Inconsistent reporting of minimally invasive surgery errors

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ABSTRACT

INTRODUCTION Minimally invasive surgery (MIS) is a complex task requiring dexterity and high level cognitive function. Unlike surgical 'never events', potentially important (and frequent) manual or cognitive slips ('technical errors') are underresearched. Little is known about the occurrence of routine errors in MIS, their relationship to patient outcome, and whether they are reported accurately and/or consistently.

METHODS An electronic survey was sent to all members of the Association of Surgeons of Great Britain and Ireland, gathering demographic information, experience and reporting of MIS errors, and a rating of factors affecting error prevalence.

RESULTS Of 249 responses, 203 completed more than 80% of the questions regarding the surgery they had performed in the preceding 12 months. Of these, 47% reported a significant error in their own performance and 75% were aware of a colleague experiencing error. Technical skill, knowledge, situational awareness and decision making were all identified as particularly important for avoiding errors in MIS. Reporting of errors was variable: 15% did not necessarily report an intraoperative error to a patient while 50% did not consistently report at an institutional level. Critically, 12% of surgeons were unaware of the procedure for reporting a technical error and 59% felt guidance is needed. Overall, 40% believed a confidential reporting system would increase their likelihood of reporting an error.

CONCLUSION These data indicate inconsistent reporting of operative errors, and highlight the need to better understand how and why technical errors occur in MIS. A confidential 'no blame' reporting system might help improve patient outcomes and avoid a closed culture that can undermine public confidence.

KEYWORDS

Minimally invasive surgery – Laparoscopy – Medical errors – Decision making

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Humans spend much of their day engaged in skilled behaviours (such as driving a car or writing with a pen) that involve complex motor and cognitive processes. The ease with which these skills are normally accomplished is a testament to the incredible capacity of the human nervous system (and years of training). Nevertheless, everyone has experienced an 'off-task moment' where movements are clumsy and/or online decisions are not as fast or accurate as required. The impact of this depends on the behaviour being executed: errors when writing usually have minimal cost whereas errors when driving can have catastrophic consequences.

While a great deal of research has concentrated on surgical 'never events' (serious yet preventable errors), the safety mechanisms in a surgical setting mean that most technical errors do not result in a cataclysmic outcome (ie patient death). Despite this, the errors that do occur can still have a high cost to the patient and the health service; technical errors in a healthcare setting can lead to delayed

or prolonged medical care, and patients may suffer unnecessary pain and/or be rendered disabled.¹ Furthermore, the probability of a cataclysmic outcome must logically become greater as the incidence of near miss errors increases.

The Harvard Medical Practice Study showed that 3.7% of hospitalisations lead to 'adverse events' (ie injuries caused by medical professionals).² An analysis of malpractice claims in the US suggested that the majority of errors in surgery were due to technical errors during routine procedures performed by experienced surgeons.³ It was concluded that surgical safety research should focus on improving decision making and performance in routine operations for complex patients and difficult circumstances.

The issue of surgical errors has become particularly relevant with the advent of new surgical techniques that offer great advantages to the patient but require a high level of visuomotor skill from the surgeon. Minimally invasive surgery (MIS), such as laparoscopic and robotic surgery, is

recommended by the National Institute for Health and Care Excellence for many procedures. MIS is especially beneficial in cases of upper and lower gastrointestinal cancers and bariatric surgery as it is associated with reduced pain, shorter hospital stays, and a decreased risk of operative and 30-day mortality.⁴

However, MIS has inherent risks due to the variety of constraints on the surgeon, such as degradation or loss of haptic feedback (touch and kinaesthetic sense) and restricted movement. MIS limits and/or transforms the visual information and haptic information used to guide skilled movements during surgery, meaning that surgeons need to learn challenging new mappings between vision and movement. In most laparoscopic surgery in the UK, for example, the surgeon views a monitor displaying a two-dimensional representation of the patient's three-dimensional abdominal cavity, resulting in impaired depth perception. Moreover, as the surgeon is unable to manipulate tissue directly, he or she uses instruments that can impair dexterity and tactile sensation while amplifying hand tremor. Use of these instruments also means that the surgeon must adapt to the fulcrum effect (where the hand needs to move in the opposite direction to that in which the tip of the instrument needs to move).^{5,6}

These constraints and novel visuomotor demands increase the risk of inadvertent injury to the patient. In response to this, a number of studies have examined the factors affecting MIS performance.^{7–12}

Despite the difficulties with MIS, the number of major catastrophic disasters is remarkably low. Nevertheless, it seems probable that many operations have technical errors that can be described as a 'near miss,' where the procedure was conducted in a suboptimal manner (owing to human error) but the error did not result in a catastrophe.

Even relatively minor errors can carry considerable cost and, based on perceptuomotor performance of people in other domains (eg skilled sportspeople), we might expect errors to occur on a reasonably regular basis.¹⁵ For instance, remedial work to correct an error will prolong the time spent by skilled staff on a single procedure with an immediate financial impact on the hospital. The need to keep a patient under anaesthesia for longer might have a number of covert adverse consequences on the patient's ultimate outcome (eg their later cognitive ability and the speed with which they recover).¹⁴ The occurrence of these near miss errors may therefore be an important factor that is overlooked when determining patient outcome.

While under-reporting of intraoperative error has been widely documented,^{15,16} relatively little is known about the nature of non-catastrophic intraoperative errors. Recent work has called for a need to disclose near misses¹⁷ but so far, attempts to quantify these errors have been limited and the nature of current reporting habits associated with technical errors is unknown. The purpose of our study was to bridge this gap in our knowledge of surgical error by quantifying the incidence of non-catastrophic intraoperative errors as well as providing an insight into the frequency and consistency of error reporting. To these ends, we surveyed surgeons experienced in MIS.

Methods

An electronic survey exploring the issue of near miss errors was developed over a series of iterations in discussion with several surgeons highly experienced in MIS. A focus group of surgeons, psychologists and translational research fellows with experience of psychometric evaluation provided input to the final version. Prior to dissemination, in a pilot study, five surgeons completed the survey. The final survey was sent via email to all members of the Association of Surgeons of Great Britain and Ireland (ASGBI). The full survey (Appendix 1 – available online) consisted broadly of six parts:

1. Introduction: a brief explanation of the study purpose
2. Anonymised demographic background information of the participant: surgical specialty, grade, number of MIS procedures per annum etc
3. Participant-perceived importance of factors affecting error prevalence during MIS
4. Experience of errors in past 12 months: reflecting participant's own errors, those of their trainees and those of their colleagues
5. Participant experience of error reporting in their institution
6. Participant-perceived factors affecting likelihood of reporting an error made during MIS

Ethical approval for the study was granted by the University of Leeds School of Psychology research ethics committee (reference: 13-0152). All information was gathered anonymously with each respondent automatically given a numeric identifier by the survey software so investigators could not identify any individual respondent.

Results

Two hundred and forty-nine ASGBI members responded to the survey from a total membership of approximately 2,300, with 203 completing more than 80% of the questions. Of the respondents, 168 (83%) were consultant surgeons, 25 (12%) were specialist registrars, 3 (1%) were associate specialists, 1 was a research fellow, 1 was a core trainee and 1 was a foundation trainee. Four respondents classified themselves as 'other'. Of the 249 respondents, 42% listed their specialty as upper gastrointestinal surgery, 31% as lower gastrointestinal surgery, 15% as hepatopancreatobiliary surgery, 2% as breast surgery and 10% as 'other'.

Incidence of intraoperative errors

In the preceding 12 months, 47% of surgeons had reported a significant error in their own performance that may have contributed to a postoperative complication, adverse patient outcome or serious untoward incident. Almost 40% of respondents had experienced a significant error during MIS performed by a trainee when they were present in theatre, while 30% had experienced a significant error during MIS performed by a trainee when they were not in theatre. Two-thirds (75%) were aware of a consultant colleague

who had experienced a significant error in his or her practice. When asked to estimate how they compared with their colleagues in terms of intraoperative errors, the vast majority felt they made similar or fewer errors.

Factors influencing incidence of errors

When asked what factors had contributed to an error that had occurred, many respondents highlighted 'difficult case', 'technical difficulty', 'distorted anatomy' and 'previous surgery'. Other factors included 'fatigue' or 'tiredness' along with 'overwork' and 'stress'. Respondents also listed 'poor equipment' or 'equipment failure' with one surgeon mentioning 'having to use substandard equipment as per trust directions'. Other factors were 'inexperienced staff' (theatre or surgical) and 'distractions' such as 'outside issues being brought into theatre and causing loss of focus'.

Factors influencing length of procedure

When asked to estimate their average time to complete a laparoscopic cholecystectomy, respondents' estimated time was (on average) 49 minutes (range: 20–120 minutes). Over half of the respondents highlighted technical skills, surgical knowledge, situational awareness and decision making as the most important factors in performing surgery (Fig 1).

When asked to respond in free text why procedures can be prolonged, respondents highlighted factors such as 'difficult cases', 'slower decision making or movements by trainees', 'poor equipment' and patient factors such as 'body habitus'. One surgeon responded: 'because the surgeon is not thinking or does not have the insight when to stop or convert early to open'. Others commented that 'trainees are on the whole slow and inexperienced' and 'I often think poor

surgical skills can contribute but that is as a result of watching some very poorly performed procedures'.

One detailed response listed several factors: '1) technical skillset not complete (slower actions); 2) trainee not thinking ahead about the next steps of the operation (admiring the view, not progressing the surgery); 3) more actions that fail to progress the surgical task (unnecessary dissection, repeated movements to establish retraction, failure to employ team or non-dominant hand effectively); 4) late communication with scrub staff about needs for next steps'. These themes were reiterated by several respondents. One respondent felt very strongly that 'if a lap chole is taking more than 120 minutes, it should have been converted to open prior to this or the skill of the operator taken into question – especially a consultant. I carry out 3 lap choles regularly in 3.5 hours, if I am not progressing after 15 minutes I convert – hence the complication rate is low'.

Intraoperative error reporting

Reporting of errors varied: 85% of respondents indicated they were very likely to report an intraoperative error to a patient while only 50% were very likely to report an error via their institution's reporting mechanisms. Critically, 12% of respondents were not aware of the procedure for reporting an error in their institution and 59% felt error reporting guidance is needed. Overall, 40% of respondents believed that a confidential reporting system would increase the likelihood that they would report an operative error during MIS.

Factors influencing error reporting

When asked what factors would make surgeons more likely to report an error, some felt that any error should be reported ('All errors should be reported. We are in the era of transparency', 'We record and report all', 'All errors fulfil the

Figure 1 Important factors in surgery (survey question 2) arranged in order of perceived importance (Black = Very Important; Dark grey = Quite Important; Light Grey = Not Very Important; White = Very Unimportant).

Duty of Candour'). The majority of respondents believed that any error that affects or is likely to affect a patient's outcome should be reported, with many highlighting the need for a second operation for a life affecting/threatening injury.

Others said that a robust reporting mechanism is needed with 'a fair blame culture and institutional maturity' and a 'clear and honest indication of how the information is going to be used', along with a supportive 'attitude of management and colleagues' and an environment in which 'lessons could be learned'. Some mentioned that if an error resulted 'from institutional or external factors which need to be changed (eg equipment problems, staffing problems, lack of resources which causes increased stress or failure of equipment)', then they would report it.

In contrast, when asked what factors would make them less likely to report an intraoperative error, the respondents cited factors such as 'unauthorised discussion of these errors outwith the surgical community by uninformed managers', 'blame and lack of support from colleagues and institution', 'fear and intimidation', 'likely management hysteria and over-reaction', 'crass managerial involvement', and a 'lack of trust and blaming natures of senior surgeons or colleagues'. One respondent noted that one of the main barriers was a '5-page form on a computer that was impossible to fill in'.

Many respondents mentioned that if there is 'no effect on morbidity', they may not report an error and several highlighted that if it was a recognised complication of a complex procedure, they may not highlight it as an intraoperative error *per se*. Conversely, one respondent stated that they 'always report a significant error [as it is] dishonest and unprofessional not to'.

Discussion

The advent of MIS has benefitted patients in various ways. It is associated with shorter hospital stays and decreased mortality compared with traditional open surgery.⁴ Nevertheless, MIS is a complex skill that requires surgeons to adapt to a range of novel visuomotor demands. As a result, near miss errors are likely to occur (where human error arises but does not result in patient fatality) despite the fact that catastrophic errors are rare. These errors can still have detrimental effects for both the institution and the patient⁸ so it is important to determine the incidence and cause of such errors.

Information from our survey indicates that intraoperative errors during MIS occur frequently, with almost half of the respondents reporting a significant error in their own performance in the past year that had adverse effects. Several common themes were highlighted for intraoperative errors, including trainee experience/visuomotor skills, difficulty of the case (eg patient anatomy or previous surgery) and fatigue/overwork, all of which may contribute to a prolonged operative time.

In essence, all surgical operations are at the mercy of 'surgeon factors' (eg inexperience, trainee surgeons and surgical error) and 'patient factors' (eg a difficult case). We would expect an operation performed by a trainee surgeon to be longer than that performed by a consultant with

greater experience of the procedure and we might also predict that trainees are more likely to make an intraoperative error. These expectations were reflected in the responses to our survey. Surgeon factors can, however, also interact with patient factors. Patient obesity, previous surgery and cause of biliary disease (eg biliary colic vs acute cholecystitis) may all make a laparoscopic cholecystectomy more challenging technically and can increase the likelihood of an intraoperative error.

Having a greater understanding of the factors that increase the likelihood of errors in MIS would assist in identifying difficult cases and allow appropriate preparations. For instance, if a patient has complex anatomy or has had previous surgery, then more time could be set aside for the procedure with more experienced staff on hand who are prepared to convert to open surgery if required. Despite this, there will always be practical limits on the adjustments that can be made to address these issues. Instead, it may be that focusing on minimising the surgeon factors will provide the greatest scope for reducing near miss errors in the future.

If we can better understand why errors occur, how surgeons learn MIS and the ways in which surgical performance varies, we can begin to develop strategies to improve training and minimise intraoperative errors so as to improve patient outcomes. Furthermore, training could be focused on those factors identified as the most important for performing surgery: technical skill, knowledge, situational awareness and decision making. As has been suggested previously, training for improving decision making and performance in routine operations for complex patients in difficult circumstances may be an important avenue of research.^{5,18}

In order to increase safety, surgery has borrowed from other high risk industries such as aviation; the World Health Organization Surgical Safety Checklist has had some success in reducing the number of surgical never events.¹⁹ On the other hand, aviation and surgery do not correspond completely and so the possibility of applying aviation models to surgery may be limited (particularly with regard to more subtle, near miss errors). While aeroplane cockpits can be standardised and simulated relatively easily (easing the transfer of training to practice), in surgery, there is inherent variability: from patient to patient and from one operation to another.

It may be that alternative approaches that deal with uncertainty and volatility in the decision making environment could prove to be more fruitful.^{20,21} Specifically, theoretical principles from the cognitive sciences regarding skilled human cognitive and motor performance could be instructive in the development of procedures that reduce errors. Much has been published on the phenomena of action slips (performance of a routine behaviour in an inappropriate context, such as planning to go to the supermarket but driving to work)^{22,23} and choking under pressure (substantial performance decrement relative to typical level of performance).²⁴ The insights gained from this work might be usefully applied to understanding surgical error in the operating theatre. Future research needs to examine the value of these approaches in a surgical context.

While our survey confirmed that surgical errors are occurring, perhaps the most surprising result was the wide variation in error reporting among surgeons. Some respondents stated that they reported all errors although the majority said it would depend on the nature of the error and whether there were consequences for the patients. Respondents indicated that they were more likely to report an error to the patient than to the institution; a significant number highlighted difficulties with reporting errors, and a reluctance in reporting due to the perceived attitudes of colleagues and management.

Increased awareness of the procedure for reporting an error could improve reporting institutionally; over 10% of respondents were unaware of how to report errors via their institution and more than 50% agreed that guidance is needed. A confidential reporting system could help circumvent some of the concerns regarding fear of blame and criticism in the institution. Many respondents felt such a system would increase the likelihood of them reporting an error. Increased error reporting could help ensure that factors that were possibly responsible for creating errors (eg substandard equipment) were addressed.

Surveys are potentially subject to reporting bias and it is likely this was evident in our sample, with the respondents underestimating their own intraoperative errors and overestimating errors by others. Similar biases have been observed in other domains of skilled performance such as driving – most people believe they are more skilful and take fewer risks than other drivers.²⁵ Such biases should not be surprising since it is remarkably difficult to accurately examine your own motor skills despite feeling that you know how you perform a task.²⁶

As the respondents only represented 10% of the total ASGBI membership, it is also possible that there was some selection bias, with more committed/interested surgeons taking part in the survey. Nevertheless, it seems unlikely that these issues would have led to over-reporting of surgical errors. In fact, given that nearly half of those who did respond reported an error in their own performance, it would appear likely that the number of actual surgical errors is greater than estimated by this survey. Of course, the true magnitude of surgical errors will only be properly understood through complete reporting.

Conclusions

This survey indicates that potentially large numbers of intraoperative errors are being inconsistently reported. These data highlight the need to better understand how and why technical errors occur, which will in turn allow identification of factors that contribute to adverse events and improve patient outcomes. It would also be beneficial to review current error reporting procedures in institutions; for example, confidential systems could be introduced that would facilitate a 'no blame' approach. Increased error reporting might help address the factors responsible for the errors and avoid a closed culture that could undermine public confidence in the National Health Service.

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