UROLOGY PRACTICE
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Video-Based Coaching as an Educational Platform for Urological Residency Training: A Pilot Study

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Abstract

Introduction: Surgical experience requires skills traditionally taught through real-time operating room education and a variety of supplemental educational strategies. Video-based coaching is a modality that may offer potential advantages of immediate, direct and targeted feedback. The objective of this study was to demonstrate and evaluate the utility and educational value of video-based coaching in urology by conducting a qualitative analysis with a coding schema.

Methods: Residents and attendings were recorded operating during randomly selected cases in the operating room. Video-based coaching sessions were held during urology grand rounds and required residents to describe a selected portion of the operating room video and attendings to provide teaching points. Audio recordings from the operating room and video-based coaching sessions were reviewed by 2 independent coders. A coding scale classifying surgical educational goals into 5 categories (information, operative technique, questioning, response to resident interaction and unrelated commenting) was used to identify the interactions and was adjusted for time.

Results: Four urological cases were selected for recording. In the video-based coaching sessions compared to the operating room, attendings made more teaching points per hour, provided more information to residents (mean teaching points 7.7 for video-based coaching vs 2.9 for operating room, $p < 0.005$), emphasized operative skills and technique (mean teaching points 10.5 for video-based coaching vs 4.1 for operating room, $p < 0.005$), and were more likely to ask open-ended discussion leading questions (mean teaching points 28.5 for video-based coaching vs 4.4 for operating room, $p < 0.05$).

Conclusions: Video-based coaching delivered in short time frames offers an easily implementable additional learning opportunity for resident education to further enhance skills learned in the urological operating room.

Key Words: instructional film and video, mentoring, teaching rounds, urologic surgical procedures

Abbreviations and Acronyms

DVIU = direct vision internal urethrotomy

OR = operating room

PGY = postgraduate year

PVP = prostate photovaporization

TP = teaching point

VBA = video-based assessment

VBC = video-based coaching

Submitted for publication November 16, 2020.

This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.

This work was presented at the 2019 Mid-Atlantic AUA meeting as a poster, and was accepted for presentation in a moderated poster session at the 2020 AUA conference but was presented online due to cancellations because of COVID-19.

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† Financial interest and/or other relationship with Maryland Innovative Initiative, GOODELL, DEVRIES, LEECH & DANN LLP, and The Beacon Group.

2352-0779/21/83-393/0
UROLOGY PRACTICE
https://doi.org/10.1097/UPJ.0000000000000211
Vol. 8, 393-401, May 2021
Published by Wolters Kluwer

Surgical proficiency requires technical operative skills as well as nontechnical decision making skills.[1] Traditionally, technical skills are cultivated in the operating room by performing large volumes of surgical operations.[2] However, the resident operative experience is increasingly limited secondary to duty hour restrictions, conservative management practices, increasing numbers of fellows and an expanding array of surgical techniques to learn.[3−5] These limitations are worrisome considering that the most commonly cited factors contributing to surgical errors are inexperience and/or lack of competence in a surgical task.[6] Furthermore, junior residents may underestimate the complexity of surgical cases and subsequently make more errors than anticipated.[7] These considerations along with the dynamic training climate have caused concern regarding the surgical aptitude of new medical graduates.[8−10]

Multiple modalities have been explored to enhance surgical training, including didactic lectures, web-based courses, simulation, grand rounds, alternative training formats and video-based coaching.[11−18] Simulation laboratories are limited in their implementation due to the cost and accessibility of simulations.[19,20] Traditional didactic lectures and web courses are limited in opportunities for interactive discussion.

In video-based coaching in surgery, an attending surgeon works with a training physician to identify areas for improvement and evaluation. Prior research has expanded on the advancing capability of video in surgical education.[15−18,21−23] A 2018 systematic review of video surgical education found significant gains in surgical skills and surgical simulation scores from video-based educational techniques and recommends that video be implemented in surgical education.[16] Another recent study surveying residents and specialists found that 98% of residents have used videos displaying surgical technique to prepare for surgery.[17] In addition to increased attending-resident interactions, VBC may produce opportunities for residents to interact with and teach each other. Resident-to-resident teaching has been shown to be an effective teaching method.[24] However, there is no prior research on the use of VBC in urological surgical education.

A recent investigation found that video-based coaching teaching points made by surgeons measured 102.7, compared to 63.0 operating room teaching points when reviewing general surgery cases.[25] However, the time commitment to review an entire case during coaching offers challenges to implement given current work-hour restrictions. We aimed to assess if video-based coaching with a review of key points during an operation in a limited time period would offer similar educational benefits. We hypothesized that video-based coaching in urological surgery would generate a greater volume of teaching points per hour than in the OR, and that our methodology would demonstrate a feasible and successful alternative method for educating urological surgeons.

Methods

Participant Recruitment and Data Collection

PGY 2−5 urology residents and 4 attending urological surgeons at an academic tertiary care center were recruited for this study. We recorded 4 urological procedures between 09/2019 and 02/2020, including a robotic partial cystectomy, PVP, DVIU and vaginal hysterectomy (table 1). Cases were chosen based on the operative skill expectations of the resident as determined by the attending physicians with various years of teaching experience as faculty members (35, 17, 6 and 2 years).

Audio and video of each operation were recorded, focusing the audio on the resident-attending pair. Audio for both the operating room and the subsequent grand rounds coaching sessions was recorded using the H4n Pro recorder (Zoom Corp., Hauppauge, New York). Operating room videos were recorded via the da Vinci® Surgical System internal camera, Stryker (Kalamazoo, Michigan) laparoscopic camera or StrykeCam HD surgical in-light camera (Stryker). Each video was then used for a coaching session, which took place at a designated urology grand rounds session.

At our institution, urology grand rounds occur monthly and are attended by all institutional urology attendings, residents and medical students on service. Community urologists are invited to attend most educational grand rounds. However, during coaching sessions they were not invited to attend. VBC sessions occur once quarterly. Two

Table 1.
Cases observed from September 2019 to September 2020

	OR			VBC				
Case	Total TPs	Case Length (hrs)	TPs/Hr	Total TPs	Session Length (hrs)	TPs/Hr	PGY Level	Teaching Experience (yrs)
Robotic partial cystectomy	498	6.46	77.1	34	0.19	178.9	4	6
Prostate photovaporization	65	0.75	86.7	156	0.42	371.4	4	35
Direct vision internal urethrotomy	23	0.57	40.4	104	0.28	371.4	4	17
Vaginal hysterectomy	82	0.52	157.7	84	0.2	420	5	2

Total teaching points included only instructive teaching points (excluded "conversing" subcategory within unrelated commenting).

videos were reviewed per grand rounds session lasting 1 hour in total duration. Attendings, designated as coaches, were given a brief overview of the project and made aware that they would be providing feedback regarding resident performance during surgical cases at a subsequent grand rounds VBC session. Coaches were given a "Coaching Residents" pamphlet adapted from prior studies at the Center for Surgery and Public Health at Brigham and Women's Hospital and instructed to teach as they normally would.[25] Residents were told to select time frames from the video that they wanted to discuss and were encouraged to limit their video clip selections to approximately 10 minutes of operative footage. The discussion content of the VBC session was determined solely by participating residents and attendings. Time spent during this portion of the session varied between cases.

Coding

Operating room audio recordings and coaching audio recordings were transcribed with patient and surgeon identifiers removed. The coding schema and categories (see Appendix) were adapted from prior investigations on VBC. Five overarching categories were used for coding: information, operative technique, questioning, response to residents and unrelated commenting, adapted from Hu et al.[25] The Appendix includes definitions and urological surgery specific examples. Two independent trained raters reviewed audio transcripts to identify teaching points.

Statements made by residents and attending physicians were recorded, independently analyzed and categorized according to content. Categorization of individual statements were determined by analyzing each statement and determining which subtopics best pertained to each statement. If applicable, a single statement could be assigned to more than 1 teaching point. Discrepancies between raters were resolved by consensus by the research team.

Statistical Analysis

Teaching points per hour for both the OR and VBC were computed by dividing the total number of teaching points made per session by the duration of the session. Time discrepancies between OR cases and VBC sessions were resolved by applying a multiplier to the teaching point counts (60/length in minutes of OR case or VBC session). Paired 2-sample t-tests were used to compare the mean counts of teaching points per hour, including overall means as well as means for each subtopic, between the OR and VBC sessions. Significance was set at a 2-sided $p < 0.05$. All analyses were performed using SPSS® statistical software.

Results

A comparison of teaching points and comments was made between OR and VBC sessions occurring during grand rounds. Among 4 OR cases, we observed 668 teaching points during 8.3 hours of video (80.5 per hour, table 1). In the coaching sessions, we observed 378 teaching points during 1.1 hours of video and group discussion (343.6 per hour). Conversing (a subcategory of unrelated commenting) was excluded from totals as it was deemed to be non-instructive. So across all 4 cases, attendings made more teaching points per hour while coaching (343.6 vs 80.5, $p=0.01$, table 1). During VBC sessions, attendings made more teaching points focused on informing the resident (mean±SD teaching points 7.7±7.3 vs 2.9±3.3, $p < 0.005$), put more emphasis on operative skills and technique (mean±SD teaching points 10.9±10.6 vs 4.2±4.1, $p < 0.005$), and preferentially used questioning as a modality for teaching (mean teaching points 8.6±7.8 vs 2.4±2.5, $p < 0.005$, table 2).

When looking at individual categories, more teaching points per hour were made across all categories in VBC sessions than during OR cases (fig. 1, *A*). In both VBC and the OR, the largest share of teaching points focused on operative technique (mean±SD 10.9±10.6 vs 4.2±4.1, $p < 0.005$). While the difference in surgeon responses to residents in VBC sessions vs the OR was not statistically significant (mean±SD 6.8±9.1 vs 3.0±4.0, $p=0.08$), there was an increase in surgeon responses across all observed categories (table 2).

In all cases observed in this study, more teaching points were made per hour during VBC sessions (fig. 2). Especially during shorter cases like PVP and DVIU, there tended to be a relatively greater amount of teaching during coaching sessions than in the OR when compared to longer cases like a robotic partial cystectomy or vaginal hysterectomy, where the differences in teaching points per hour were smaller (absolute difference in teaching points per hour was 326.8 in DVIU vs 98.0 in robotic partial cystectomy, fig. 1, *B*).

Informative Teaching

Attending surgeons were more informative during VBC sessions than cases (mean±SD 7.7±7.3 vs 2.9±3.3, $p < 0.005$), providing more teaching content during coaching sessions regarding intraoperative decision making (mean±SD 10.5±4.1 vs 2.3±1.0, $p < 0.05$) and situational awareness (mean±SD 11.7±3.1 vs 2.9±2.1, $p < 0.005$). Room setup was discussed by surgeons less during VBC sessions compared to in the OR, but it was not significant (mean±SD 2.5±4.2 vs 4.4±4.9, $p=0.63$, table 2).

Table 2.
Mean teaching points per hour during VBC sessions vs in OR

Variable	Mean Teaching Points		p Value*
	VBC	OR	
Information:	7.7	2.9	**<0.005**
Preop decision making	13.6	1.9	0.19
Room setup	2.5	4.4	0.63
Incision+exposure	9.4	2.4	0.23
Anatomy	11.3	5.9	0.35
Pathophysiology	2.7	0.5	0.30
Progress	8.3	6.4	0.68
Intraop decision making	10.5	2.3	**<0.05**
Situational awareness	11.7	2.9	**<0.005**
Surgical pitfalls	10.9	1.0	0.22
Summarizing/reflecting	4.5	2.6	0.44
Postop care	4.7	3.7	0.67
Educational needs assessment	5.4	1.3	0.33
Informing pt history	6.4	2.6	0.16
Operative technique:	10.9	4.2	**<0.005**
Informing surgical technique	24.3	5.2	**<0.005**
Demonstrating technique	1.8	2.1	0.91
Advising technique	15.0	8.8	0.41
Justifying technique	7.2	3.1	0.28
Warning about technique	12.9	1.1	0.16
Directing or commanding technique	4.4	4.8	0.91
Questioning:	8.6	2.4	**<0.005**
Closed question	7.0	3.8	0.17
Open question:	28.5	4.4	**<0.05**
Regarding action	20.5	2.3	**<0.05**
Regarding information	8.0	2.2	0.15
Interrogating	5.9	0.2	0.10
Response to resident interaction:	9.2	4.0	0.08
Confirming	9.4	4.1	0.18
Feedback:	3.2	1.1	0.09
Pos	5.4	2.6	0.28
Neg	1.7	0.1	0.40
Corrective	2.4	0.7	0.32
Response to question	18.3	9.7	0.39
Ignoring	3.4	0.7	0.49
Unrelated commenting:	11.1	5.8	0.23
Instructive/joking	11.0	0.8	0.13
Noninstructive/conversing	11.3	10.7	0.93

Single statements could be coded for multiple variables.
* Values in bold are significant.

In the OR, attendings made more teaching points about operative technique than any other category observed, including information, questioning, response to resident interaction and unrelated commenting (mean±SD 4.1±4.1 vs 2.9±3.3 for information, 2.4±2.5 for questioning, 3.0±4.0 for response to residents, 4.0±6.2 for commenting). However, attendings made significantly more teaching points regarding operative technique during VBC sessions than in the OR (mean±SD 10.9±10.6 vs 4.2±4.1, p <0.005, table 2). During several VBC sessions, the attending would point out a specific action taken in the OR, have the presenting resident explain the reasoning behind the action, and then justify the action or advise for or against a different action in similar future scenarios.

Teaching via Questioning

During VBC sessions, attendings asked more questions overall and were more likely to ask open-ended discussion leading questions (mean±SD questioning 8.6±7.8 vs 2.4±2.5, p <0.005; mean±SD open questions 28.5±8.7 vs 4.4±1.3, p <0.05). Attendings presented significantly more questions exploring resident reasoning and thought process for their next action in the case (mean±SD 20.5±6.8 vs 2.3±1.0, p <0.05).

Informal Feedback for VBC

Following VBC sessions, residents expressed that it was helpful to have more time to ask questions during coaching sessions and learn from attendings in a lower pressure setting than the OR. One resident commented that the "grand rounds setting for learning allows us to be more involved and ask questions" while another felt that "grand rounds covered areas in a time-efficient manner."

Discussion

Surgical education is constantly evolving to include a variety of educational techniques. Recent literature continues to

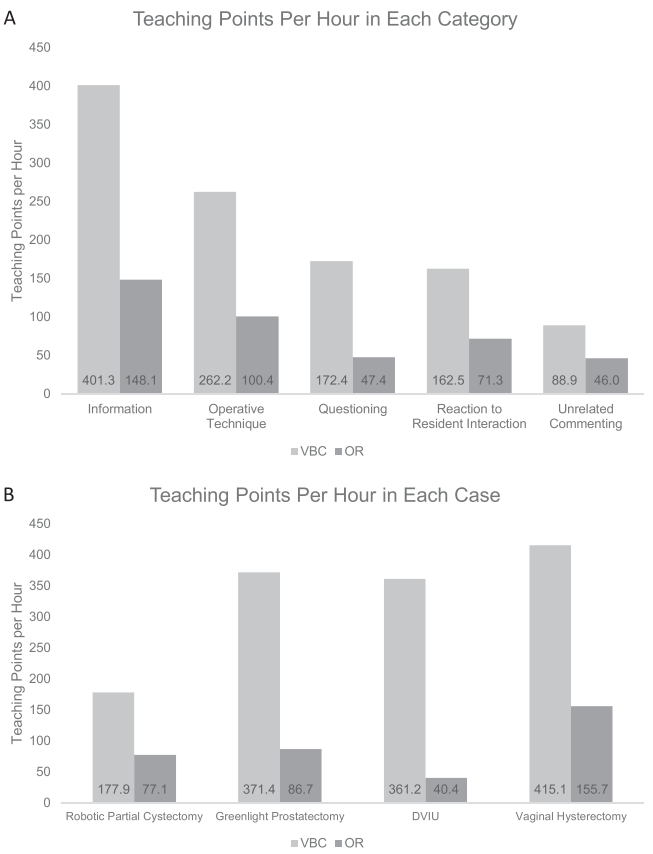

Figure 1. Total cumulative teaching points made per hour across all 4 cases separated by overall categories (*A*) and by case (*B*). Single statements could be coded for multiple types of teaching points.

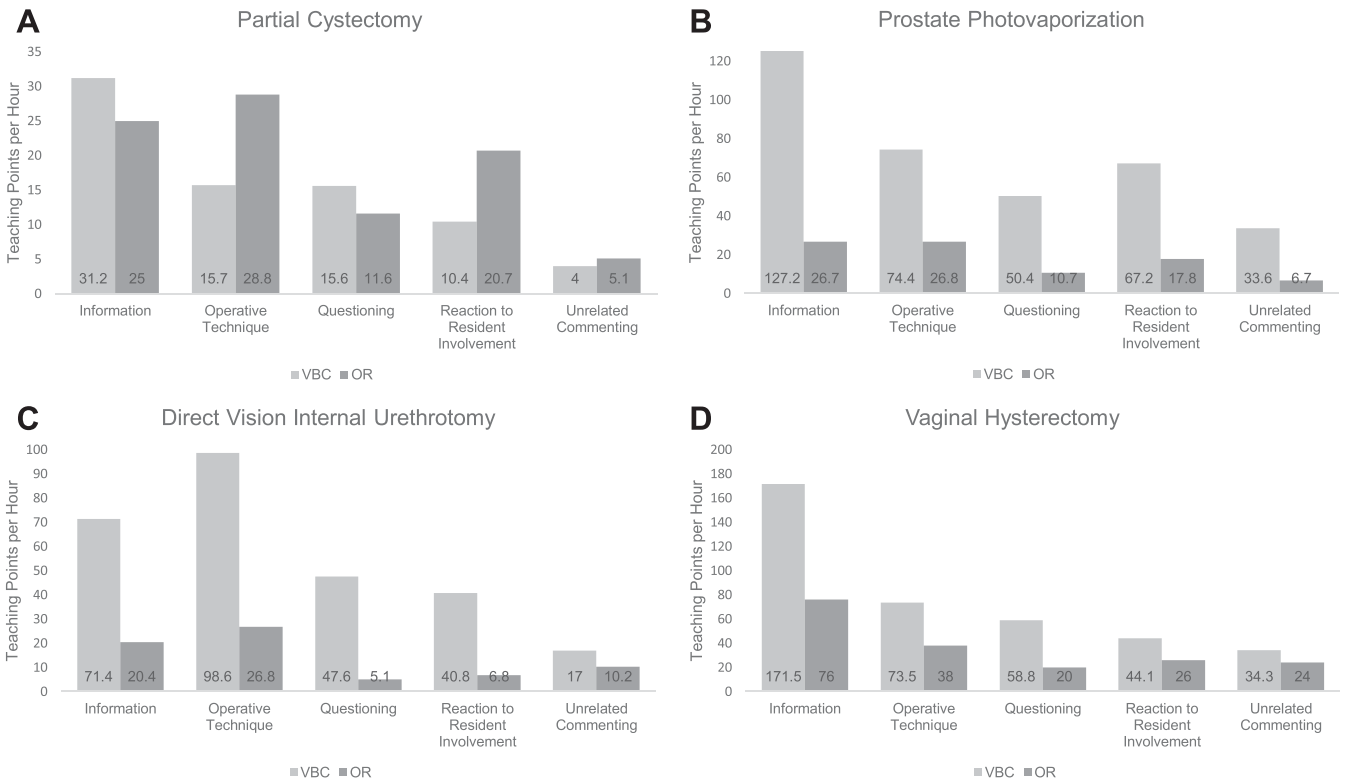

Figure 2. Total cumulative teaching points made per hour in each case. *A*, partial cystectomy. *B*, PVP. *C*, DVIU. *D*, vaginal hysterectomy.

suggest that the dictum "see one, do one, teach one" is not optimal as a single modality for surgical teaching.[26] In addition to motor skills, cognitive skills are important in surgical training, including planning, problem-solving and situational awareness. These cognitive learning skills are well established in athlete training,[27] and over the last few years are being applied to the surgical community. VBC is a relatively new teaching modality utilizing a combination of technology and coaching strategies to maximize efficient learning.[26]

Our study highlights 4 diverse cases in urology and identifies differences in education patterns, both in content and teaching style, that are seen when VBC is added to traditional OR learning. We emphasize the feasibility, time efficiency and educational benefit of implementing VBC strategies in a urological residency teaching curriculum. Some operating rooms in the United States are already equipped with recording capabilities; recording surgeries for teaching purposes, publications and patient recordings is becoming increasingly popular.[28] Lack of recording technology availability was not a difficulty that was encountered throughout this study.

For the presenting residents, there was little preparation involved. Residents were not required to edit the OR footage, and were able to record and store cases using a flash drive. The residents were able to present the videos at grand rounds and spent less than 10 minutes on each case, highlighting the efficiency of both teaching and review that is achieved with incorporating VBC in this novel approach using truncated video segments from the OR. VBC yielded more teaching points per hour of learning than the OR. This is likely due to both an increased volume of comments as well as an increase in the depth of comments (comments that can be attributed to multiple categories).

During VBC sessions, there was a focus on resident education. In VBC sessions, attendings responded to resident comments frequently, gave feedback of all types (positive, negative and corrective), and offered confirmation. One survey of surgery residents showed that 80% of residents report feedback as very or extremely important during surgical training.[29] VBC sessions may provide a good environment to debrief for all cases, and especially for a more extensive review of shorter cases. Residents also utilized VBC sessions to help teach each other and provide each other with feedback.

Teaching points made on operative technique during VBC sessions were distinctly different from those made in the OR. Surgeons tended to demonstrate technique and direct or command technique more often in the OR. While the traditional model of surgical learning in the OR retains tremendous educational value, the diversity of teaching techniques produced by VBC may offer significant added

value for learners and trainees. VBC sessions of cases that have not yet been performed by an observing resident can provide important preoperative information such as the indications for and procedural steps of the operation.[30]

VBC does not replace traditional learning in the operating room which incorporates muscle memory and tactile learning. In this study, surgeons spent more time demonstrating and directing operative technique in the OR, where residents can receive immediate feedback. However, VBC may offer increased opportunities for questions and the ability to assess resident competency in a low stress environment, where communication is less urgent than in the OR.

There are several limitations to this study, including the small number of cases observed. This study is limited to a small group of residents and faculty at our institution. This may limit the generalizability of this study to the other academic teaching centers. Although faculty and resident response was positive, there was no formal process of evaluating faculty or resident impression of VBC sessions. Additionally, each surgery was discussed at a single grand rounds session, and both residents and attendings were aware that they were being recorded. Thus, the results could have been influenced by the Hawthorne effect as their teaching and learning behavior may have been affected by their knowledge of being recorded. Additionally, statements coded for multiple categories may obscure the numerical quantity of individual comments observed per case. There was also no standardized review of residents on a case-specific basis.

Further studies aided by collection of formal written feedback and evaluation of resident performance on 2 consecutive cases before and after VBC could further elucidate the true value of VBC. Other limitations included the inability to record multiple screens at the same time to capture the complete OR experience. Additionally, the quality of videos during a robotic or laparoscopic case may be better relative to open cases using operating room cameras that are not optimized to focal surgical sites. Widespread adoption of VBC may be limited by the lack of available equipment in locations where rounds take place, or lack of surgical video recording equipment.

Conclusions

VBC is a feasible modality and can be incorporated into most, if not all urology training programs. VBC sessions offered a significantly increased number of teaching points in the areas of intraoperative decision making, situational awareness, informing surgical technique and open questions. VBC offers a valuable adjunctive educational opportunity for surgical education that is effective and easy to implement.

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Appendix.

Coding schema

Parameter	Definition	Example
Information:		
Preoperative Decision Making	Preoperative workup, operative indications, anticipated findings	"We counseled him that this procedure [green light] would possibly not work. But because of his severe symptoms, he wanted to go through with the procedure."
Room Setup	Patient positioning, draping, surgeon positioning or posture, lighting	"You need at least one good assistant who can retract [for a vaginal hysterectomy]."
Incision and Exposure	Choice of incision, retractor positioning, dissection, identification of operative site	"You always want to take your Heaney [retractor] and go towards the uterus so you're getting across the vessels rather than going alongside them."
Anatomy	Identification of structures	"So this is a lymph node right here."
Pathophysiology	Disease process, identification of abnormal structures	"We found the tumor, these patchy areas from prior resections. We then demarcated the entire border using these marks."
Progress	Steps of the procedure	"OK, so why don't we see if we can get around the artery here."
Intraoperative Decision Making	Decisions about approach, handling unexpected findings, resection margins, etc	"He had 2 diaphragmatic injuries that were not identified prior to surgery. And that's one of the risks of air seal, is that you can't identify diaphragmatic injuries."
Situational Awareness	Consideration of available resources, interdisciplinary coordination	"The big thing is you can see that once you start cutting in [the bladder], what's within your circle starts contracting."
Surgical Pitfalls	Risks, potential or real complications	"The key here is we did air-filled cystoscopy. Because the big concern with partial cystectomy is tumor spillage when you go in from the top and you open the bladder."
Summarizing/Reflecting	Reviewing existing data, knowledge, or completed steps	"Looking back on it, the big part was just getting a good margin before you cut. Because if you didn't mark out prior, you would lose your bearings."
Postoperative Care	Wound care, diet, medications, drain management, activity restrictions, further workup or treatment	"If it's a bad bladder I'd leave the Foley in for a while."
Educational Needs Assessment	Making statements or asking questions solely for the purpose of determining the learning goals of the resident	"What do you do if you're doing a TURP [transurethral prostatectomy], and the adenoma goes beyond the veru [montanum]?"
Informing Patient History	Explaining, justifying, providing information regarding the patient's specific circumstances	"The guy was quite sick and didn't want to go through a full cystectomy. So we did a partial cystectomy."
Operative Technique:		
Informing Surgical Technique	Explaining, justifying, providing information regarding surgical skills	"Yeah, so you can release the more lateral suture because that would be the one that would be concerning for impinging on the ureter."
Demonstrating Technique	Giving a practical exhibition of surgical skill	"We insufflated the bladder."
Advising Technique	Verbally guiding surgical skill	"Sometimes you can't find the UOs [ureteral orifices] in the bladder. If the bladder is empty, fill it. If the bladder is full, empty it."
Justifying Technique	Explaining the purpose of surgical skill	"So when you do these pressures, you actually rely on the port and the Foley, since they're already in place."
Warning about Technique	Considering adverse events associated with surgical skill	"When you're up in that bladder neck area, you don't want to undermine the trigone. This is coming from a guy who's done it."
Directing or Commanding Technique	Directing without explanation	"Alright, go ahead and take that out."
Questioning:		
Closed Questions	Questions leading to a simple response, often "yes" or "no"	"Did you watch him cutting in?"
Open Question:		
Re: Action	Questions asking for subsequent actions to perform	"All right, looks great. So what do we do next from here?"
Re: Information	Questions asking for further information	"So when we do all this, what sort of things are you thinking about? Like what could go wrong?"
Interrogating	Questions asked with aggressive/accusatory tone	"Why not use saline or water?"
Response to Resident Interaction:		
Confirming	Establishing correctness of an action	"Yeah, that makes sense to clamp the artery there."
Feedback:		
Positive Feedback	Affirming an action	"I like how well you followed your margins."
Negative Feedback	Opposing an action	"You couldn't [redo your lateral suspension] right, since everything else is already closed, so you just have to have a little less suspension."
Corrective Feedback	Suggesting improvement to technique or decision making	"I think you theoretically would want to ablate tissue rather than create more scar tissue."

(*continued*)

Parameter	Definition	Example
Respond to Question		"If you think about it, a stent's not going to hurt, so you can either put in an access catheter or a stent and take it out later. But if there's good efflux and the urine's clear, then you'd probably be okay."
Ignoring	Lack of response to resident question/statement	"Now, in this case, you don't have that option. It was already put in by somebody else. I would've thought of just putting the sphincter in and left that [contracture] alone." "Wait—" "The gamble is he goes into retention," "Yeah—" "but you could always go back later and do [the DVIU] if that happened."
Unrelated commenting:		
Joking	Humor	"I always did [straight cath protocol] just to make guys do something."
Conversing	Conversation outside of medicine/surgery	"Do you know who Mikaela Shiffrin is?"

*Adapted from Hu et al.[25]

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Editorial Commentaries

The authors evaluate the educational value of video-based coaching during residency training. Perhaps one of the mainstays of resident education is real-time feedback provided by faculty in the operating room. While such live feedback cannot be easily replicated, the authors remind us that surgical video may have additional value long after the case.

VBC will not change what happens in the OR, but it may allow for directed learning without the distractions of being "in the moment." Both residents and faculty have 1 paramount goal during a live case–get it done safely. As such, teaching may take a back seat as the secondary objective. Faculty often debrief with residents after a case. But given the discrete opportunity of VBC, there is both time to digest what had happened and perhaps an opportunity to further discuss alternative surgical decisions.

The authors should be commended for attempting to categorize and quantify all types of feedback provided to the resident during the OR vs VBC. Not surprisingly, VBC fared better. The present work can be taken further, where the types of feedback are further dissected to understand why certain feedback happens during VBC but is potentially missed in the live OR. And perhaps faculty development can encompass how best to provide feedback in the OR vs VBC. In our own

experience of providing feedback, we have learned that even the most seasoned surgeons are not always the best surgical coaches. Even surgical coaches can use some coaching.

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The authors have made the leap from surgical dogma to applying current technology capabilities to develop progressive modes of teaching trainees.[1] As a subscriber to video-based assessment of skills, having championed the use of crowdsourcing of surgical skills to provide surgical feedback, I believe wholeheartedly that we are headed to a VBA world (reference 23 in article).[2] The American Board of Medical Specialties, which oversees the surgical boards, is now requiring that lifelong learning certification include VBA opportunities.[3] This has prompted the American Board of Surgery to partner with the American Board of Urology and the American Board of Orthopaedic Surgery to develop a plan for lifelong learning opportunities for diplomates that focus on technical skills and surgical decision making. This manuscript is a pilot study testing the hypothesis that the quality and, more so, quantity of a grand rounds-based VBA teaching model would be higher than intraoperative coaching. The authors demonstrated this and created an elegant study to do so. Truthfully, as I read this manuscript, my mind immediately went to our own residency program (and fellowship where I am the program director) and I thought about swapping out a few journal clubs for such an experience. I support endeavors that show that VBA is highly engaging and educational. This method also addresses a more difficult aspect of surgery to train, which is the decision making aspect. Although this study applies this workflow to resident education, a similar process could be envisioned for practicing surgeons in the future.

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