higher prevalence of fear of malfunction [16], are more prone to RAS than younger patients (37.5 vs. 27.4, $p < 0.01$). Contrary to the Saudi-Arabian study [16], we found that the usage of computer technologies ($p = 0.51$) does not significantly influence surgical preferences.

In line with the previous study, misconceptions in our cohort are strongly associated with preference for conventional surgery (without misconceptions: 81% preference for RAS, with misconception 57% preference for RAS, $p < 0.01$). This gap puts misinformation at the origin of reluctance toward RAS. As informing patients properly increased RAS acceptance in the UK [15], implementation of RAS in Germany could be easily boosted by reducing misconceptions through better information of the public.

Misconceptions are most prevalent among pensioners (48% (46) of pensioners vs. 38% (122) of all, $p < 0.01$), yet surprisingly, those holding unrealistic views about RAS are younger on average (31.5 vs. 36.8, $p < 0.05$). This could be explained by the younger cohort (<18 years), in which awareness and knowledge are still developing. Accordingly, multivariate testing was not able to show age >60 as a risk factor for misconception ($p = 0.12$).

As well as for surgical preference, misconceptions were unevenly distributed among professions ($p < 0.01$). As expected, well-informed health care providers showed few misconceptions (24% vs. 38% of all, $p < 0.01$). Remarkably, tech-professionals showed an above-average rate of misconceptions (43% vs. 38% of all, $p < 0.01$), even though showing a clear preference for RAS (78%). Tech-savy participants might rather overestimate robotic systems with positive misconceptions linked to rather excitement than fear. As fears toward RAS do not significantly differ among professions ($p = 0.06$), a proper analysis is not possible. However, human failure (rather than technical failure) is the biggest fear among tech-professionals with 51% (21). A percentage unreached for any fear in any other group, speaking in favor of a belief in technology.

Previous findings of patients fearing increased risk [15] or believing in no reduction of complications [17] were not reproduced in this study. As elaborated before, this collective shows a relatively high confidence in RAS with the majority believing in higher accuracy (81% (277/339) and more participants convinced of fewer (45% (152/339)), rather than more (7% (23/339)) complications and faster (38% (130/339)) rather than slower (6% (21/339)) treatment by RAS. Apparently, participants' awareness on technological aspects exceeds awareness for the scientifically repeatedly reported advantages of pain reduction, reduced blood loss (i.e., fewer complications), and shorter hospital stays (i.e., faster treatment) [4–8]. The ranking of advantages is odd since direct-to-consumer marketing of RAS via websites promotes high precision less often than pain reduction and faster treatment [21]. However, excitement for the mechanical versatility of RAS systems might exceed effects of public promotion.

Limitations

Even without a power analysis, this study clearly does not reach representation of the general population, as geographic representation is not fulfilled, a bias by scientifically interested individuals and possibly study degree may apply and no explicit sampling was applied. Distribution among professions also shows an overrepresentation of health care professionals (27% in our cohort vs. 18% in Germany [20]). Nonetheless this cohort of 339 participants gives a profound impression of opinions on RAS in the public.

Inclusion of participants aged <18 produces a wholesome but flawed image of public perception of RAS. However, results were backed by additional analyses within more concise age cohorts if relevant.

The unvalidated questionnaire used in this study was self-composed. In lack of validated questionnaires, comparability was attempted to be achieved by leaning on questions used in previous studies [15, 17]. Development of validated items is needed for more reliable research.

Conclusion

Our limited, local study in 339 participants shows a higher preference for RAS than previous studies but reaffirms the need of patient education addressing misconceptions surrounding RAS, particularly among pensioners. Meanwhile younger, tech-savy patients mostly fear lack of surgeon skill, showing a high confidence in technology. Bridging these gaps in knowledge and fears may help shift preferences further toward RAS, ultimately fostering wider acceptance and more differentiated understanding of its advantages. However, the generalizability of findings remains limited and deeper insight about the general population requires a sample with more representative characteristics, unaffected by regional variations and potential biases.

Statement of Ethics

Ethical approval was not required for this study in accordance with local/national guidelines. The study was conducted in compliance with the Declaration of Helsinki. Consent to participate in the survey anonymously was precondition to visiting the exhibition on RAS. Patients were informed about the usage of data for scientific analyses and gave implied informed consent by participation (see online suppl. mat. 2). Written consent was not required by local law as no identifying data was processed.

Conflict of Interest Statement

The authors declare to have no conflicts of interest.

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Author Contributions

Study concept and design: Thomas, Herout, Mehralivand, Baunacke, and Vilimas, Hirtsiefer. Acquisition of data: Ehrt, Hirtsiefer and Vilimas. Analysis and interpretation of data: Hirtsiefer and Thomas. Drafting of the manuscript and statistical analysis: Hirtsiefer. Critical revision of the manuscript for important intellectual content: Thomas and Baunacke. Administrative, technical, or material support: Thomas, Baunacke, and Ehrt. Supervision: Thomas. Obtaining funding: none obtained.

Data Availability Statement

The data that support the findings of this study are not publicly available due to data privacy reasons but are available from the corresponding author C.H. upon reasonable request.

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