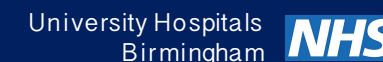# The development and validation of a scoring tool to predict the operative duration of elective laparoscopic cholecystectomy

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Introduction

70,000 cholecystectomies are performed in the UK each year, making it one of the most common general surgical operations [1]. With the average hourly cost for a theatre being £1,200, efforts to utilise every minute of allocated theatre time is vital [2]. This is especially so in a resource constrained NHS that is required to save £20bn by 2020 to remain sustainable [3]. Poor planning can lead to cancellations, which are expensive and, more importantly, distressing for patients. Careful planning and scheduling is therefore paramount to increase operating theatre efficiency and, in doing so, it is estimated that NHS trusts can make efficiency savings of approximately £4m per year [4]. The ability to predict operative duration has the potential to optimise theatre efficiency and utilisation, thus reducing costs and increasing staff and patient satisfaction.

Aims

To create a clinically useful scoring tool to predict the operative duration of laparoscopic cholecystectomy using preoperative patient factors and to externally validate its reliability using a separate dataset.

Methods

Data collected from the CholeS study on patients undergoing cholecystectomy in UK and Irish hospitals between 04/2014 and 05/2014 were used to study operative duration. A multivariable binary logistic regression model was produced in order to identify significant independent predictors of long (>90 minute) operations. The resulting model was converted to a risk score, which was subsequently validated on second cohort of patients using ROC curves.

Results

After exclusions:
- 7,227 surgeries in the derivation (CholeS) cohort
- Sample mean age of 51 years and 74.8% female
- Median operative duration = 60 minutes
- 17.7% operations took > 90 minutes

All of the factors considered were found to be significantly associated with longer operative durations. A multivariable analysis was performed to independently identify associated factors.
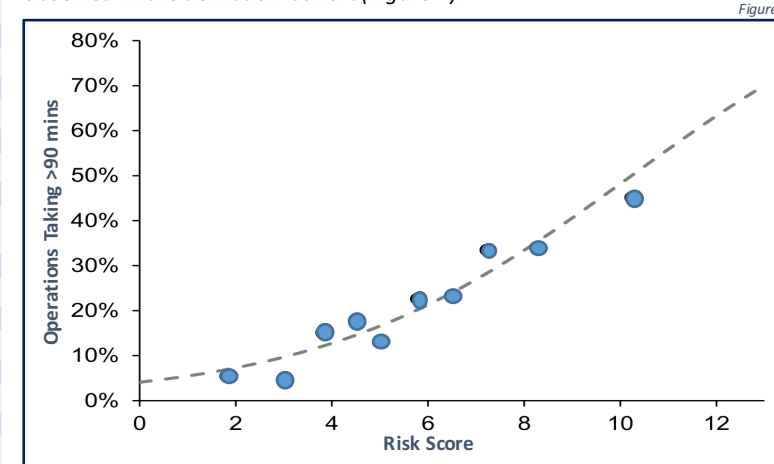
Table 1

Age (Years)	Points		Points
<40	0	**Gallbladder Wall**	
40+	1.5	Normal	0
Gender (Male)		Thick	1.5
Female	0	**Pre-operative CT**	
Male	1	No	0
Indication		Yes	1.5
Pancreatitis	0	**Planned Intra-op Cholangiogram**	
Colic / Dyskinesia / Polyp	0.5	No	0
CBD Stone	2	Yes	3
Acalculous / Cholecystitis	2.5	**Number of Previous Surgical Admissions**	
BMI		0	0
<25	0	1-2	1
25-35	1	>2	2.5
>35	2	**ASA**	
CBD Diameter		1	0
Normal	0	2	1
Dilated	2	>2	2.5

Analysis found the likelihood of an operation taking >90 minutes to increase significantly with:

Age > 40 (p=0.004)	Gallbladder Wall
Male (p=0.002)	Pre-operative CT
Indication (p<0.001)	Planned Intra-op Cholangiogram
BMI (p<0.001)	Previous surgical admissions
CBD Diameter	ASA

These 10 factors were then combined to form a risk score (Table 1).

Risk score was applied to a similar cohort of N=2,405 patients from UHB for external validation. It had a similar degree of predictive accuracy to that observed in the derivation cohort (Figure 1).

Figure 1

Discussion

- This scoring tool uses preoperative patient factors to predict the probability that a laparoscopic cholecystectomy will take more than 90 minutes. It has been successfully externally validated against a separate dataset (UHB) to demonstrate predictive accuracy.
- Thiels et al. and Zdichavsky et al.'s similar research didn't look at all these factors together [5,6].
- Our study expands on their work and has developed a clinically useful scoring tool by using high-quality, validated, prospective data that was collected as part of the CholeS study.
- 7,227 patients is considerably larger than those used by past researchers, which gives greater assurance as to the tool's reliability.
- Retrospective validation dataset could have inaccuracies such as ASA grade

Conclusion

Using the 7,227 patient CholeS dataset to derive the scoring system, and a UHB database of 2,405 patients to validate the tool, we have shown that it is possible to predict operations that are likely to last greater than 90mins. This is useful for theatre schedulers to ensure lists are planned appropriately to optimise theatre utilisation and achieve cost savings.

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