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SURGICAL EXPERIENCE MAY INFLUENCE THE IDENTIFICATION OF ERRORS IN LAPAROSCOPIC CHOLECYSTECTOMY. A PILOT STUDY.

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Introduction

- Surgical error is an act or omission that results/can result in a negative consequence or an increase in operative time (1-4).
- The Observational Clinical Human Reliability Assessment (OCHRA) uses External Error Modes (EEM) (Table 1) to describe error (1-4).
- EEM 1 - EEM 6 describe procedural errors and EEM 7- EEM 10 describe executional errors.
- OCHRA used to examine laparoscopic cholecystectomy (LC) surgical error by expert raters, which limits its wider use for surgical training(2).
- Performance metrics results can differ between attendings in research and clinical settings (5).
- We hypothesise that surgeons with different levels of experience may perceive or interpret surgical errors differently.
- This pilot study aims to provide an initial, high-level description of errors reported in a sample of (LC) videos by resident and attending surgeons.

EEM 1	Step not done
EEM 2	Step is partially completed
EEM 3	Step is repeated
EEM 4	Second step is done in addition
EEM 5	Second step is done instead of first step
EEM 6	Step is done out of sequence
EEM 7	Step is done with too much force, speed, depth, distance, time, or rotation
EEM 8	Step is done with too little force, speed, depth, distance, time, or rotation
EEM 9	Step is done in wrong orientation, direction, or point in space
EEM 10	Step is done on/with the wrong object (or plane)

Table 1. Definitions of errors and External Error Modes (EEM). Adapted from Tang *et al.* (2004)

Description	Score
Adhesions <50% of gallbladder	1
Adhesions burying gallbladder	3
	Maximum score 3
Distension/contraction of gallbladder	1
Unable to grasp with atraumatic lap forceps	1
Stone >1cm impacted in Hartmann's pouch	1
Access	
Body Mass Index >30	1
Adhesions from surgery limiting access	1
Severe Sepsis/Complications	1
Bile/pus outside of gallbladder	1
Time to identify cystic artery and duct >90mins	1
TOTAL (MAXIMUM 10)	

Table 2. Intraoperative grade score adapted from Sugrue *et al.*(2015). Body mass index was not available for this study.

Methods

- Ten anonymized videos were randomly selected from the Cholec80 Dataset (6) stored on a cloud-based video storage and annotation platform provided by Touch Surgery™ (Figure 1).
- Videos are accompanied by phase and instrument annotations.
- General surgery residents and attendings from the UK and Ireland volunteered
- Intraoperative grade score (Table 2) was assessed by all annotators.
- Collaborators identified and classified surgical errors using OCHRA and label video clips with EEM, consequentiality and a free-text description online after on-line training.

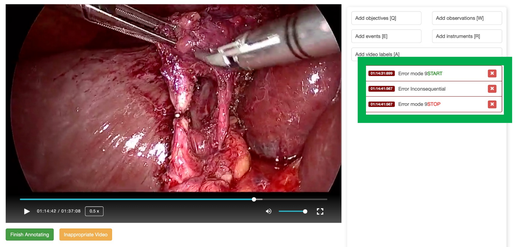


Figure 1. Touch Surgery™ cloud-based video storage and annotation platform with error timestamp annotation.

- Free-text was coded and data was collated and analyzed using SPSS and GraphPad/Prism with descriptive, parametric and non-parametric statistics.

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Results

- 13 surgeons volunteered; 10 surgeons completed the task.
- 1 video was excluded due to an incomplete phase.
- 2 surgeons were excluded with outlying error counts.
- Excellent inter-rater reliability (ICC=0.93, p<0.05) in assessing interoperative grade score (total value).
- 550 total errors - procedural (22%) and executional (78%)
- Ratio 1:2 consequential: inconsequential classification.
- Figure 2 shows the error counts of each video.

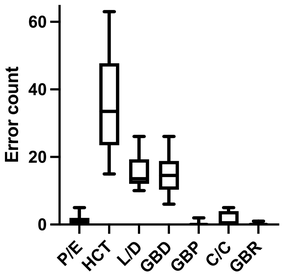


Figure 3 Error counts by intraoperative phases. Preparation/Exposure (P/E), dissection of the hepatocystic triangle (HCT), ligation/division of cystic structures (L/D), gallbladder dissection, (GBD), clean and coagulation (C/C) and gallbladder retrieval (GBR)

UK/Ireland Grade	Grade used for study	Logged laparoscopic cholecystectomy STS/STU/P
ST4	Junior Resident	24
ST7	Senior Resident	96
ST4	Junior resident	29
ST8	Senior resident	280
Consultant	Attending	>500
Consultant	Attending	500
ST4	Junior resident	55
ST7	Senior resident	156
Consultant	Attending	456
ST4	Junior resident	48

Table 3. Collaborators UK/Ireland Specialist Trainee (ST) grade, grade used for study and operative experience. (STS - Supervised trainer scrubbed, STU - Supervised trainer unscrubbed, P – Performed)

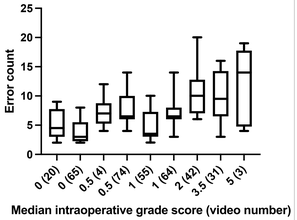


Figure 2. Median, IQR and range of errors identified in each video. Videos have been arranged along the x-axis by increasing median intraoperative grade score.

- Positive linear relationships were found between
  - Intraoperative grade score and error count (r^2=0.1573 p=0.0006)
  - Intraoperative grade score and total operative time (r^2=0.5778 p<0.0001)
  - Error count and total operative time (r^2=0.2844 p<0.007).
- Significantly different error counts were found in intraoperative phases (p<0.001) (figure 3).
- Frequently identified in HCT, L/D and GBD phases (table 3).
- No significant difference was found between median error counts between surgical grades.
- Attendings reported more inconsequential errors than residents (figure 4).
- Attendings identified proportionally more errors as in the incorrect plane (figure 4).
- Junior residents identified more clip application errors (figure 4).
- All identified errors with the visualization of the critical view of safety (figure 4).

Classification (description)	Sub-classification (description)	Dissection of hepatocystic triangle (HCT) % (n)	Ligation/division of cystic structures (L/D) % (n)	Gallbladder dissection (GBD) % (n)
Thermal injury**	Liver	14 (39)	0.1 (1)	18 (21)
	Gallbladder	3 (9)	0	2.6 (3)
	Duodenum	0.4 (1)	0	0
	Abdominal wall	0.4 (1)	0	0
Bleeding**	Small vessel	10.5 (30)	3.2 (4)	7.7 (9)
	Liver	2 (5)	0.1 (1)	24 (28)
	Omentum	0.4 (1)	0	0
	Cystic artery	0.4 (1)	2.4 (3)	0
Inappropriate dissection*	Inappropriate use of dissection tool	19.1 (54)	10	5.1 (6)
	Incorrect plane	5.7 (16)	0.1 (1)	6 (7)
	Non visualisation of cutting tip	2.5 (7)	6.5 (8)	4.3 (5)
	Dissection without lifting from structure beneath	2.8 (8)	0	0.9 (1)
	Inadequate countertraction	0.7 (2)	0	0.9 (1)
Poor economy of movement**	Instrument out of view	10.3 (29)	3.2 (4)	8.5 (10)
	Incorrect direction	2.1 (6)	0	0.9 (1)
	Overshoot	1.1 (3)	0.1 (1)	0

Table 3. Frequency of errors by descriptions (adapted from Tang *et al.*(2004)). Coded from free-text responses. (**Consequential errors, *Inconsequential errors)

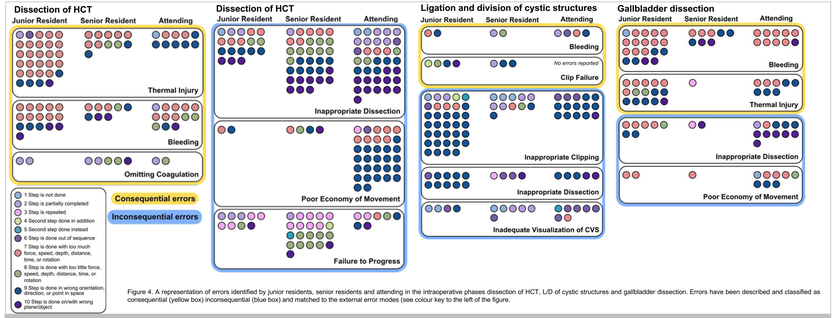


Figure 4. A representation of errors identified by junior residents, senior residents and attending in the intraoperative phases dissection of HCT, L/D of cystic structures and gallbladder dissection. Errors have been described and classified as consequential (yellow box) inconsequential (blue box) and matched to the external error modes (see colour key to the left of the figure.

Discussion

- The distribution of errors across phases, procedural/executional and consequentiality were consistent with previous research (2).
- Collaborators reported higher error counts in more challenging cases.
- No significant difference was found in total error counts between surgical experience subgroups.
- Surgical experience subgroups showed variability error events descriptions and EEM.
- Errors were associated with the visibility of the Critical View of Safety (CVS). This result was not seen in previous OCHRA studies (2).
- OCHRA may be too detailed and/or subjective for wider use as an assessment tool in clinical training.
- There may be additional subjectivity from bimanual operating in laparoscopic surgery.
- A small sample of videos and collaborators limits our ability to generalise this to the wider population.
- To understand the variation in error identification individual errors will be assessed as part of this ongoing research.

Conclusion

This study suggests surgical experience may influence the identification and classification of surgical errors in laparoscopy. Future research in error interpretation is required to explain these differences and how this may support surgical training.

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