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Live broadcasting in cardiac surgery does not increase the operative risk☆

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Abstract

Objective: Live broadcasting of cardiac surgical procedures has an educational intention. There is an ongoing debate whether live surgery increases risk. Aim of this study was to evaluate the outcomes of patients who underwent a cardiac surgical procedure during live broadcasting. **Methods:** A total of 250 cardiac operations were performed during 32 live broadcastings at four different clinical sites between 1999 and 2009. Data on patient characteristics, intra-operative procedures and patient short- and long-term outcome were collected and analyzed. All participating centers complied with the rules for the conduct of live surgery developed by the European Association of Cardiovascular and Thoracic Surgery (EACTS) Techno College Committee. **Results:** Primary educational focus was the mitral valve in 126 cases, aortic valve including transcatheter valve implantations in 34, coronary artery bypass grafting (CABG) in 29, congenital in 26, aortic (ascending, arch, and descending) in 15, atrial fibrillation in 13, and heart failure in seven. Mean EuroSCORE (European System for Cardiac Operative Risk Evaluation) was 8.7 ± 11.5 (range: 0.8–72). Thirty-day mortality was 1.2% (3/250): reasons for death were multi-organ failure in two and respiratory failure in one patient, respectively. Stroke rate was 2.4% (6/250). Five patients (2%) required cardiac re-operations within 30 days. The rate of mitral valve repair was 96% (121) and compares favourably with repair rates presented in national registries. Mean follow-up of all patients was 3.7 ± 2.8 years with an estimated survival of 92% (95% confidence interval (CI): 87–95%) at 5 years. **Conclusions:** Based on this large experience there is no evidence for an excess perioperative risk for patients operated under the conditions of live broadcasting.

Key words: Live broadcasting; Cardiac surgery

1. Introduction

1.1. Objective

Live broadcasting of cardiac surgical procedures has an educational intention. However, there is an ongoing debate whether live surgery increases the operative risk. In a recently published joint article on behalf of the American Association of Thoracic Surgeons (AATS) and the Society of Thoracic Surgeons (STS), it is recommended to not perform live broadcasting of cardiac surgical procedures to the general public as it may increase the potential patient risk [1]. The main criticism is the potential distraction of surgeons due to the special circumstances of live transmission such as interactive communication with the audience and/or a non-familiar operative environment, and thereby deprive the patient of the highest quality care [1]. Furthermore, ethical considerations are quoted. However, opposing views stressing the importance of live broadcasting as a valuable teaching instrument have been expressed [2]. So far, no objective data on the outcomes of live broadcasting in cardiac surgery exist. Thus, the aim of this study was to evaluate the outcomes of patients who underwent a cardiac surgical procedure during live broadcasting.

2. Material and methods

2.1. Patients

Patients were recruited at the respective clinical site well in advance of the meetings. All patients had an indication for elective surgery. For the purpose of this analysis, patients are categorized into subgroups with regard to the main indication

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for surgery and with respect to the educational focus of the performed procedure. A patient with left ventricular (LV) aneurysm due to coronary artery disease with an indication for LV restoration was, therefore, assigned to the heart failure group. For the majority of patients, the educational focus was concordant with the primary indication for surgery: mitral valve (MV) disease in 126 (50.4%) cases, aortic valve disease in 34 (13.6%), coronary artery disease in 29 (11.6%), congenital in 26 (10.4%), aortic disease (ascending, arch, and descending) in 15 (6%), atrial fibrillation in 13 (5.2%), and heart failure in seven (2.8%). Patients were consented for the surgical procedure and gave permission for live broadcasting to the respective meeting audience and recording of the procedure the day before surgery.

2.2. Clinical sites and surgeons

Overall, 250 cardiovascular operations were performed at four clinical sites: 120 (48%) surgeries at the Leipzig Heart Centre, 74 (29.6%) at the OLV-Hospital in Aalst, 32 (12.8%) at the Heart Centre in Bad Neustadt, and 24 (9.6%) at the German Heart Centre Munich. Surgeries were performed by in-house surgeons as well as invited surgeons. Surgeons performing the operations were selected due to their personal and scientific experience in their respective field.

2.3. Scientific meetings and live broadcasting

A total of 32 scientific meetings, which used adjacent live broadcasting, were included in the analysis: the annual European Association of Cardiovascular and Thoracic Surgery (EACTS) Techno College hosted at the Leipzig Heart Centre (2006–2009), the bi-annual Latest Techniques in Cardiac Surgery hosted at Leipzig Heart Centre (1999–2009), the Master of Mitral Valve Repair hosted at the OLV-Hospital Aalst (2000–2009) and at the Heart Centre Bad Neustadt (2003–2007), Atrial Fibrillation and Beating Heart hosted at the OLV-Hospital Aalst (2002, 2005, 2006, 2008), Focus on Congenital Heart Surgery hosted at German Heart Centre Munich and Leipzig Heart Centre, respectively (2002, 2003, and 2006), and Aortic surgery and Mitral valve workshop hosted at German Heart Centre Munich (2002 and 2004). All surgical procedures were broadcasted to a remote audience and recorded for later educational use. During the operations, a video and audio connection between the audience and the active surgeons was installed to allow for interaction.

2.4. Guidelines for broadcasting

All participating centers complied with the rules for the conduct of live surgery developed by the EACTS Techno College Committee. In brief, safety of the patient is the overriding principle. The surgeon must be familiar with the procedure and the used devices. To enhance surgeon comfort, surgeons were asked to bring team members (e.g., nurses and assistants) with them to the respective site. Local staff was available to assist and a trained local surgeon was at the table to assist on every case. Special equipment needed (i.e., instruments) could be requested and were provided well in advance. Surgeons were asked to indicate their preference for patient selection and were given the opportunity to review all relevant data (imaging data/case histories) well in advance. Surgeons were asked to arrive the day prior to surgery to be able to visit the patient and to familiarize them with the facility. Questions to the surgeon during the case were communicated via the moderators. The moderators were asked to prioritize live surgery over concomitant presentations to minimize interference with the treatment of the patient. Live transmission from the operation room (OR) to the session room was to be terminated by the moderators and/ or surgeons; both have the chance to terminate broadcasting at anytime should the surgeon feel uncomfortable or experience unforeseen difficulties during the case. The session moderators were to terminate live transmission immediately in case of an emergency or if the safety of the patient was being compromised in any way.

2.5. Data collection and statistical analysis

Data on patient characteristics, intra-operative procedures, patient short- and long-term outcome were retrospectively collected from the participating clinical sites. After collection, the data were combined in one database followed by statistical analysis. Categorical variables are expressed as proportions and continuous variables as mean $\pm$ standard deviations throughout the article. Long-term survival was analyzed with the Kaplan–Meier actuarial method. All analyses were performed using the SAS JMP7.0 (SAS Institute, Cary, NC, USA). Guidelines for reporting morbidity and mortality after cardiac valvular operations were followed [3].

3. Results

3.1. Operative results

A total of 250 patients at a mean age of 59.7 $\pm$ 19 years were operated. A total of 155 (62%) received an isolated procedure, whereas the remaining had a combined procedure.

A 98% procedural success rate was achieved meaning that the planned procedure was successfully performed in all patients. Five patients needed early cardiac re-operations. The intra-operative course was uneventful in all but one patient: during transfemoral aortic valve implantation in an 83-year-old patient, cardiogenic shock developed after balloon valvuloplasty necessitating cardiopulmonary resuscitation. Therefore, live broadcasting of this case was terminated following EACTS Techno College Committee guidelines. The patient was stabilized and the procedure was successful performed; however, the patient died due to low cardiac output (LCO) syndrome with subsequent multi-organ failure on the 19th postoperative day. The overall 30-day mortality was 1.2% (three patients). Reasons for death in the remaining two patients were LCO with subsequent multi-organ failure after isolated MV repair for ischemic mitral insufficiency on the 8th postoperative day in a 70-year-old patient with severe LV dysfunction (preoperative ejection fraction 15%), and LCO with respiratory failure after MV and tricuspid valve (TV) repair on the 15th postoperative in a 73-

Table 1. Predicted and observed operative mortality for the overall cohort as well as sorted by the primary indication for surgery.

	Number of cases	Predicted operative mortality by EuroSCORE	Observed operative mortality
Overall	250 (100%)	8.7 ± 11.5	1.2% (3)
Mitral valve	126 (50.4%)	4.4 ± 4.1	1.6% (2)
Aortic valve	34 (13.6%)	15.6 ± 18.2	2.9% (1)
CABG	29 (11.6%)	3.5 ± 3.9	0%
Aortic	15 (6%)	19.9 ± 11.3	0%
Afib	13 (5.2%)	4.9 ± 2.9	0%
Heart failure	7 (2.8%)	9.1 ± 9.1	0%
Congential	26 (10.4%)	Not applicable	0%

year-old patient. The observed mortality was lower than the predicted mortality using the European System for Cardiac Operative Risk Evaluation (EuroSCORE) in the overall patient cohort (Mean EuroSCORE: 8.7 ± 11.5, range: 0.8–72) and subgroups (Table 1). Regarding the subgroup of MV surgery, a repair rate of 96% (121 out of 126) was achieved.

3.2. Clinical outcome

Stroke rate was 2.4% (6). The patients who suffered from stroke had transfemoral aortic valve replacement (one patient), aortic arch replacement using the frozen elephant trunk technique (one patient), thoraco-abdominal aortic replacement (one patient), and MV repair (three patients). Five patients (2%) required cardiac re-operations within 30 days: bypass graft to the right coronary artery due to occlusion after Bental procedure on the 1st postoperative day, TV repair for severe regurgitation and atrial septum defect II closure on the 1st postoperative day after correction of Fallot, revision of a left internal mammary artery (LIMA) to LAD graft on the 1st postoperative day after off-pump coronary artery bypass (OPCAB) procedure, mitral valve re-repair for severe regurgitation after initial repair on the 2nd postoperative day, and rescue surgery due to cardiac tamponade on the 2nd postoperative day after MV repair. Re-operation for bleeding was necessary in 5.6% (14 patients). Acute renal failure with the need for haemodialysis occurred in 3.2% (eight patients). A total of 13 patients (5.2%) received pacemaker implantation during the postoperative course. Respiratory failure with the need for prolonged ventilator support was necessary in nine patients (3.6%). There was no evidence for an increase in surgical site infections or generalized infections in the study cohort.

3.3. Follow-up

Mean follow-up of all patients was 3.7 ± 2.8 years and was 100% complete. Estimated survival at 5 years using Kaplan–Meier analysis was 92% (95% confidence interval (CI): 87–95%) and at 10 years 90.5% (95% CI: 83–94%). During follow-up, two patients (0.8%) needed cardiac re-operation: implantation of left ventricular mechanical assist device on the 33rd postoperative day in a 55-year-old patient after MV repair for functional mitral regurgitation and coronary artery bypass grafting (CABG), and MV repair/TV replacement 2 years after closure of a ventricular septum defect in a 12-year-old congenital patient.

4. Discussion

Surgical knowledge and teaching the art of surgery has been passed down from teachers to their students for generations. It can be assumed that residents will only be as good and as successful as taught by their mentors. Thus, there is a commitment in the surgical society to provide excellence and passion to their successors. This historical mandate of education and teaching is unchanged even in times of unlimited access to open libraries and sources on the Internet.

There has been a growing interest in live broadcasting of surgical procedures and the distribution of knowledge to a greater audience as a source of surgical education and training. The continuous evolution of operative techniques and development of surgical tools and devices demands a professional educational process. This is reflected in the continuously increasing numbers of attendees to meetings such as the annual Techno College of the EACTS that focus on the presentation of new surgical techniques. This trend however is not limited to cardiac surgery but is also reflected in the field of interventional cardiology with rapidly growing meetings such as EuroPCR from the European Association of Percutaneous Cardiovascular Interventions (EAPCI) and the Transcatheter Cardiovascular Therapeutics (TCT) supported by the American College of Cardiology with high attending numbers. Both meetings are popular for their live formats.

Despite this development, there is an important ongoing debate on the risks and benefits of live broadcasting in surgery. The AATS and STS have recently published their recommendations regarding *Broadcast of Surgical Procedures as a Teaching Instrument in cardiothoracic surgery* [1]. A battery of dos and do nots regarding live broadcasting is provided, which is mainly based on one case report, two studies regarding infectious potential in the operating room, and 15 ethical recommendations [1]. A strong message derived from this article highlights the following 'The Society believes a possibility exists wherein participating surgeons might fail to follow proper medical procedures or might be distracted because of the media and, thereby, deprive the patient of the highest quality care.' An additional comment yields: 'AATS members should not participate in public broadcasts of live surgery and live broadcasts at national meetings should be prohibited.' [1] However, the author is also stating clearly that: 'no objective data exist to support or oppose arguments for or against any form of broadcasting surgical procedures.' [1].

The surgeons consider live broadcasting as an important educational and training tool rather than a threat. One of the pioneers of live broadcasting, founder of the popular EACTS Techno College, and author of this article, Hugo Vanermen has popularized this medium to enhance surgical education. In a recently published editorial, he took a vital pledge regarding the value of live surgery to pass surgical knowledge to a broader audience [2]. He also stressed the fact that the operating surgeon, the clinical site, and the surgical technique/ innovative procedure should never be misused to trade solid work for a commercial presentation or to promote the ego of the involved surgeons.

Due to the lack of scientific data concerning this issue, it is assumable that decisions and opinions on live broadcasting are, to a reasonable extent, are based on personal perception, emotions and theoretical ethical considerations rather than on facts and scientific expertise, although there are no data to support this assumption. We therefore aimed to contribute to the discussion by reporting the data of live broadcasted surgeries and to bring the debate from a rather speculative to a more factual level.

This is the first study reporting on the outcomes of live broadcasting in cardiac surgery. Overall, excellent results were achieved with a high procedural success of 98% (an early procedure-related re-operation was necessary in five patients (2%)), a low operative mortality of 1.2%, low rates of postoperative complications, and a good long-term outcome with an estimated survival of 92% (90.6%) at 5 (10) years. Considering the wide range of interventions from isolated valve surgery to complex aortic arch replacement, hybrid procedures and even congenital surgery, the results compare well to data reported in other studies or registries. Based on the findings of this study, no excessive risk for patients could be identified. Data on the true educational value, however, are not available. Based on the increasing number of attendees, it can be assumed that educational meetings on new technical developments including live broadcasted surgical cases are of interest to the cardiac surgical community.

4.1. Limitations

The nature of this study is a retrospective observational study without any control group and is therefore subject to the inherent weakness of any retrospective analysis.

To present state-of-the-art surgical techniques and performances, only expert surgeons in their respective field were invited to the respective meetings. It may therefore be argued that a bias with regard to the quality and experience of operating surgeons and case selection exists, which, to some extent, may have false positively influenced the outcomes of live surgery. Vice versa, this is however an argument in favour of live surgery, as some patients were operated by world experts rather than local staff, which, in fact, may have effectively decreased the risk in some cases.

It is, however, unclear if there is any benefit for patients subjected to live broadcasting. The extent of additional educational gain of live broadcasting over recorded procedures and/or textbooks for the learning surgeon remains to be determined. The answers to these and other questions cannot be drawn from the results of this study although those would be vital to contribute to the on-going discussion of live broadcasting in cardiac surgery.

5. Conclusions

This large study shows that there is no evidence for an excess perioperative risk for patients operated under the conditions of live broadcasting.

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Appendix A. Conference discussion

Dr L. von Segesser (*Lausanne, Switzerland*): I think it's good to know that live surgery is not necessarily an evil thing. I think it is fair to say that the potential risk of live surgery can be compensated for by a very thorough analysis and preparation of the procedure, and by making available a very gifted surgeon to a procedure which would not be realized in this fashion otherwise.

I was a little concerned when I studied the manuscript about the statement 'the patients were consented the day before.' I think this is a weak point of the study; it should be at least 24 hours, and maybe even more, so that the people can really think about it and say if they agree with this type of procedure.

Another weak point I feel is the absence of a control group. And I wondered if you could not study also the patients that were consented but for one reason or another were not operated with live broadcasting.

Dr Seeburger: Well, that one day before means more or less 24 hours. We usually identify these patients weeks in advance, speak to them, and then the day before, when they get admitted to the hospital, they get consented. And this is more or less 24 hours before surgery.

In terms of the control group, that's an idea and that's an option, but not something that we have considered so far. However, I don't know if it would give us more information regarding the topic at this time.

Dr L. Hamilton (*Newcastle Upon Tyne, United Kingdom*): It's a huge amount of work to go and chase these patients back to 1999. This is a very important topic and I'm delighted that you've done this.

But I would put it to you that actually mortality is not a particularly good indicator of risk in the current era of cardiac surgery. And we have a saying in English that 'the absence of evidence (and here we're talking about the absence of evidence of an increased risk) is not actually evidence of absence'. And I would suggest to you that you haven't shown that the risk for the patient undergoing live broadcast surgery is not increased.

You mentioned the paper by Sade from the STS and the AATS Ethics Committees. In that they say in their guidelines: 'The surgeon must disclose the fact of an increased risk'.

Now, I agree, the evidence for an increased risk is not strong. But when you take consent from these patients in the future, will you say to them that there is an increased risk?

Dr Seeburger: That's a difficult question. It depends on the procedure that is being performed and who performs it. However that's the main advantage of live surgery: usually you have expert surgeons in the field, so they are considered to be some of the best surgeons in their respective subspecialties. And because they are expert surgeons, you would consider that there is not going to be a higher risk than with any staff surgeon who would do the procedure.

But, of course, while I've consented some of these patients, we do not especially tell them about the increased or decreased risk depending on the surgeon. We tell them that there will be live broadcasting and it's for educational purposes, to show new techniques and new operations, but we also tell them that from our experience this does not make much of a difference.

But, of course, it's a fair question. Everything can go very perfectly and everything can go wrong, so we don't know in advance what the actual risk will be. And of course, with regard to Dr von Segesser's comment, there is no control group.

Dr M. Mack (*Dallas, TX*): I have shared the paper with Bob Sade, who is the chairman of the Ethics Committee of the STS and AATS and who wrote the Guidelines for Live Surgery, and I have three comments from him.

The first is to echo exactly what Leslie just said, that is, although we agree with you that there is no evidence for excess risk, there is also no evidence of its absence. So in other words, by your own admission, you've totally biased this toward the best patients done by the best surgeons under the best conditions and arguably you could say these results aren't what you would expect or hope for when everything is absolutely perfect. So the absence of showing a risk does not mean that there is not a risk there.

The second is that you have misquoted the guidelines. And let me read you directly what the guidelines do say. Item number 4 in the guidelines is: 'Surgeons should not participate in live surgery broadcast to the public using any medium including television and the Internet.' That's the only prohibition in the guidelines.

Guideline number 5 states: 'National and international cardiothoracic societies should consider prohibiting live surgery broadcasts to large audiences at their annual meetings.' And indeed, the STS did consider and decide to not go with live surgery, but the AATS has not.

Third is that live surgery to professional audiences should conform to a couple of different guidelines that all make sense, (1) is they should be performed from a surgeon's home operating room if at all possible; (2) the complexity of the procedure should be as minimal as possible; (3) there should not be rigid time constraints so that the patient isn't waiting too long, or similarly that the operation is not hurried to meet broadcast times; (4) that there should be educational value and not just a showcase for a company's product; and (5) the surgeon should not be distracted by interacting with the audience. It's the same thing as texting while driving. You don't do as good a job driving while you're texting. So there should be a moderator interfaced in that operating room between the surgeon and the audience. And I think all those are very reasonable guidelines to put in place.

Furthermore, there is no evidence that any of these procedures you have reported were in violation of anything in the guidelines by any means.

So Dr Sade congratulates you on finally putting some facts behind the emotion, that nothing that was done here is in violation of the STS/AATS ethics guidelines, and he would encourage you to do a randomized trial. The trial he would recommend is randomizing between live surgery and live-on-tape surgery. You could do it in alternate years or you could do it in alternate sessions. Then poll the audience on a very careful, well thought out poll, as to what they think the educational value was and whether edited live-on-tape is as good as live surgery or not, to truly determine the educational value.

Dr T. Treasure (*London, United Kingdom*): Three of us present here today, Dr Paul Sergeant, Dr Ludwig von Segesser and myself, and maybe others, sat through a number of EACTS Council meetings in which this was very carefully and seriously discussed with a lot of concern.

And so I personally am pleased that you haven't discovered anything too awful. What Dr Leslie Hamilton says is absolutely right, but at least the results are good and we don't have a number of disasters. But I think we ought to remember that that is as a result of sticking to some very strict rules imposed by Council. And I have certainly seen a thoracic case and a major aortic case go horribly wrong because people were 'on stage' trying to do something. You could see that they were off home ground and performing badly. These are anecdotes, but it is a reminder that it matters.

Now, I would like, before we close, to ask the audience, because this is the nub of it, in a way what drives it. There is a belief that live surgery is wanted by you, the audience, and that's what brings you to meetings. And there are others of us who say the educational content would in fact be better (and I am one of these I think), who believe that edited tapes, edited to show the pitfalls and the virtues, are actually more valued.

So who of you values real live surgery as something that brings you to the meeting?

(Show of hands.)

Who would prefer that it wasn't live surgery but taped videos?

(Show of hands.)

Actually that's the majority. That's the majority by about two or three to one, which is quite interesting, quite a good take-home message. That's not scientific, but you're all here, you've heard the debate and it gives us an idea.