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Laparoscopy and major retroperitoneal vascular injuries (MRVI)

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Abstract. Injury to major retroperitoneal vessels is a potential serious complication of laparoscopy occurring when the Veress needle or trocar is inserted. This report is a review of major retroperitoneal vascular injuries (MRVI) occurring during laparoscopy, as these injuries have not been well documented in the literature. A retrospective, observational review of general surgical laparoscopy cases was conducted over a 3.5-year period in three community, university-affiliated hospitals. We identified 4 MRVI in 3591 laparoscopic procedures. These cases were critically analyzed and compared. The incidence of MRVI was ~ 0.1%. All cases occurred with the closed (blind) insertion technique of Veress needle and primary trocar insertion technique with disposable "safety" shield trocars. All patients sustaining MRVI had acute hypotension introperatively and significant blood loss necessitating postoperative transfusions. Recognition and rapid conversion to laparotomy are keys to enhancing outcome. There is significant potential for morbidity and mortality with laparoscopic MRVI, although each patient in this series was discharged without obvious short-term problems. The advantages of an open approach for primary trocar insertion are numerous and should alleviate the risk of MRVI associated with general laparoscopic surgery.

Key words: Vascular injury — Laparoscopy — Major retroperitoneal vascular injuries

Laparoscopic procedures are performed by general surgeons with increasing frequency. New applications for laparoscopy are emerging and surgeons should be familiar with complications related to specific procedures as well as those inherent to laparoscopy. Insertion of the Veress needle and the initial (primary) laparoscopic trocar may result injuries to the intraabdominal organs and/or major retroperitoneal vessels. Placement of subsequent (secondary) trocars is associated with a lower risk as they are inserted under direct vision. One of the most potentially serious complications of laparoscopy is that of injury to major retroperitoneal vessels. These injuries occur when the Veress needle or primary trocar is "blindly" inserted the closed fashion.

The closed (blind) placement of the Veress needle for insufflation of the peritoneal cavity with subsequent blind insertion of the primary trocar is an accepted method for gaining access to the peritoneal cavity for celioscopy. The American Association of Gynecological Laparoscopists has long supported the use of this technique, and it has probably become the most commonly accepted technique for general surgeons performing laparoscopy.

This report is a review of major retroperitoneal vascular injuries (MRVI) occurring during laparoscopy with the goal of defining its incidence. There has been much debate and discussion published regarding specific complications associated with specific laparoscopic procedures (e.g., bile duct injuries) [3, 5–7, 9–11, 14]. MRVI is a potential complication of any laparoscopic case, but its incidence has not been well documented in the literature [1, 2, 4, 6]. In a national survey of 77,604 laparoscopic cholecystectomy procedures, Deziel reports an incidence of MRVI of 0.05% [6]. Thirty-six cases were identified with injuries involving the aorta, iliac vessels, or inferior vena cava. Two deaths were reported as a consequence of the injuries (mortality = 5%). Case reports of fatality as a result of aorto-iliac injuries during laparoscopy are found in the gynecology literature [4, 12]. Baadsgard, in a review of published case reports in the gynecological literature, reported a series of 15 patients who sustained MRVI associated with laparoscopic procedures [2].

The general laparoscopist must be aware of this

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Table 1. Patient data

Case	Age	Sex	Height (cm)	Weight (kg)	Ideal body weight (kg)
1	30	F	170	55	55–73
2	32	F	163	61	50–66
3	28	F	155	57	46–60
4	24	F	152	64	44–58

severe potential complication. It is essential that MRVI be recognized early during a laparoscopic procedure. A delay in diagnosis is probably the major contributor to associated morbidity and mortality. Although the incidence is low, the magnitude of MRVI and its potential impact on a patient outcome, added health-care costs, and possible related litigation combine to make such injuries significant.

Methods

A retrospective observational review of consecutive laparoscopy cases (appendectomies, cholecystectomies, and hernias) over a 3 ½-year period in three community university-affiliated hospitals was done. Computer databases were reviewed at each hospital. Laparoscopy cases were identified using the ICD-9-CM code 5421 (laparoscopy) in conjunction with 5300–5539 (hernia repair), 470 (appendectomy), 5122 and 5123 (cholecystectomy and laparoscopic cholecystectomy), and 998.2 (accidental puncture or laceration during a procedure). Each chart identified as having a complication during laparoscopy was then individually reviewed by one of the authors to identify the number of MRVIs. Each identified case was critically analyzed, and numerous variables including age, height/weight indices, trocar insertion technique and type of trocar, vessel injuries and location, other complications, hospital stay, morbidities, and pertinent intraoperative events were compared. Descriptive statistics were purposefully not used as the few number of patients preclude their meaningful use in this study; raw data are presented.

Results

There were 3,591 cases of laparoscopy completed in the 3 ½-year period. There were four MRVIs occurring for an incidence of 0.1%. Two of these injuries occurred in 1990 (August and October), one in July of 1991, and one in September of 1993. Table 1 compares general patient data and height/weight indices. All cases of MRVI occurred in females with an age range of 24–32. Standard height/weight indices based upon standardized Department of Agriculture tables were compared [15]. One of four patients was "overweight" according to standard indices.

Surgical indications, laparoscopic procedures, and data on the retroperitoneal vascular injuries are listed in Table 2. None of the four patients had a history of previous abdominal surgery. Three cases of VI were associated laparoscopic cholecystectomy and one with a laparoscopic appendectomy. All four patients had Veress needle insufflation and the closed (blind) insertion technique of primary trocar insertion. Additionally, each injury was associated with insertion of disposable, retractible "safety shield" trocars. Associated injuries secondary to blind insertion of the primary trocar were also identified. The patients in cases 1–3 were converted to laparotomy secondary to acute intraoperative hypotension following (blind) closed insertion of the primary trocar indicating immediate recognition. The vascular injury in case 4 was not recognized prior to conversion to open laparotomy. The decision for conversion in this case was secondary to obstruction of the falciform ligament and subsequent poor visualization of the gallbladder endoscopically.

Operative and laboratory values are contrasted in Table 3. Two cases of VI occurred with senior surgical residents as primary surgeon.

The remaining two cases were associated with a single attending surgeon who is considered experienced. Postoperative complications included one patient with postop ileus and one patient with adult respiratory distress syndrome (ARDS) (Table 4). All patients were discharged in satisfactory condition and no short-term sequelae were identified; however, no long-term follow-up has been reviewed.

Discussion

A retrospective review of 3,591 general laparoscopy procedures over a 3 ½-year period identified an incidence of 0.1% for MRVI. This compares with reported rates of 0.05%–0.09% for MRVI in the surgical and gynecological literature, [4, 6]. All cases occurred in young females (age range 24–32)—probably reflective of the incidence of gallstones generally being higher in females. Patient height and weight indices were compared to standard tables [15]. One of four patients was considered "overweight" (>20% over ideal body weight) but the sample size is too small to form conclusions concerning the relationship of patient height and weight. The injuries occurred in a sporadic fashion across time, indicating that these injuries may not be specifically attributable to the "learning curve." The authors know of two additional recent injuries not included in this report (one occurring in 1993 and one in 1994), further supporting this concept.

In two of four cases there was documented difficulty with Veress and primary trocar insertion secondary to "tough" abdominal fascia, indicating increased resistance to fascial penetration in some patients. Increased force required for penetration of the abdominal fascia could jeopardize a controlled peritoneal entry with possible increased risk of intraabdominal injury or MRVI. In a survey of possible contributing factors of Veress and trocar injuries in laparoscopy, Yuzpe reported that injuries to intraabdominal viscera and/or MRVI were found to occur twice as often among those who reported difficulty with trocar insertion [16]. A slow, twisting motion with Veress or trocar placement allows for a more controlled fascial entrance vs increasing perpendicular forces applied in instances of "tough" fascia. Operative descriptions indicating "tough" fascia may be a retrospective comment or perception by a surgeon who causes one of these injuries.

Surgeon's experience may be an important factor in laparoscopically associated MRVI. However, the

Table 2. Preoperative diagnosis, laparoscopic procedure, and MRVI[a]

	Case			
	1	2	3	4
Diagnosis	Acute appendicitis	Symp. cholelithiasis	Symp. cholelithiasis	Symp. cholelithiasis
Laparoscopic procedure	Appy.	Chole.	Chole.	Chole.
Retroperitoneal vessel injured	Aorta, above bifurc. below IMA	Aorta, above bifurc. below IMA	R. common iliac artery	SMA in mesenteric root
Associated trocar injury	No	Mesenteric vessel injury	Mesenteric vessel injury	No
Converted to laparotomy	Yes	Yes	Yes	Yes
Injury recognized prior to laparotomy	Yes	Yes	Yes	No

[a] Symp., symptomatic; appy., appendectomy; chole., cholecystectomy; bifurc., bifurcation; IMA, inferior mesenteric artery; MRVI, major retroperitoneal vascular injuries; SMA, superior mesenteric artery

Table 3. Patient operative and laboratory data

	Case			
	1	2	3	4
Lowest intraop BP (mm Hg)	58	78	81	80
Intraop pressor utilized	Neo[a]	Neo	Neo	Neo
EBL (cm^3)	1,000	1,000	500	1,200
Crystalloid	3,250	2,300	2,900	4,700
Colloid	1,300	1,000	1,000	500
Postop transfusions				
PRBC's (units)	3	3	2	2
FFP (units)	5	0	0	0
Hemoglobin (g/d)				
Preop	—	13.1	13.8	13.6
Postop	7.1	8.1	6.3	6.8
Post Transfusion	11.2	11.5	9.3	11.1

Neo, neosynephrine

Table 4. Postoperative complications, hospital stay, and sequelae

Case	Postop complication	Hospital stay (days)	Short-term sequelae
1	ARDS[a]	8 days	None
2	Ileus	7	None
3	—	4	None
4	—	4	None

[a] Adult respiratory distress syndrome

same experienced attending surgeon was involved in two of four cases of MRVI (neither of the authors). In the remaining two cases, senior surgical residents were the primary surgeon. All cases of MRVI reviewed were associated with the closed (blind) insertion technique of Veress needle and primary trocar placement. Additionally, all were associated with disposable, retractable "safety" shield trocars. Advocacy for these trocars related to the safety shield which retracts and (supposedly) covers the sharp trocar point once the peritoneum has been penetrated. No prospective, comparative studies are available to document the proposed advantage of these safety trocars although it continues to be a marketing ploy. Obviously, safety shield trocars alone do not prevent MRVIs.

Blind Veress needle placement to obtain insufflation followed by primary trocar insertion is an accepted and probably the most commonly used technique for gaining access to the peritoneal cavity for laparoscopy. The continued popularity of the blind techniques is perhaps partially due to the low incidence of bowel and vascular injuries associated with the technique. The advantage of the blind approach is quick access to the peritoneal cavity. Disadvantages to the blind approach include potential for insufflation of the pre- and retroperitoneal spaces, thus complicating access to the peritoneal cavity secondary to subcutaneous emphysematous distortion of the preperitoneal space. There are steps that can be taken to lessen the risk of MRVI associated with the blind approach of peritoneal access. Veress needle aspiration for blood and water drop tests (saline water drop placed on the Veress needle inlet, the abdominal wall is lifted, and the negative pressure produced in the peritoneal cavity will aspirate the drop) can be utilized to confirm the intraperitoneal location of the needle. These tests may allow immediate recognition of bowel or vascular injury but will not prevent their occurrence.

Concerns about risks associated with blind Veress and primary trocar insertion into the peritoneal cavity have long existed, and led to the development of the blunt trocar by Hasson to facilitate an open insertion technique without the loss of pneumoperitoneum [8]. Utilization of a modified Hasson technique with open trocar placement under direct visualization is feasible. The fascia underlying the periumbilical incision is visualized and incised with a scalpel. The properitoneal fat is identified and penetration of the peritoneum is completed utilizing gentle hemostat spreading and/or grasping of the peritoneum and incising it. A simple figure-of-eight suture is loosely placed along the fascial edges, and the primary sheath can be placed directly in the peritoneal cavity. The stay suture can then be tightened to assure an airtight seal around the primary trocar. CO_2 insufflation can then be initiated at high flow rates as the trocar was directly guided into the

peritoneal cavity under direct visualization. The figure-of-eight suture can be utilized at the end of the procedure to facilitate fascial closure of the trocar site.

Sigman found the mean duration of surgery utilizing the open technique the closed technique was significantly shorter [13]. The shorter operating time was felt to be secondary to more rapid insufflation of CO_2 pneumoperitoneum as well as rapid fascial closure by the already-placed fascial stay sutures. Finally, he reports no increased complications related to the open technique. We have also found this to be true.

All patients sustaining MRVI became acutely hypotensive (SBP nadir range 58–91) following closed (blind) insertion of the Veress needle and primary trocar. Faulty hemodynamic monitor equipment, decreased venous return, intraoperative acute cardiac events, and acute blood loss are important in the differential diagnosis of acute hypotension during laparoscopy following Veress needle and primary trocar placement. Acute blood loss as the etiology is supported by associated tachycardia. This may also be confirmed by aspiration of blood via the Veress needle and/or laparoendoscopic visualization of intraperitoneal blood or an expanding retroperitoneal hematoma. The surgeon must be aware of the potential and rare complication of MRVI. Its occurrence must be recognized for prompt and appropriate management to avoid potential increased morbidity and mortality.

Each patient required significant and aggressive crystalloid and colloid resuscitation secondary to acute blood loss as well as utilization of acute vasopressor support. The surgeon's prompt recognition of MRVI, as well as acute resuscitative measures including laparotomy, is vital to avoid possible increased morbidity and even mortality. Delay in diagnosis is probably the most significant contributor to associated morbidity and mortality. Significant intraoperative blood loss resulted in each case (range 500–1,200 cc). All patients received postoperative blood transfusions once resuscitative measures and vascular repairs were completed. Vascular injury secondary to Veress needle placement will usually be noted with aspiration of the needle, indicating entrance into a vascular structure. Primary trocar placement resulting in MRVI is usually associated with evidence of acute hemorrhage as in the cases presented. However, bleeding may temporarily be contained within the retroperitoneal space. This may lead to a delay in diagnoses as illustrated by case 4 in our series.

The indications for exploration include blood via Veress needle aspiration, hemodynamic instability, active intraabdominal hemorrhage, or an expanding retroperitoneal hematoma. If MRVI is suspected or recognized immediately, conversion to open laparotomy is mandatory. The small intestine should be packed superiorly and the retroperitoneum should be opened initially above the level of the suspected MRVI while digital compression is used to control hemorrhage from the injury site as proximal vascular control is obtained. Proximal occlusion may be required for several minutes to allow adequate resuscitation and hemodynamic stabilization prior to proceeding.

Once the patient is stable, further exploration and distal control of the injured vessel can be secured. MRVIs secondary to Veress needle insertion usually result in a small 2–3-mm puncture lacerations which can be repaired primarily with placement of a few interrupted vascular sutures to obtain adequate hemostasis. Trocar MRVIs may present with a more significant vessel injury that may require resection of an injured vascular segment and prosthetic graft placement for repair. Regardless of the mechanism of vascular injury, it is essential that the posterior aspect of the injured vessel be explored to assure that a "through and through" injury has not occurred. Case 1 in our series was found to have an adjacent posterior wall injury requiring repair.

Associated visceral and/or mesenteric injury must be excluded by careful exploration. Two of four cases in this series had an associated mesenteric injury necessitating repair. MRVI in case 4 was solely attributed to mesenteric vascular injury at the root of the superior mesenteric artery which was not apparent on initial exploration. Once the vascular injury has been repaired and the patients hemodynamic stability has been maintained, the original procedure can then be completed. Following completion of the procedure it may be prudent to closely monitor the patient for continued hemorrhage or hemodynamic instability in the intensive care unit.

If laparoscopic-associated MRVI is appropriately managed, survival without sequelae is the rule. Two patients in our series had postoperative complications, one with ARDS and one with a prolonged postoperative ileus. The length of hospital stay ranged form 4 to 8 days, significantly longer than those of published reports associated with uncomplicated laparoscopic procedures [3, 5–7, 9–11, 14]. All patients in this series were discharged in stable condition without sequelae related to MRVI; however, there is no long-term follow-up.

Although rare in occurrence (0.1% in this review), laparoscopic-associated MRVI can result in significant morbidity and mortality. All surgeons who perform laparoscopy must be aware of this potential complication and be prepared to manage it acutely. Safeguards have been developed to alleviate possible vascular injury with the closed (blind) Veress and primary trocar insertion; however, even the theoretical advantage of retractable "safety shield" trocars does not eliminate the potential for MRVI. The advantages of open primary trocar placement are numerous and this technique shortens the length of laparoscopic procedures. Routine use of open primary trocar placement should eliminate the risk of MRVI occurring during laparoscopy due to initial trocar placement.

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