



Live-case demonstrations in pediatric urology: Ethics, patient safety, and clinical outcomes from an 8-year institutional experience

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Purpose: Live case demonstrations have become a common occurrence at surgical meetings around the world. These demonstrations are meant to serve as an educational medium for teaching techniques, promote discussion, improve interventions and outcomes. Despite the valuable educational benefits, many authors still question the ethics of this approach. We present our 8-year experience in live surgery, discuss the ethical issues, and provide recommendations.

Materials and Methods: We reviewed records of patients who underwent live robotic surgery during broadcasting events. Procedures performed were robot-assisted laparoscopic pyeloplasty (RAL-P), ureteral reimplantation (RALUR), and hemi-nephrectomy (RAL-HN). Peri- and post-operative outcomes were compared to our previously published case series.

Results: From October 2011 to May 2019, the senior author (MSG) performed all live surgery demonstrations on 22 patients: 9 RAL-P, 9 RALUR, and 4 RAL-HN. Live RAL-Ps had a 100% success rate and lower 30-day Clavien–Dindo grade (CDG) III complications when compared to our previous case series (11.1% vs. 21.2%). RALURs performed during live demonstrations had a higher success rate than our previously published cohort (100% vs. 82%). RAL-HN operative time and length of stay were comparable to our non-live control group.

Conclusions: Live surgery is a valuable didactic tool, but even experienced surgeons may be adversely affected by inappropriate case selection, technical difficulty, and anxiety associated with particular settings, such as operating at different institutions or working with unfamiliar surgical teams. We suggest consultation of an ethics review board and formulation of standard guidelines for patient selection, surgical equipment, and operative team.

Keywords: Ethics, clinical; Minimally invasive surgical procedures; Robotic surgical procedures; Teaching; Urology

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INTRODUCTION

Live case demonstrations have become a common occurrence at surgical meetings around the world. These demonstrations are meant to serve as an educational medium for

teaching techniques by skilled clinicians to many attendants who otherwise would not have access to such procedures. In addition, live surgery can offer a forum to share techniques, promote discussion on ways to improve interventions and, ultimately, patient outcomes. This concept is not new as

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traditional surgical teaching started with the attendance of performance amphitheatres. Over the years this has been replaced by digital media and live broadcasting.

Despite the valuable educational benefits, many authors still question the ethics of this approach regarding patient safety, informed consent, intraoperative decision making and clinical outcomes. The whole apprenticeship structure of medical education presumes that care of every kind is done under the observation of trainees. However, the transition from small groups of observers, standing in a quiet operating room (OR), to a large audience continuously interacting with surgeon and OR team through cameras and microphones, is a huge leap. The delivery of patient care in front of a large audience creates a unique set of circumstances that could put additional pressure upon surgeons and increase the risk of poor outcomes. The unknown risks associated with live case demonstrations have led many surgical societies worldwide to not only discourage but to ban these presentations from national meetings [1,2].

The pediatric patient is unique for physiology and tolerance to adverse effects, requiring additional vigilance and precautions. We aimed to present our 8-year experience in live surgery, by reporting clinical outcomes of all patients involved in pediatric urology case demonstrations and comparing them to our own previously published data. In addition, we discuss the ethical issues related to live surgery and provide recommendations for patient safety.

MATERIALS AND METHODS

We performed a retrospective review of a prospectively maintained database. Only pediatric patients who underwent live robotic surgery demonstrations during courses or conferences were included for analysis. Type of procedures included robot-assisted laparoscopic pyeloplasty (RAL-P), robot-assisted laparoscopic ureteral reimplantation (RALUR), and robot-assisted laparoscopic hemi-nephrectomy (RAL-HN). Demographics, perioperative data, such as operative side and time (OT), length of stay (LOS), intraoperative complications, and postoperative outcomes, such as 30-day postoperative Clavien–Dindo grade (CDG) III complications and need for surgical revision, were compared to our own previously published institutional case series on RAL-P, RALUR and RAL-HN.

RESULTS

From October 2011 to May 2019, the senior author (MSG) performed live surgery demonstrations on 22 patients. Sur-

gical procedures performed were 9 RAL-P, 9 RALUR, and 4 RAL-HN. A specific informed consent describing details of live transmission was obtained from parents. There were no intraoperative adverse events and all procedures were successfully completed. One patient planned for appendicovesicostomy was converted to an open approach due to absent appendix. The OTs and complication rates were comparable, while overall outcomes were at par or superior. When comparing the 9 patients undergoing RAL-P with our previous series of 52 RAL-P [3], we found lower 30-day postoperative CDG III complications (11.1% vs. 21.2%) and a 100% success rate in the live surgery series. The only patient of the live surgery group with CDG III was an infant who had port-site hernia. Similarly, when comparing the 9 RALUR performed during live demonstrations to our previously published study [4], we found a higher success rate for live RALUR (100% vs. 82%). Finally, we compared our 4 RAL-HN performed during live conferences to a previously published study reporting outcome on 16 RAL-HN [5]. We found similar operative times (OTs) and LOS. Complications with a CDG III, in the first 30 days after surgery, were found in 1 patient (25.0%) of the live surgery group and in 2 patients (12.5%) of our published case series. The live surgery patient with CDG III had a hematoma with superinfection after a challenging RAL-HN, which required interventional radiology drainage. Patients data are summarized in Table 1 [3-5].

DISCUSSION

The surgeon-patient relationship represents a type of fiduciary liaison, in which patients display unconditional reliance on surgeons' abilities to cure. The physical intimacy of the procedure and the high degree of trust set into this relationship entail the placement of great responsibility upon surgeons. The ethical values that surgeons have established throughout the years are salient to maintain standards of care and deal with a unique set of emerging issues, often driven by the continuous advancements in surgical technology. This evolutionary process has increased complexity of procedures and created new challenges in surgical education that require continuous adjustments of training schemes.

The traditional surgical training was based on an apprenticeship model designed to engage new learners in clinical environments for a prolonged period. American surgeon William Stewart Halsted's phrase "see one, do one, and teach one" formerly characterized traditional surgical instruction [6,7]. However, Halsted's method is outdated as the continuous unfolding of new surgical approaches and techniques, such as robotic surgery, has challenged surgeons with ad-

Table 1. Outcomes comparison in patients who underwent surgery during live events and patients of previously published case series

Type of procedure	Live surgery	Previous studies
RAL-P		Murthy et al. (2015) [3]
Patients	9	52
Age	8 infants, mean 4.8±2.5 months 1 patient of 4 years	Number of infants NA, overall mean 8.7± 6.1 years
Sex (male/female)	5/4	
Side (left/right)	6/3	
SFU grade (IV/III)	8/1	
OT (min)	133.5±29.8	203.3
LOS (d)	1.3±0.5	NA
Intraoperative complications	0	0
30-day post-operative CDG III (hernia)	1 (11.1)	11 (21.2)
Post-operative revision pyeloplasty	0	3 (5.8)
RALUR		Gundet et al. (2016) [4]
Patients	9	58
Age (y)	5.5±4.2	
Sex (male/female)	2/7	
Ureters	10	83
Side (right/left, 1 double ureter)	5/4	
VUR grade (III/IV/V)	4/3/2	
OT (min)	108.7±12.1	NA
LOS (d)	1.2±0.4	2
Intraoperative complications	0	0
30-day post-operative CDG III	0	0
Post-operative VUR	0	15 (18)
RAL-HN		Malik et al. (2015) [5]
Patients	4	16
Age (y)	5±4.7	
Sex (female)	4	
Side (right upper/left upper moiety)	3/1	
OT (min)	144.8±50.7	135±36
LOS (d)	1.5±0.6	2±0.8
Intraoperative complications	0	0
30-day post-operative CDG III (hematoma)	1 (25.0)	2 (12.5)

Values are presented as number only, mean±standard deviation, or number (%).

RAL-P, robot-assisted laparoscopic pyeloplasty; SFU, Society of Fetal Urology grade; OT, operative time; LOS, length of stay; CDG, Clavien–Dindo grade; NA, not available; RALUR, robot-assisted laparoscopic ureteral reimplantation; VUR, vesico-ureteral reflux; RAL-HN, robot-assisted laparoscopic hemi-nephrectomy.

ditional complexity, requiring further preparation and skill learning outside of the operative field [8]. Therefore, the old paradigm has now changed to “watch a procedure multiple times (live or video recorded), learn and assess the technical skills in a simulated environment, transfer the skills to the real setting”.

Societal perceptions fueled by media have propagated the myth that surgeons at teaching institutions see patients as means for surgical education and “practice”, entailing an increased risk for safety. Indeed, some patients request not to have trainees involved in their surgical care, let alone an entire plethora of newbies watching the surgeon performing

complex procedures. This conflicting situation placed surgeons in an uncomfortable position where it’s hard to fulfill their ethical responsibilities: respecting the patient’s choice, and passing down medical knowledge to other surgeons, while providing excellent care. Surgeons, especially at academic institutions, have the moral and ethical responsibility to train the next generation of surgeons. In order to deliver high professional standards, it is critical to coordinate prioritization of patient best interest with live teaching activities. In Table 2 we list our recommendations to warrant patient safety during live surgery events. Among these recommendations, we also describe roles and responsibilities of all team

Table 2. Recommendations to ensure patient safety during live surgery events

Patient safety recommendations
The educational value must exceed that of a prerecorded operation.
Patient selection and decision making, before and during surgery, must not deviate from routine care or be affected by the live setting (i.e., audience opinion).
Patients should sign a specific informed consent highlighting the risks associated with live surgery. A mutual informative discussion is crucial and understanding the risk factors involved but at the same time emphasizing to family about patient safety is first and mutual trustworthy discussion.
Surgery can only be performed by surgeons deemed to be experts. The definition of expert should be mainly based on surgical volume and previous live surgery experience and such unique skill often not objectively assessed is based on intuition and once own comfort of working under stress.
Ideally, surgery should be performed at the surgeon's home institution and with the familiar team, to reduce the risk of unforeseen circumstances.
Live broadcasting should be moderated by a representative within the OR, who will serve as a filter between the moderators in the audience and the surgeon. Allowing direct discussion with the surgical team only when appropriate, minimizes distraction.
Patient safety comes first, and the surgeon must be willing to terminate the live broadcast if this becomes compromised.
The representative in charge of filtering communication should be also trained to identify dangerous situations or deviations from standard and cease the transmission if patient safety is at risk.
Data collection of all cases should be stored in a prospectively maintained database to monitor patient safety, short- and long-term outcomes.
Most of these are CME activities and conflict of interests are disclosed.

OR, operating room; CME, continuing medical education.

members, explain how to manage interactions between the audience and OR team, and emphasize *non-maleficence* and *beneficence* as critical obligations that surgeons have toward patients, in order to ensure patient safety and deliver best outcomes.

It is equally important to establish an open and honest communication with patients and their parents, describing how the live event unfolds, and to reassure that a patient-centered approach is preserved throughout the entire procedure. This information flow between patient and surgeon is accomplished through an appropriate informed consent. The intent of informed consent is to respect the autonomy of patients by providing them with information about nature, risks, benefits of, and alternatives to a procedure. Patients should specifically consent to have their cases performed during live events. Patients may gain satisfaction by understanding that their participation as subjects of the broadcast operation will expand surgical education, potentially improving surgical outcomes for others in the future.

Other positive aspects of live surgical procedures include potential benefits to surgeons and public. Live surgery, as compared to video recordings, may draw better attention from surgeons attending conferences, because of the interactive involvement with the OR team. A major advantage of surgical broadcasts to professional groups—one that accrues equally to both live and recorded operations—is the acknowledged educational value of learning operative methods and technical points from experienced master surgeons. Similarly, public broadcasting helps educating the general

public, increasing the understanding of a disease, recognition of early symptoms and its treatment. Of note, in 2005 our senior author was part of the surgery team in “City Hospital”, a medical documentary television series that aired surgical procedures on British Broadcasting Corporation (BBC), the United Kingdom National Network. Another notable example is an educational project resulted by the fruitful collaboration of Penn State University and Whitaker Center. The two institutions created a live surgery course to stimulate the interest of high school students in career in health care [9].

In the era of digital education, resources such as virtual reality, animated video, simulation and inanimate training are made available to the risk of patient harm. However, factors such as human anatomy are intricate and such educational tools need to be supplemented by live learning.

Live surgical demonstrations will always be attractive to surgeons in practice. It is a direct way of comparing our techniques with those of our well-known colleague leaders, particularly in the less commonly performed operations and when there are multiple choices where no one approach seems obviously superior. Live surgery gives an immediacy not found in edited surgery and gives the audience access to ask questions not afforded by any other medium.

Overall, data comparing the outcomes of live case presentations with cases undertaken in normal settings are scarce, and no pediatric report is available as of today. Brunckhorst et al. [10] reviewed the literature from 1980 until 2014 on live surgery outcomes, identifying eight studies in differ-

ent fields. In three of these studies, the success rates of live surgery were lower than the routine practice, yet there was no difference in complications. More recently, three studies evaluated the outcomes of live endourological procedures and robot-assisted prostatectomies. These studies did not report statistically significant differences in surgical outcomes as compared to routine cases [11-13].

Our data are in line with the scarce available evidence, showing that live surgery in the hands of experienced surgeons can be a safe and powerful tool to improve surgical education, especially for niches like pediatric urology where small case load is training limitation. It is possible that there is case selection bias involved for live case and may show better outcomes than regular case series as these cases are performed by an experienced attending and the team involved is working at the best of their performance.

Although presented at different academic events, all surgeries were performed at our home institution and broadcasted live to different networks (Table 3). Our senior surgeon has also extensive experience on live surgery demonstrations performed abroad, at national and international institutions (India, Mexico, Chile, Spain, Israel, etc.). The arrangement of live demonstration as a visiting surgeon adds

additional complexity to the operation. Specifically, physical and mental stress could be triggered by travel and jet lag; unknown experience and work routine of the surgical team; unspecified patient selection process; unfamiliar instrumentations. Based on personal experience we suggest active participation to case selection and discussion with the local team; adequate rest before surgery; extensive preoperative review of the case with host surgeon and family; accurate inspection of the OR and familiarization with the surgical team members; proper examination and selection of the surgical equipment. In case of language barriers, it is imperative to hire a professional translator and avoid miscommunication debacles.

CONCLUSIONS

Live surgery may be a valuable way to educate surgeons, but there are issues which performers must be prepared to deal with. Even well-trained and experienced surgeons may be adversely affected by inappropriate case selection, technical difficulties, anxiety associated with specific settings such as working in a different institution with unfamiliar or inexperienced surgical team, and instruments availability.

Table 3. Live surgery broadcasting events

Event	Year	Surgical procedure
2nd University of Chicago International Symposium on Pediatric Robotic Urology	2011	RAL-P
		RALUR
3rd University of Chicago International Symposium on Pediatric Robotic Urology	2012	RAL-P
		RALUR
American Academy of Pediatrics (AAP) Annual Meeting	2012	RALUR
4th University of Chicago International Symposium on Pediatric Robotic Urology	2013	RAL-P
		RALUR
		RAL-HN
5th University of Chicago International Symposium on Pediatric Robotic Urology	2014	RAL-P
		RALUR
		RAL-P
6th University of Chicago International Symposium on Pediatric Robotic Urology	2015	RAL-P
		RALUR
		RAL-HN
1st North America Robotic Urology Symposium (NARUS)	2017	RAL-P
		RALUR
		RAL-HN
3rd North America Robotic Urology Symposium (NARUS)	2019	RAL-P
		RALUR
7th University of Chicago International Symposium on Pediatric Robotic Urology	2019	RAL-P
		RALUR
		RAL-HN

RAL-P, robot-assisted laparoscopic pyeloplasty; RALUR, robot-assisted laparoscopic ureteral reimplantation; RAL-HN, robot-assisted laparoscopic hemi-nephrectomy.

We suggest consultation of an ethics review board before participation to live events, and formulation of institutional guidelines for patient selection, surgical equipment, and OR team.

CONFLICTS OF INTEREST

Dr. Mohan S. Gundeti is co-director for the NARUS course. The another author has nothing to disclose.

AUTHORS' CONTRIBUTIONS

Research conception and design: Ciro Andolfi and Mohan S. Gundeti. Data acquisition: Ciro Andolfi. Statistical analysis: Ciro Andolfi. Data analysis and interpretation: Ciro Andolfi and Mohan S. Gundeti. Drafting of the manuscript: Ciro Andolfi and Mohan S. Gundeti. Critical revision of the manuscript: Ciro Andolfi and Mohan S. Gundeti. Administrative, technical, or material support: Ciro Andolfi and Mohan S. Gundeti. Supervision: Mohan S. Gundeti. Approval of the final manuscript: Ciro Andolfi and Mohan S. Gundeti.

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