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ORIGINAL ARTICLE

Operating room communication in robotic surgery: Place, modalities and evolution of a safe system of interaction

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Summary
Introduction: The aim of this study was to evaluate by questionnaire the feelings and the expectations of the different members of the operating room (OR) team in terms of communication during a robotic surgery with remote operator immersion.
Materials and methods: A total of 130 questionnaires were sent to several surgical units equipped for robotic surgery and addressed to operators (O), operative assistants (OA) and scrub nurses (SN). It included 32 questions addressing the following themes: function, experience, previous training, impressions about communication (difficulties, the place of verbal interactions, evolution with experience and role of each team member in communication).
Results: Only 17.4% of responses reported the use of communication protocols. The need for systematic description by the OA/SN of the difficulties in performing an action outside the operator's visual field was perceived as ''essential'' by 59%, 44.4% and 73.7%, ''useful'' by 35.9%, 55.6% and 21.1% of the SN, OA and O, respectively. Impaired communication was experienced during the learning phase by 60%, 80% and 57.9% of the SN, OA and O, respectively. During the apprenticeship phase, > 92% of the OR team members felt that a systematic mode of verbal control was particularly useful. With the acquisition of experience, 82.1%, 80% and 73.7% of the SN, OA and O, respectively, thought it was necessary to continue a systematic mode of communication.
Conclusion: With immersion, the surgeon unconsciously loses non-verbal exchange and becomes cut off from his surgical environment. The assistant is the one who perceives feelings of isolation most acutely. Therefore, interaction and communication must be verbal, systematic and safe. Systematic verbal communication should be reinforced during the training phase and continued thereafter although it could become more relaxed as experience increases.

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Introduction

The development and utilization of the surgical robot continue throughout the world, affecting different surgical specialties such as urology, gynecology, digestive surgery and ear-nose and throat (ENT) surgery. The concept of remote surgery, with the surgeon removed from the patient's side to his console, has not evolved much. The relationship and the communication between the operator (O) and his operating assistant (OA) are therefore different from that in open surgery or laparoscopy and can be further impaired by the environmental noise pollution of the device. OA's-in-training, whose attention is focused on the technical gesture, often hesitate to communicate and express their difficulties, which can be a source of nervousness or feeling of insecurity for the O. The objective of this study was to evaluate by questionnaire the feelings and expectations of the various participants in robot-assisted laparoscopic surgery and to specify potential modalities for improved interaction and cooperation.

Materials and methods

In 2017, 130 questionnaires addressed to O, OA and scrub nurses (SN) were sent by post or e-mail to various French surgical centers equipped for robotic surgery, after obtaining the approval of the operating room managers. The questionnaire consisted of 32 questions, covering the following topics: function in the operating room, experience, training received, impressions regarding communication during robotic surgery (difficulties, the place of verbal interactions, evolution with experience, each person's role in communication). The study of the responses was analyzed statistically with Chi^2 tests.

Results

From the 130 questionnaires, 69 responses were received from 40 SN, 10 OA and 19 O. Of these responses 31.9% came from of the public sector, 40.6% from the private sector and 27.5% from private non-profit or mutual institutions. All these establishments used the DaVinci® Robot produced by Intuitive Surgical®. The surgeon specialties were 73.7% urology 15.8% digestive surgery, 5.3% visceral endocrinologic surgery and 5.3% gynecology. The proportion of registered nurses and certified operating room techs was 52.5% and 47.5% for the SN compared to 70% and 30%, respectively for the OA ($P = 0.31$). SN's were not used in the private sector.

The results expressed by percentages are summarized in the different tables. The responses were grouped by themes: working conditions and training (Table 1), perception of potential communication difficulties in robotic surgery (Table 2), origin of communication difficulties in robotic surgery (Table 3), environment and roles (Table 4), secure communication and environment (Table 5), and training phase in robotic surgery (Table 6).

Discussion

Evaluation of the questionnaire results that dealt with the feelings and expectations of the various participants in robot-assisted laparoscopic surgery revealed a certain lack of awareness of the potential difficulties of communication. In fact, we found that almost three-quarters of the centers did not have communication protocols in place and that more than half of the robotic surgery training courses did not address the specificities of communication in this setting. Our results particularly indicated a lack of awareness and sensitivity to this issue on the part of the O.

Table 1 Work conditions and training.

	SN	OA	O	Significance
For robotic-assisted surgical procedures, do you systematically work with the same team?				
Yes	10	10	47	$P = 0.0024$
No	88	90	53	
NR	3	0	0	
Have you instituted communication techniques or other elements to facilitate or improve communication?				
Yes	15	30	16	NS
No	78	70	79	
NR	8	0	5	
What was your first training in robotic surgery?				
IRCAD[a]	18	33	36	NS
EEC[b]	0	0	7	
DIU[c]	0	0	0	
In-hospital training	82	67	57	
Was the issue of communication addressed during this training?				
Yes	39	50	29	NS
No	61	50	71	

NS: non-significant; NR: no response. Questions and responses in percentages. SN: Scrub nurse; OA: operative assistant; O: operator; NS: non-significant; NR: No response.

[a] IRCAD: Institut de recherche contre les cancers de l'appareil digestif/Research Institute for Digestive Cancer-Strasbourg.

[b] EEC: École Européenne de Chirurgie/European School of Surgery.

[c] DIU: Diplôme Inter-Universitaire/Inter-University Diploma in Robotic Surgery.

Table 2 Perception of potential communication difficulties during robotic surgery.

	SN	OA	O	Significance
Do you have the impression that communication is more difficult in robotic surgery compared to other operative techniques?				
Yes	40	70	37	$P = 0.022$
Maybe	30	20	5	
No	30	10	58	
Does environmental sound pollution (noise of robotic function, heating blanket, discussion) bother you more than for laparoscopy or laparotomy?				
Yes	63	70	32	$P = 0.074$
No	28	30	53	
Maybe	0	16		
NR[a]	3	0	0	
If the issue of communication is not addressed during training, do you think this is a negative factor?				
Yes	75	90	58	$P = 0.145$
No	8	10	26	
NR[a]	17	0	16	

Questions and responses in percentages. SN: Scrub nurse; OA: operative assistant; O: operator.
[a] NR: no response.

Table 3 Sources of communication difficulty in robotic surgery.

	SN	OA	O	Significance
What do you think the reasons might be for this difficulty in communication?				
The concept of ''total immersion'' of the surgeon in robotic surgery				
Yes	74	70	44	$P = 0.0018$
Probably	24	30	22	
No	3	0	33	
The concept of remote telesurgery (removed from the bedside)				
Yes	44	60	33	$P = 0.045$
Probably	22	40	17	
No	34	0	50	
Environmental noise of the system				
Yes	50	60	22	$P = 0.019$
Probably	32	10	22	
No	18	30	56	
The absence of visual feedback from the operating room to the surgeon at the console				
Yes	44	50	22	$P = 0.091$
Probably	26	30	22	
No	29	20	56	

Questions and responses in percentages. SN: Scrub nurse; OA: operative assistant; O: operator.

Indeed, questions about the perception of communication difficulties, the importance of communication during training, and also the impact of immersion, remote surgery, and ambient noise (Tables 2 and 3), showed a statistically significant difference between OA and SN compared to O. This finding was reinforced by the evolution of O responses at the end of the questionnaire concerning the training and the potential evolution of communication with experience (Table 6); these showed a clear increase of interest regarding the importance of communication. This lack of O awareness is probably induced by physical isolation and surgical immersion that serve to increase the O's concentration but also isolate him/her from the environment. Another consequence is a feeling of psychological isolation experienced by the OA, who finds him/herself alone on the operative field even though not isolated from the environment (Fig. 1).

In non-robotic surgery, Wheelock et al. reported that the most frequent intra-operative distractions were those induced by another operative team and by extraneous conversations unrelated to the surgical act [1]. Weigl et al. [2] measured an average of 9.2 to 16.27 events per hour that might potentially cause surgical interruptions, and Antoniadis et al. [3] reported an average of 9.82 distractions or interruptions per hour, while Dru et al. reported a significant link between distractions and the loss of quality

Table 4 Work environment and functions.

	SN	OA	O
Do you think that better communication could avoid the need for an operator to interrupt the operative gesture in order to see what is going on in the operating room?			
Yes	83	100	74
No	18	0	26
NR[a]	0	0	0
Have you noticed whether the central position occupied by the OA/SN favors the circulation and exchange of information?			
Yes	45	10	42
No	37	40	42
NR[a]	18	50	16
During a critical surgical phase when the surgeon is concentrated on a technical gesture, should the OA/SN discreetly warn any noisy personnel who enter the room to avoid disturbing the team's concentration?			
Indispensable	60	80	63
Useful	28	20	37
NR[a]	8	0	0
Not useful	0	0	
Do you consider this to be one of the responsibilities of the OA/SN?			
Yes	70	90	74
No	28	10	26
NR[a]	3	0	0

Questions and responses in percentages. SN: Scrub nurse; OA: operative assistant; O: operator.
[a] NR: no response.

Table 5 Communication and a safe work environment.

	SN	OA	O
Do you think that an improved communication system could avoid the operator's need to interrupt the surgical procedure in order to see what is going on in the rest of the operating room?			
Yes	83	100	74
No	18	0	26
NR[a]	0	0	0
If yes, for what reasons?			
Better comprehension			
Yes	100	100	72
No	0	0	28
To avoid delays			
Yes	85	80	76
No	15	20	24
To reduce stress			
Yes	74	90	69
No	26	10	31
To reduce the operator's distraction			
Yes	79	80	75
No	21	20	25
If no, for what reasons?			
Fatiguing	0	67	0
Noisiness	50	0	67
Loss of concentration	50	33	33

Questions and responses in percentages. SN: Scrub nurse; OA: operative assistant; O: operator.
[a] NR: no response.

Table 6 Training phase in robotic surgery.

	SN	OA	O
Have you felt any change in communication when one of the surgical operators or the OA/SN was in the apprenticeship (training) phase?			
Yes	80	80	58
No	38	20	32
NR[a]	3	0	11
Do you think that this form of verbal control is particularly useful during the apprenticeship (training) phase?			
Yes	92	100	100
No	8	0	0
NR[a]	3	0	0
Do you think that systematic description by the OA/SN of difficulties in performing a gesture out of the operator's visual field are			
Usefulness			
Indispensible?	59	44	74
Useful?	36	56	21
NS[b]	3	0	0
Not useful?	3	0	0
Frequency			
Systematic	82	80	74
As needed	18	10	26
Sometimes	0	10	0
Never	0	0	0
Have you found that communication becomes freer, better and safer as the team acquires experience and techniques become more automatic?			
Yes	80	80	95
No	15	20	5
NR[a]	5	0	0
Do you think that, as the team acquires experience and techniques become more automatic, the communication can be reduced to the essential minimum?			
Yes	56	50	74
No	43	50	21
NR[a]	0	0	5
Do you think that this systematic communication method should be continued after the team members have become experienced?			
Yes	82	80	74
No	18	10	26
NR[a]	0	10	0

Questions and responses in percentages. SN: Scrub nurse; OA: operative assistant; O: operator.
[a] NR: no response.
[b] NR: non significant.

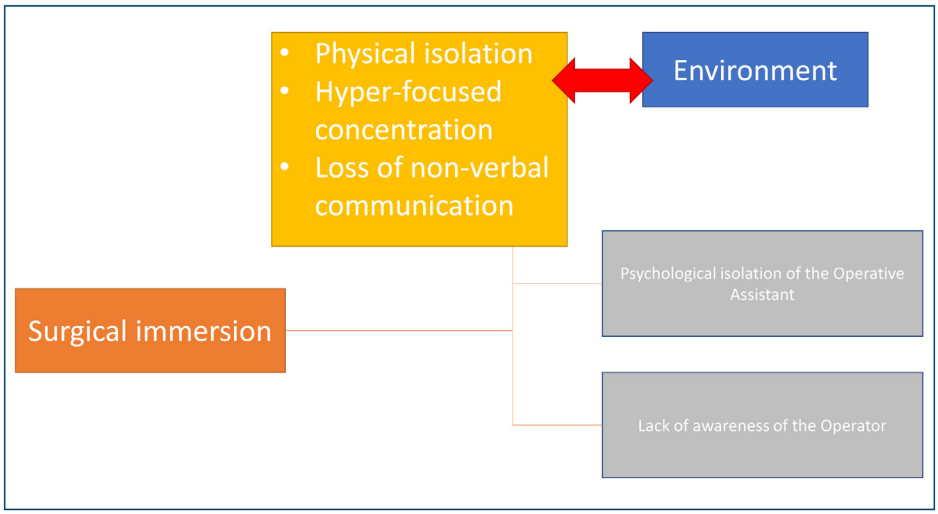

Figure 1. consequences of immersion during robotic surgery.

of teamwork among surgeons and anesthesiologists [4]. There is a clear need to reduce the potential causes of distraction during surgical procedures. In our study, more than 80% of the various stakeholders thought that better communication could prevent an interruption of the surgical procedure, especially during a critical phase. In the public sector, the OA could delegate environmental monitoring to the instrumentalist, but in the private sector where there are no SN's, only the OA was available to fulfill this function.

In robotic surgery, the various participants in our study felt that verbal communication was useful or even indispensable in 90 to 100% of cases, with a positive impact (particularly specified by the OA) on comprehension and the resultant potential of time saving and stress reduction. Conversely, the few O who disapproved of verbal communications considered them a potential source of fatigue, delay, and noise annoyance. All the OA considered systematic verbal description of the gestures made by the OA and SN outside the visual field of the operator to be useful or even indispensable. OA's felt a real need for verbal communication to alleviate their solitude in the operative field, although experienced teams who have acquired dynamic work habits can perceive this as fastidious and inconvenient. However, in our study, only 10% of SN and OA vs. 47.4% of operators ($P = 0.002$) reported ''always working with the same team''; this poses the problem of the necessary adaptive effort of OA and SN, as well as real difficulties in developing habits and team dynamics.

During the apprenticeship and training phase, Guru et al. [5] have demonstrated that the O's efforts evolve with experience, with a decrease in mental effort in favor of more efficient motor skills. In our study, 80% of OA reported communication difficulties certainly induced by the O's mental effort (concentration), constraints, and stress induced by novelty during their training phase. This improved with experience in 80-95% of cases. All O and OA thus reported a need for reliable communication during this apprenticeship phase and also the desire to maintain this systematic communication (73-80%), even after the acquisition of experience. It seems essential therefore, to prioritize explicit descriptive verbal communication for young operators and assistants from the very beginning of robotic surgical training, especially since its initiation is not natural with most of the attention focused on the technique. This finding is confirmed by Nyssen et al. [6] who showed that communication concerning the orientation localization of the organs, and manipulation of the instruments was indeed more pronounced for teams with little experience in robotic surgery.

The evolution of communication protocols as experience and teamwork habits mature might facilitate a well-thought relaxation of communication protocols, although 50-73.7% of the OA and O desired that systematic communication protocols be continued even after acquisition of experience. Eventual relaxation of communication protocols would be justified if it reduced the effort required for this necessarily forced and unnatural interaction, and could potentially reduce operating time. Indeed, Raheem et al. [7] demonstrated that an incompletely formulated operator request was statistically significantly associated with a shorter action delay (5 vs. 8 sec, $P < 0.01$) while Sexton et al. [8] showed that the OA's ability to anticipate allowed an 8% reduction in operating time. Randell et al. [9] examined the details of communication that should be systematically implemented and, in particular, they identified that an oral reply to the operator's requests reassured the surgeon and testified to the initiation of an action. In our study, 95% of operators found that a systematic description of the difficulties encountered by the operative assistant/instrumentalist in performing a gesture outside the operator's visual field was ''indispensable'' or ''useful''. We could therefore envisage safe communication evolving toward a less onerous formality as a team acquires experience and teamwork habits, while nevertheless systematically maintaining formal communication rules: an oral answer to the operative requests, a description of any events that might interfere with the gesture (instrument change, reloading of clips, change of insufflation gas bottle), description of any difficulties encountered by the OA/SN in performing a gesture outside the O's visual field, a request for confirmation of the implantation site of a clip by the OA, as well as the oral validation of the extraction of a needle or other foreign body.

While only 42.1—44.7% of respondents felt that the central position of the OA could potentially facilitate the flow of information, the need for systematic communication by the remotely placed and immersed O clearly underscored the central role of the OA to guarantee environmental oversight.

Conclusion

In robotic surgery, although the total immersion and focus of the surgeon increases concentration, it also leads to the loss of the non-verbal exchange and environment-encompassing vision available in conventional surgery. On the other hand, the OA, who is centrally placed beside the patient, seems to most seriously experience a sense of isolation and solitude. In this particular context, a system of intercommunication that is necessarily verbal and safe should be systematically taught, reinforced throughout the training phases, and can thereafter be maintained but relaxed as skills, experience, habits and a certain team dynamic are acquired.

Disclosure of interest

The authors declare that they have no competing interest.

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