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ORIGINAL ARTICLE

Laparoscopic entry—the experience of a range of gynaecological surgeons

C. Burke · E. Nathan · K. Karthigasu · R. Garry · R. Hart

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Abstract Laparoscopic entry was prospectively assessed across a range of gynaecological surgeons working in a university teaching hospital to examine technique, difficulties experienced with entry and factors contributing to difficult laparoscopic entry. Details of 586 laparoscopies were obtained. Closed entry was used in 94.4% and open entry in 4.8%. Difficult laparoscopic entry occurred in 16.2% of cases. One or more entry tests were non-confirmatory in 21% of entries. Women weighing >100 kg had a higher rate of multiple Veres needle insertions than women weighing <100 kg (p=0.006, odds ratio 3.06). Junior surgeons experienced more difficulty with laparoscopic entry than their more senior colleagues (p=0.01). The laparoscopic entry complication rate observed intra-operatively was 0.68% (n=4).

Keywords Laparoscopy · Entry · Difficult · Open · Closed · Veres · Hasson · Surgeon

C. Burke (✉) · K. Karthigasu
Department of Gynaecology, King Edward Memorial Hospital,
Perth, Western Australia, Australia
e-mail: cathy.burke@hse.ie

E. Nathan
Women and Infants Research Foundation,
Perth, Western Australia, Australia

R. Garry · R. Hart
School of Women's and Infants' Health,
University of Western Australia,
Perth, Western Australia, Australia

Present address:
C. Burke
Cork University Maternity Hospital,
Wilton, Cork, Ireland

Introduction

Entry into the abdominopelvic cavity is arguably the most perilous manoeuvre of any laparoscopic procedure. Around half of all laparoscopic injuries occur in the entry phase [1–3]. Injuries most commonly sustained during laparoscopic surgery are laceration of the epigastric vessels, bowel injury and intra-abdominal blood vessel damage [1, 4]. The two most commonly used techniques for achieving laparoscopic entry are known as closed and open entry techniques. Closed entry usually involves creation of a pneumoperitoneum by inserting a spring-loaded needle through the abdominal wall, most commonly at the level of the umbilicus. Once a pneumoperitoneum is established, the primary trocar is inserted through an umbilical incision. This entry technique is commonly referred to as Veres entry, after the Hungarian physician who invented the needle device [5]. Closed laparoscopy may also be achieved by inserting the primary trocar directly through the abdominal wall without prior establishment of a pneumoperitoneum; this technique, known as direct entry, is less commonly used. Optical trocars have more recently been introduced to laparoscopic gynaecological practice. They are used at closed laparoscopic entry allowing visualisation of the layers of the abdominal wall as the port passes through them during the entry phase. Open laparoscopic entry refers to the technique of incising and dissecting through the abdominal wall via an umbilical incision with subsequent insertion of a blunt-tipped catheter into the abdominal cavity; pneumoperitoneum is then created through the inserted trocar. This is commonly known as Hasson entry after the American gynaecologist who described the technique [6]. Gynaecologists generally favour closed (Veres) over open (Hasson) entry [1, 7]

whilst our general surgical colleagues use open entry preferentially [4].

Creation of a pneumoperitoneum with the Veres needle at closed laparoscopy is not always straightforward. There is a potential to insert the needle too superficially causing subcutaneous emphysema or an anterior retroperitoneal gas collection. Insertion of the Veres needle too deeply in the abdominal cavity may cause omental emphysema (a collection of gas within the omentum) or complications such as visceral or vascular injury. A number of tests exists which aim to determine correct placement of the Veres needle. These include the double-click test, aspiration test, saline injection test, falling column and hanging drop tests and the observed intra-abdominal pressure (IAP) following placement of the Veres needle. These tests have not however until recently come under scientific scrutiny and the predictive value of some of these tests for correct Veres needle placement has been shown to be poor [8]. Low initial intra-abdominal pressure following Veres needle insertion has been declared a good indicator of correct Veres needle placement by several authors [8, 9].

Many studies on laparoscopic surgery complications have been retrospective and focus on injury rates, which range from 1.1 to 4.0 per thousand laparoscopies [4, 10–14]. Few studies have taken into consideration the specifics of the entry process such as the conclusiveness of the entry tests used, the number of attempts needed to achieve entry and the degree of difficulty experienced by the surgeon relative to their level of experience. The rate of laparoscopic injury in an individual unit is related to the complexity of laparoscopic surgery performed, intrinsic risk of the surgical population and level of experience of the primary surgeon [2, 13–15]. We believe that laparoscopic entry difficulty is likely to relate to the last two factors.

The aim of our study was to prospectively monitor laparoscopic entry amongst all surgeons working within our gynaecology unit. We wished to establish the rate of difficult laparoscopic entry (multiple Veres needle entry attempts, conversion from closed to open entry or conversion to laparotomy because of entry difficulty) across a wide group of surgeons. Furthermore, we wished to examine whether cases of difficult entry were related to patient or surgeon characteristics.

Methods

This study was a prospective audit of laparoscopic entry conducted over the 1-year period August 2005–July 2006 in a tertiary referral university teaching hospital in Western Australia. A datasheet was developed and circulated to all consultants practising gynaecology in our unit. Comments and suggestions were incorporated into the datasheet before commencement of the study. All gynaecology trainees and consultants performing laparoscopy at our unit were asked to complete the datasheet following each laparoscopy performed by them. In the theatre holding bay a datasheet was attached to the patient file of women about to undergo a laparoscopic procedure of any type. Information was obtained on patient characteristics, entry details and intra-abdominal findings. Indication for the current laparoscopy was noted and the number and type of prior abdominal surgeries was documented. The surgeon was required to record the following operative details: abdominal wall thickness ("thin", "normal" or "obese"), entry technique used (Veres, Hasson, optical trocar or a combination), direction of umbilical incision (transverse or longitudinal), site of placement of the Veres needle (umbilical, suprapubic or Palmer's point), number of attempts at insertion of the Veres needle and primary trocar, entry verification tests used (double click, aspiration, saline injection, falling water column, hanging drop, IAP<10 mmHg after attachment of the insufflator), presence and number of non-confirmatory entry tests at first attempt at Veres needle insertion, IAP reading prior to insertion of the primary trocar, patient position on the table prior to primary trocar insertion (flat or Trendelenburg), presence of omental emphysema or anterior retroperitoneal gas following entry, occurrence of visceral or vascular injury and presence of abdominopelvic adhesions and their type (omentum, bowel). The surgeon was identified only by her or his level of training, from resident medical officer (equivalent to senior house officer) through to consultant. No post-operative follow-up was undertaken on patients. Following completion, the datasheet was placed in a sealed box in the operating room. Datasheets were collected weekly. The study was conducted over 12 months. Data were analysed upon completion of the study.

Descriptive statistics were based on frequency distributions for categorical data and medians and ranges for continuous data. Categorical comparisons were conducted using chi square tests or odds ratios (OR) and their corresponding 95% confidence intervals (CI). Sensitivities, specificities and positive and negative predictive values were calculated from categorical contingency tables for each individual entry confirmation test. SPSS version 12 was used to analyse the data. All statistical tests were two-sided and p values <0.05 were considered statistically significant.

Results

Five hundred and eighty-six laparoscopic entries were assessed over the study period, representing 55.5% of all laparoscopies performed in the unit during the study period.

Veres (closed) laparoscopic entry was used in 94.4% of laparoscopies and Hasson (open) entry in 6.6% of cases. Table 1 reports patient characteristics, previous abdominal surgical incisions, entry type and level of surgeon. Details of entry-related findings, including frequencies of difficult entry and signs of misplacement of the Veres needle, are shown in Table 2. Difficult entry was defined as the occurrence of multiple Veres needle or primary trocar insertions or conversion to open laparoscopic entry. Data on the number of Veres needle placements across all cases are displayed in Fig. 1. A range of entry tests was used by surgeons. Details of their frequency and confirmation of correct placement are shown in Fig. 2. The median number of entry tests used was 5 (range 0–6). Multiple insertions of the Veres needle and primary trocar occurred in 14.8% and 4.8% of laparoscopic cases, respectively. Findings in Fig. 3 relate to multiple Veres needle insertions. Regarding difficulty with placement of the Veres needle related to patient size, there was no correlation between the number of attempts at Veres needle placement and increasing abdominal wall adiposity when the surgeon was asked to rate the abdominal wall as "thin", "normal" or "obese". The rate of multiple Veres entries was however significantly higher in women who weighed >100 kg than those weighing ≤100 kg (OR 3.06, 95% CI 1.39–6.76, p= 0.006). Laparotomy was performed following laparoscopy in eight cases. These cases were due to failed laparoscopic entry in two cases, complication of laparoscopy in two cases and surgical difficulty, referring to technical difficulty in completion of the surgery laparoscopically, in four cases.

The sensitivity, specificity and positive and negative predictive values for each of the entry tests in terms of their ability to identify a correctly placed Veres needle are shown in Table 3. The likelihood of finding signs of misplacement

Table 1 Patient details and entry characteristics

Descriptive item	Number	Percentage
Number of women in study	586	NA
Indication for laparoscopy		
Diagnostic	158/570	27.7
Treatment	412/570	72.3
Median patient age in years (range)	36 (14–90)	NA
Median patient weight in kilogram (range)	67 (29–150)	NA
Previous abdominal surgery	320/584	54.8
Laparoscopy	220/581	37.9
Laparotomy	179/584	30.6
Midline laparotomy	35/579	6.0
Number of closed (Veres) entries	553/586	94.4
Number of open (Hasson) entries	38/586	6.5
Primary Hasson entry	28/586	4.8
Hasson entry after Veres entry	10/586	1.7
Optical trocar use	25/586	4.3
High-pressure entry (>/+20 mmHg, Veres entry only)	486/511	95.1
Surgeon level		
Consultant	280/583	48.0
Senior registrar	178/583	30.5
Registrar	127/583	21.8
RMO (SHO)	9/583	1.5
Consultant and other doctor	11/583	1.9
Patient position at entry		
Flat	479/560	85.5
Trendelenburg	81/560	14.5
Umbilical skin incision		
Longitudinal	526/582	90.4
Transverse	56/582	9.6
Veres needle insertion point		
Sub-umbilical	503/557	90.3
Palmer's point	25/557	4.5
Suprapubic	35/557	6.2

Table 2 Entry details and findings

	Number	Percentage
Difficult laparoscopic entry	95/586	16.2
>1 Veres needle insertion	80/557	14.3
>1 primary trocar insertion	27/557	4.8
Conversion closed to open entry	10/557	1.8
One or more non-confirmatory entry tests	118/557	21.2
Conversion to laparotomy	8/586	1.4
Indication laparoscopic entry failure	2/586	0.3
Indication entry complication	2/586	0.3
Indication surgical technical difficulty	4/586	0.7
Anterior retroperitoneal gas or subcutaneous emphysema	34/580	5.9
Omental emphysema	55/580	9.5
Abdominopelvic adhesions	144/583	24.7
Omental	80/144	55.5
Bowel	71/144	49.3
Midline	58/144	40.3

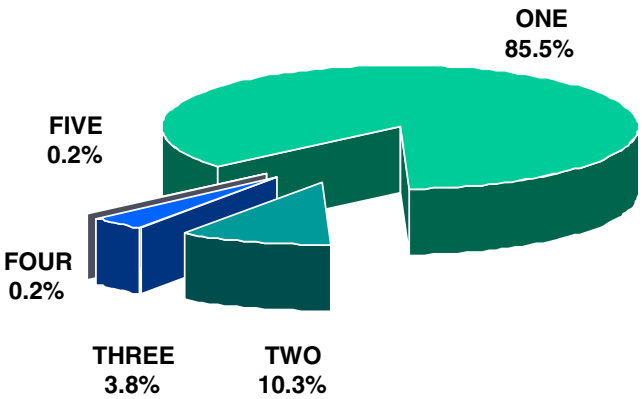

Fig. 1 Number (percentages underneath) of Veres needle insertions before correct placement achieved

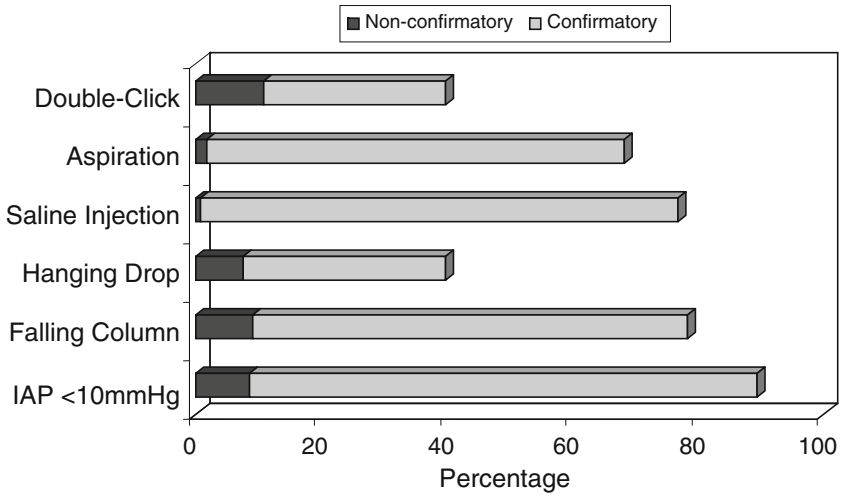

Fig. 2 Frequency in per cent of use of various entry tests with proportions of each test being confirmatory or non-confirmatory

of the Veres needle (pre-peritoneal gas or omental emphysema) was significantly higher when at least one non-confirmatory test was found at laparoscopic entry than when all test results were confirmatory (p=0.005 and p=0.004 for anterior retroperitoneal gas and omental emphysema, respectively). An abnormal entry finding was seen in 27.4% of women who had at least one non-confirmatory entry test, compared with 11.7% of women in whom entry verification tests were all documented as normal (p<0.001). There was a significantly greater chance of having an abnormal entry finding when more than one Veres needle insertion was required compared with one Veres needle insertion only (25.6% vs 13.3%, p=0.005). The double-click sign was almost twice as likely to be non-confirmatory in women who had previous laparoscopy compared with those who had no previous history of laparoscopy (13.1% vs 7.4%, p=0.024). Multiple non-confirmatory entry tests were linked with multiple Veres entries (p<0.001) and abnormal entry findings (p=0.069).

Abdominopelvic adhesions were found in 38% of women with any previous abdominal surgery. Sixty-nine per cent of women with a midline abdominal scar had abdominopelvic adhesions; 75% of these were located in the midline. Midline bowel adhesions were present in 29% of women with a previous midline laparotomy. The use of a transverse umbilical incision was not more likely to be

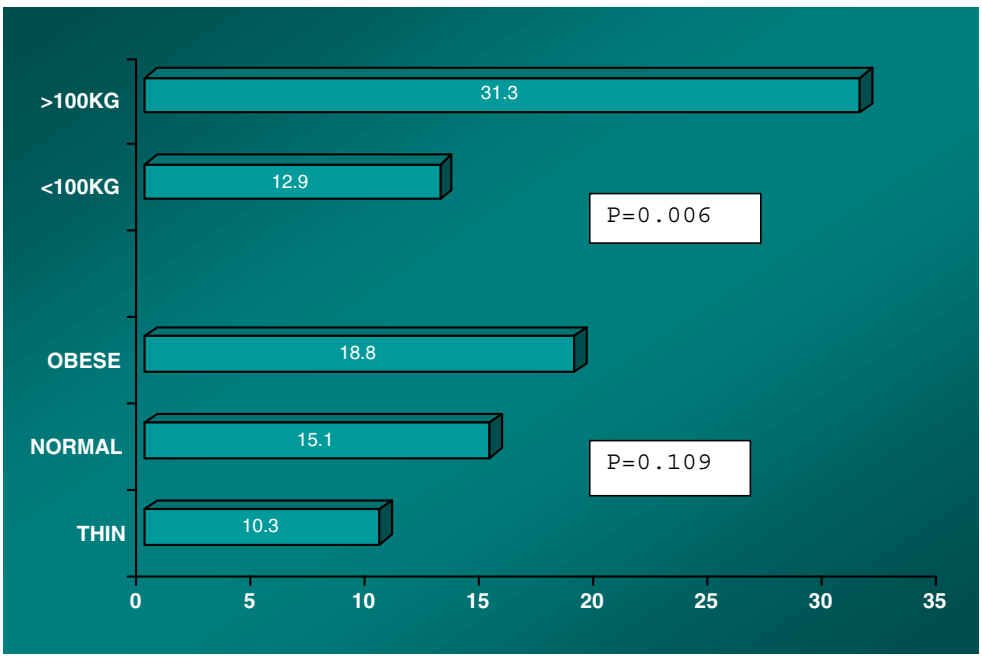

Fig. 3 Frequency, in per cent, of cases requiring multiple (>1) Veres needle insertions, categorised by absolute body weight (>100 and <100 kg) and abdominal wall thickness (obese, normal, thin) as judged by the surgeon

Table 3 Performance (sensitivity, specificity, positive predictive value (PV^+) and negative predictive value (PV^-)) of various entry tests in predicting correct placement of the Veres needle

	Sensitivity (%)	Specificity (%)	PV^+ (%)	PV^- (%)
Saline injection	99.2	1.4	83.6	25.0
Aspiration	98.4	1.7	84.4	16.7
Hanging drop	93.6	11.8	85.4	25.0
IAP<10 mmHg	92.5	14.1	86.5	23.8
Falling column	91.9	14.8	86.8	23.1
Double click	90.6	19.7	86.7	26.8

associated with a non-confirmatory test, multiple Veres needle entries or an abnormal entry finding compared with a longitudinal umbilical incision (all p values >0.05). Regarding level of surgeon, entry difficulties as defined by multiple attempts at Veres needle and primary trocar insertion and conversion from Veres to Hasson entry occurred significantly more frequently in junior surgeons (p=0.011). Details are shown in Table 4.

Four complications of laparoscopic entry occurred during the study period giving a complication rate of 0.68%. All complications occurred in the Veres entry group. A complication was regarded as any injury to an abdominal vessel or viscera. A major complication was considered to be transection of a viscera or large vessel within the abdomen. There were two major complications (3.4/1,000 cases). The first was a small bowel injury. Laparoscopic injury was suspected but not identified in this case, and follow-up of this patient was undertaken. On the second post-operative day, the patient returned to theatre and was diagnosed with a small bowel laceration at repeat laparoscopy, which was repaired via a midline laparotomy. One intra-abdominal large vessel injury occurred. Following laparoscopic entry, an excessive amount of blood was noted in the Pouch of Douglas. A haematoma was noted beneath the entry site. Midline laparotomy was performed and laceration of the inferior mesenteric vein was discovered and repaired.

Two of the four complications (serosal bladder injury and omental vessel haemorrhage) were considered minor; these were managed conservatively laparoscopically. There were three cases of port site bleeding, two at the suprapubic port site and one at the umbilical port site. All settled spontaneously and were not considered to be vascular complications.

Discussion

This study observed laparoscopic entry across a range of gynaecological surgeons affiliated to a university teaching hospital over a 1-year period. We consider the results to be a good reflection of practice and relevant to similar-sized gynaecological units. Closed laparoscopic entry (Veres entry) was the commonest entry technique in our study population, with 95% of entries initially attempted in this fashion and just 12 cases (2.0%) requiring conversion to Hasson entry or entry via laparotomy because of difficulty with Veres laparoscopic entry. These findings confirm the continuing popularity of closed laparoscopic entry amongst gynaecologists. The quest to prove which method of laparoscopic entry is safest continues, with general surgeons promoting open entry whilst gynaecologists continue to favour the classical closed approach. A recent review has shown no clear evidence to suggest superiority of open (Hasson) over closed (Veres) entry. Low rates of laparoscopic injury have been reported with direct entry and it has been suggested that direct entry reduces the number of steps in the entry process thereby potentially reducing the rate of entry injury [4]. Regardless of the entry technique used, it is essential that all surgeons are well trained in whichever is their preferred technique and familiarity with alternative sites and techniques of laparoscopic entry is recommended.

Surgeons generally used multiple tests for verification of correct placement of the Veres needle; the median number of tests used in our study was five. In one in five cases (21%), at least one entry verification test was non-

Table 4 Difficult laparoscopic entry (multiple Veres needle or primary trocar placements or conversion to open entry or laparotomy because of entry difficulty) according to surgeon level

	Junior registrars		Senior registrars		Consultants		p value
	n	%	n	%	n	%	
Overall	32	26.0	28	15.8	39	13.9	0.011
>1 Veres entry	26	21.5	19	11.1	32	12.5	0.026
>1 primary trocar insertion	8	6.7	10	5.8	9	3.4	0.291
Conversion from Veres to Hasson entry	1	0.8	3	1.7	6	2.1	–[a]

[a] p value not obtained due to small numbers

confirmatory. The entry tests confirmed correct placement of the Veres needle in at least 90% of cases, when visualisation of anterior retroperitoneal gas, subcutaneous emphysema or omental emphysema were used as visual confirmation of misplacement. However, when all entry tests used were noted to be confirmatory for correct placement, an abnormal entry finding was still seen in 11.7%. This unexpected finding could be explained by a Veres needle initially misplaced in the omentum being quickly pushed out of its incorrect location by injected saline or insufflated CO_2 gas. It may also be explained by the surgeon elevating the anterior abdominal wall by the surgeon after display of an initial high pressure, with subsequent normal pressures. High intra-abdominal pressure occasionally also results from too-light anaesthesia, which, if noted, should be addressed prior to the next Veres needle insertion. We omitted loss of liver dullness, a very useful and commonly used sign of correct Veres needle placement. This was an oversight related to focussing on the utility of the various tests pertaining to use of the Veres needle.

The specificities of the individual entry tests for correct placement of the Veres needle (non-confirmatory test findings with evidence of placement of the Veres needle in the omentum or retroperitoneum) were uniformly poor. The result for the aspiration test is not surprising as this test is useful only in excluding placement of the Veres needle in the bowel or a blood vessel, both rare events. A small amount of gas in the retroperitoneum or omentum of women who had non-confirmatory entry tests may not have been visible or noted by the operating surgeon, giving normal placement findings. The double-click test, the best-performing test for the prediction of misplacement of the Veres needle, had a sensitivity of just under 20%. However, the double-click test is likely to be affected by the presence of scarring of the tissue layers at the level of the umbilicus following previous laparoscopy, being twice as likely in our study to be non-confirmatory in women with a prior laparoscopy compared with in those without prior laparoscopy.

There are practical advantages to using a range of entry tests at laparoscopic entry. The usefulness of the aspiration test in outruling insertion of the Veres needle into the bowel or a blood vessel cannot be disputed. Moreover, insufflation of gas through a Veres needle into a blood vessel without any prior checks would be indefensible. This study has shown that multiple non-confirmatory entry tests are significantly more likely to be associated with multiple Veres entries, not a surprising finding as a surgeon will attempt another entry if multiple tests are non-confirmatory on the first entry attempt. Multiple non-confirmatory test findings were however linked with abnormal entry findings (omental emphysema, anterior retroperitoneal gas or subcutaneous emphysema), although results did not reach significance. We suggest that surgeons using Veres entry continue to use a range of entry tests to confirm correct Veres needle placement.

Difficulty with laparoscopic entry was experienced in 16% of laparoscopies. The factors chosen to define difficult entry were multiple Veres needle or primary trocar insertions or conversion to open entry or laparotomy because of entry difficulty. Insertion of the Veres needle was successful on the first occasion in 85% of cases in this study and 96% of women had successful Veres entry with no more than two attempts. Our data show that registrars were significantly more likely to insert the Veres needle multiple times compared with senior registrars and consultants. This finding is in keeping with previous research findings showing higher complication rates for more junior surgeons where misplacement of the Veres needle was regarded as a complication of surgery [16]. The statistical significance of these results was not however calculated in that study. These findings suggest the need for trainee laparoscopic surgeons to optimise their skills prior to performing surgery on humans. Laparoscopic surgery training models have advanced rapidly in recent years with a variety of training models available, from relatively inexpensive standard training boxes to virtual reality and hybrid systems, the use of which has been shown to develop skills [17] and translate into better in vivo surgical technique [18, 19]. The amount of force applied to the primary trocar and its control during insertion are also important skills to be acquired by surgeons learning laparoscopic surgery. Training devices have been created which measure that applied force [20], and other training aids designed specifically for laparoscopic entry are currently on the market. There no definitive evidence that using such training models reduces injury; however, with very low injury rates at laparoscopic gynaecological surgery, studies including hundreds of thousands of patients would be needed to demonstrate this potential effect. With an increasing emphasis on surgical skills training and safe surgical practice in modern gynaecology, we believe it should now be mandatory for units teaching laparoscopic surgery to provide such aids and supervised skills sessions to trainees in a “dry laboratory” setting before embarking on live surgery.

Multiple Veres needle insertions were required in 14% of cases and substantially more frequently in women weighing >100 kg than in women weighing ≤100 kg, a previously unreported finding. However, surgeon-based assessment of the abdominal wall as thin, average or obese was not related to number of Veres needle placements. The average abdominal wall thickness at the level of the umbilicus in obese women has been shown to be approximately double that of non-obese women (3.7 vs 1.7 cm) [21]. Our results suggest a reluctance by some surgeons to insert the Veres

needle sufficiently deeply into the abdominal cavity in obese women, resulting in superficial misplacement. As body weight is a more objective measurement tool of body habitus than visual assessment by an individual surgeon, we suggest that body weight be recorded pre-operatively in all women undergoing laparoscopic surgery and a body weight of >100 kg be considered a risk factor for difficult laparoscopic entry, with particular attention given to supervision of junior gynaecologists performing these cases. The authors accept that body weight of >100 kg does not necessarily imply obesity, which is classified according to body mass index (BMI) which is also dependent on patient height. Absolute weight only was used in this study for the sake of minimising the amount of data to be entered by the surgeon. BMI may be even more useful in determining patient risk of multiple Veres insertion and use of this calculation is recommended by the authors for future research in the area.

One in four women had abdominopelvic adhesions; one in eight had bowel adhesions and one in ten had midline adhesions. In the subset of women with a midline abdominal scar, a higher rate of abdominopelvic adhesions was found (69%). Midline bowel adhesions were present in 29% of women in with a midline abdominal scar. These findings are consistent with other prospective studies [22–24]. Women with a prior midline laparotomy would therefore appear to be at higher risk than others for bowel injury at laparoscopic entry. It is believed that the rate of laparoscopic bowel injury is unlikely to be altered in the presence of existing peri-umbilical bowel adhesions, regardless of whether open or closed entry is used [25]; therefore, using an alternative entry site such as Palmer's point is a logical approach in this high-risk group and has been recommended by the Middlesborough consensus group [26]. In the author's opinion, Palmer's point entry should also be considered when two attempts at entry via a sub-umbilical incision have failed. Palmer's point is located 3 cm beneath the left costal margin in the mid-clavicular line. Insertion of a nasogastric tube to empty the stomach, reducing the risk of injury to this organ, is recommended prior to commencing Palmer's point entry.

High-pressure entry (≥20 mmHg) was utilised in 95% of women undergoing Veres entry in this study. In a small number of cases (n=11), an intra-abdominal pressure below ten was recorded prior to primary trocar insertion. These are most likely to have been cases of direct laparoscopic entry but this was not included as a data item on our datasheet. The Middlesborough group recommended that higher IAP (20–25 mmHg) be attained prior to insertion of the primary trocar at closed laparoscopic entry on the basis that higher IAP decreases the potential for entry injury by creating a larger gas bubble between the anterior abdominal wall and intra-abdominal structures. The safety of the temporary use of higher intra-abdominal pressures during the entry phase in healthy women has been established [27].

The overall complication rate (excluding port site bleeding) at laparoscopic entry in our study was 6.8 per thousand cases (n=4). Our rate of major complications was 3.4 per thousand cases (n=2). This rate is comparable to figures from other laparoscopic entry studies, reported between 0 and 4.0 per thousand cases [28–30]. The major complications which occurred were one small bowel laceration and one inferior mesenteric vein injury, both requiring laparotomy to treat. All four laparoscopic injuries occurred in the Veres (closed) entry group. However, there was no overall difference in complication rates between the two groups. Because of the design of our study whereby the surgeon and patient remained anonymous to the researchers, only injury recognised or suspected intra-operatively is reported in this study. It is quite possible that the true rate of laparoscopic injury in our population has been under-reported in this study. The lack of follow-up of all patients may be considered a flaw in the study design. The rationale for anonymising patients and surgeons however was to encourage surgeons to accurately record their findings on the datasheet in the knowledge that their competence was not being monitored via our study. Additionally, the purpose of this study was to assess difficulties with the process of laparoscopic entry, which may be regarded as a proxy measure for laparoscopic injury.

Despite anonymisation of patients and surgeons for the purposes of the study, only just over one half of all laparoscopic surgeries performed during the study period were examined. Reasons for this include a high turnover of theatre staff in the holding bay of theatre, as well as difficulty ensuring that surgeons completed the datasheets following emergency surgeries at night. As completion of the datasheet was voluntary, we did not anticipate data from all laparoscopic entries. However, because we had decided to anonymise the datasheet so that neither the patient nor the surgeon could be identified, we would have been glad of a greater recruitment of cases. There is a chance that more difficult laparoscopic entry cases or even entry complications were not recorded.

Conclusion

This study is one of the largest prospective audits of laparoscopic entry in the medical literature. It studies laparoscopic entry across a range of gynaecologists working in a large gynaecological unit and our results should therefore be applicable to other gynaecological units of similar size. Our study showed Veres (closed) entry to be highly favoured over Hasson (open) laparoscopic entry.

Commonly used entry tests are specific but not sensitive for correct placement of the Veres needle. Multiple non-confirmatory entry tests are linked with initial misplacement of the Veres needle; therefore, we recommend that gynaecological surgeons continue to use a range of entry tests during closed laparoscopic entry.

Some degree of difficulty with laparoscopic entry is experienced in one in six laparoscopies. Difficulty is more likely to occur in women weighing >100 kg and when the primary surgeon is a junior laparoscopic surgeon. Women with a previous midline laparotomy have a high rate of midline bowel adhesions (30%). There is a potential for increased laparoscopic entry injury in these groups. Our study findings highlight a need for laparoscopic surgeons to develop strategies to minimise the risk of laparoscopic entry injury to our patients. Measures include providing adequate dry laboratory training and intra-operative supervision to junior laparoscopic surgeons, being aware of prior abdominal incisions in women about to undergo a laparoscopic procedure, assessing patient weight, and undertaking a pre-operative discussion about entry-related risks and planned entry technique. Laparoscopic gynaecological surgery continues to advance in terms of its accessibility, the complexity of procedures we now undertake, and the sophistication of training aids now available. The challenge for laparoscopic surgeons today is to individualise aspects of surgery, such as laparoscopic entry, in order to minimise the risk of harm to the people who entrust themselves to our care.

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Contribution to authorship Cathy Burke designed the draft study questionnaire. Roger Hart, Krish Karthigasu and Ray Garry contributed to the design of the study questionnaire, revised the draft article and reviewed it before submission for publication. Cathy Burke collated and entered the study data for analysis. Elizabeth Nathan gave advice regarding statistical tests and performed statistical analysis on the study data.

Details of ethical approval The study was registered with the local institutional ethical committee. Full ethical approval was not seen as necessary by the ethical committee. The study was classified as a quality improvement audit by the ethics committee. The study did not break any national laws

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