Montefiore
THE UNIVERSITY HOSPITAL

EINSTEIN
Albert Einstein College of Medicine
OF YESHIVA UNIVERSITY

Recognition and Management of Vascular Injuries

Reza Ghavamian MD
Professor and Interim Chairman
Department of Urology
Montefiore Medical Center
Albert Einstein College of Medicine

Laparoscopic Complications

Colombo & Gill et al: Single institution analysis 2007:
1867 procedures

- **intraoperative 3.5%**
- **Postoperative 8.9%**
- **Mortality 0.4%**

Associated with more complications:

- **lap cystectomy, partial nephrectomy**
- **Length of surgery >4hrs**
- **Serum Cr> 1.5mg/dl**
- **Hemorrhage most common complication intraop and postop**
- **Complications decrease with surgeon experience**

Colombo JR et al: J Urol 178: 786-791, 2007.

Montefiore
THE UNIVERSITY HOSPITAL

EINSTEIN
Albert Einstein College of Medicine
OF YESHIVA UNIVERSITY

WHY COMPLICATIONS?

Experience: 4 fold ↓ if > 100 cases

Complexity: 9 fold ↑ if more complex

Patient risk: As ASA increases so does risk of complications.

Montefiore
THE UNIVERSITY HOSPITAL

EINSTEIN
Albert Einstein College of Medicine
OF YESHIVA UNIVERSITY

A PLEA FOR CONFORMITY IN REPORTING COMPLICATIONS

Clavien System:

I: Any deviation for a normal postoperative course without need for any intervention or medication

II: Need for medications, blood transfusion, or parenteral nutrition

IIIa: Intervention – without general anesthesia

III b: Intervention – with general anesthesia

IVa: Life threatening, Single organ dysfunction

IVb: Multiple organ dysfunction

V: Death

(I, II, and IIIa are largely minor whereas IIIb and IV would be considered major complications)

(Dindo,D., Clavien, P. et al.: Ann. Surg. 240: 205, 2004)

Montefiore THE UNIVERSITY HOSPITAL

EINSTEIN Albert Einstein College of Medicine OF YESHIVA UNIVERSITY

COMPLICATIONS

1. Entry
2. Pneumoperitoneum
3. Intraoperative
4. Postoperative
    a. Early
    b. Late

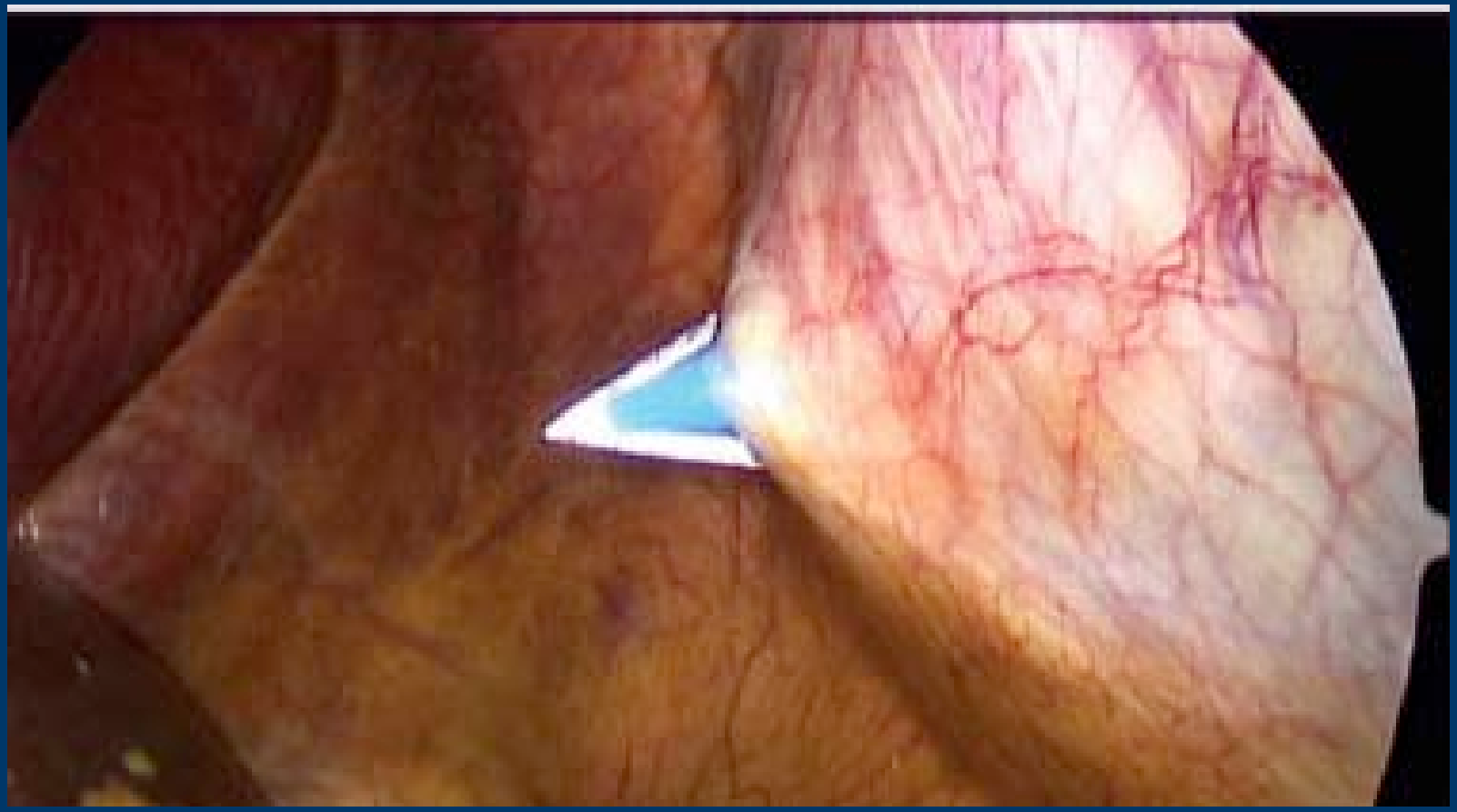
Access Related Complications

Montefiore
THE UNIVERSITY HOSPITAL

EINSTEIN
Albert Einstein College of Medicine
OF YESHIVA UNIVERSITY

ENTRY:

1. Initial access
2. Trocars



Montefiore
THE UNIVERSITY HOSPITAL

EINSTEIN
Albert Einstein College of Medicine
OF YESHIVA UNIVERSITY

ENTRY

A good beginning is essential:

"More than one half of the complications related to laparoscopy are related to the entry technique."

Incidence: 0.3 – 1.0%

(Magrina, J. F.: Clin. Ob. and Gyn. 45: 469, 2002)
(meta-analysis: 1,549,360 laparoscopic cases)

Montefiore
THE UNIVERSITY HOSPITAL

EINSTEIN
Albert Einstein College of Medicine
OF YESHIVA UNIVERSITY

ENTRY INJURIES

Veress or Open?

	Veress (n= 12,444)	Open (n= 489,335)
Vascular injury:	**0.08%**	**0.0%***
Bowel injury:	**0.08%**	**0.05%**
Gas embolism:	**0.001%**	**0.0%**
Death:	**0.003%**	**0.0%**

*p < .05; (Bonjer, H: Br. J. Surg. 84: 599, 1997) (N.B.: other prospective studies showed no difference

Montefiore THE UNIVERSITY HOSPITAL

EINSTEIN Albert Einstein College of Medicine OF YESHIVA UNIVERSITY

Access Related Complications (0.03 – 1%)

- Extraperitoneal insertion
- Vascular injury
  - Abdominal wall vessels
  - Retroperitoneal vessels
  - Mesenteric vessels
- Visceral injury
  - Stomach, bowel, liver, spleen, bladder

Options for Gaining Intraperitoneal Entry:

- Closed puncture technique- Veress needle (highest injury rate) FOR THE NOVICE!!
- Hassan Technique
- Hand-Assist access first
  - Insert additional trocars with hand in abdomen

Strategies to avoid access-related complications:

- Use Hassan technique or make hand-assist device incision
- Use visual introducing trocars when using Veress
- Always verify Veress needle position
  - Saline drop test
  - Move 1-1.5 cm
  - insufflation pressure

Montefiore
THE UNIVERSITY HOSPITAL

EINSTEIN
Albert Einstein College of Medicine
OF YESHIVA UNIVERSITY

VERESS NEEDLE

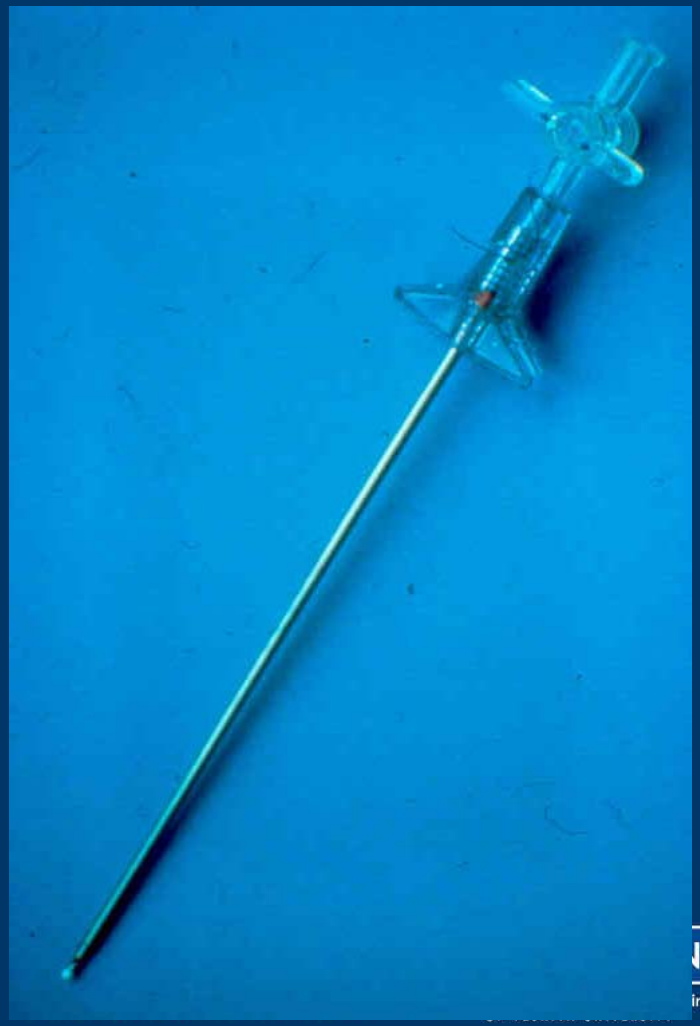
- The operator should feel or sense the needle passing through two distinct planes.
- The needle is advanced and withdrawn several times. If this is done easily and without obstruction, the tip is in proper position.

TRANSPERITONEAL STANDARD ENTRY

Veress needle:

- **Test needle prior to placement.**
- **Aspirate, irrigate, aspirate (then irrigate)…drop test and advancement test. Needle rotation.**
- **"If in doubt, pull it out." (High pressure and low flow, remove needle.)**

Tip: Increase abdominal pressure to 25 mm Hg for initial trocar placement.



TRANSPERITONEAL STANDARD ENTRY

<u>Open cannula</u>:

- **Place in an unscarred area of the abdomen.**
- **Finger to palpate underside of peritoneum 360 degrees, to insure absence of adherent bowel, etc.**
- **Use the balloon trocar – reduces any leak or subcutaneous emphysema**

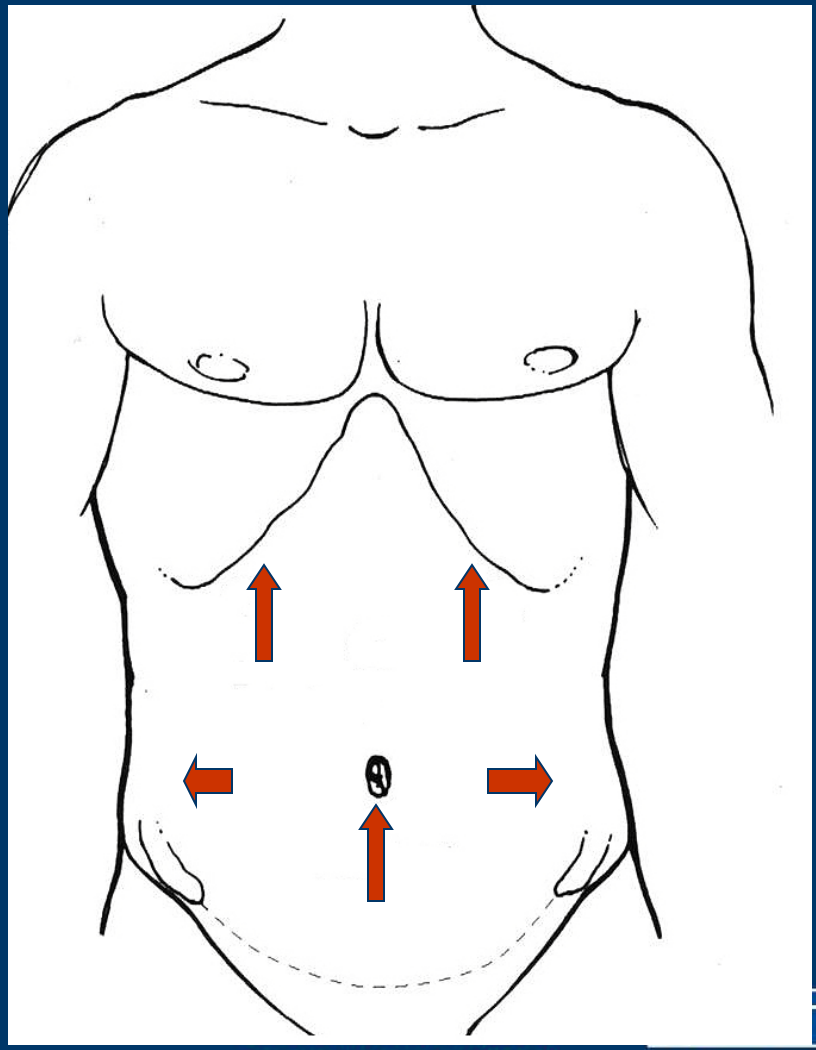
WHERE'S THE BEST PLACE?

Entry sites: 5!

- **Umbilical**
  (Danger – IVC/Aorta)
- **Right (Palmer's point) or Left MCL subcostal**
  (Danger – Liver or Liver/spleen)
- **Right or Left side AAL – 2 fingerbreadths above the iliac crest**
  (Danger – colon)

(Don't hesitate to go left when you are operating right!)

(McDonald, D., et al.: SLEPT 15: 325, 2005)



INTRAOPERATIVE COMPLICATIONS

The BIG 3:

1. **Cardiac arrest**
2. **Vascular**
3. **Bowel**

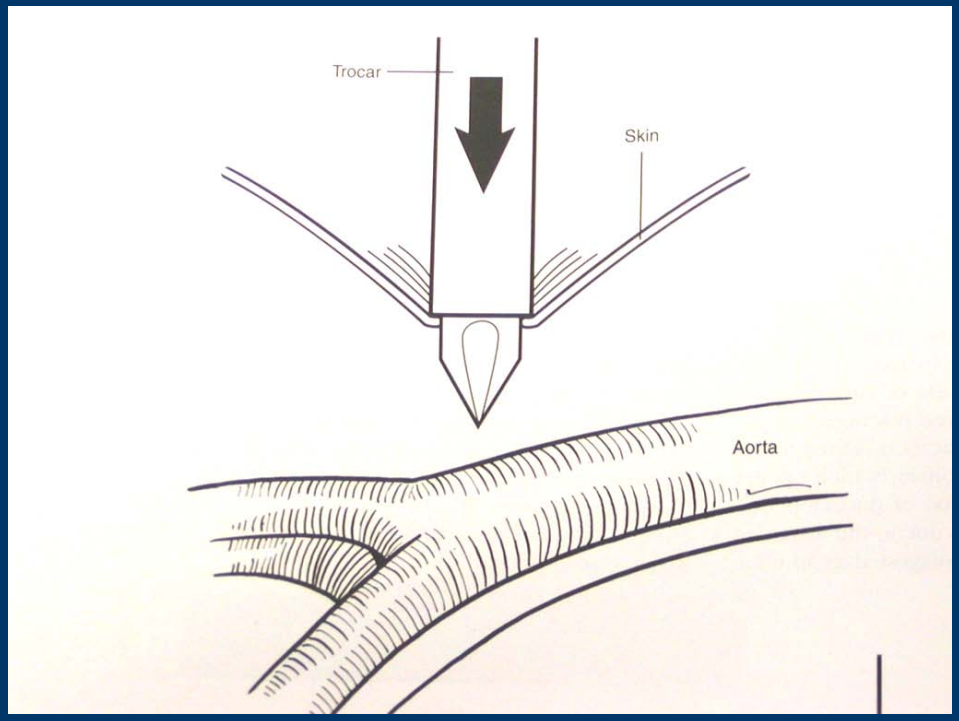
The others: **Spleen, Liver, Pancreas, Bladder, Ureter, Diaphragm, Instrumentation, Oliguria**

Montefiore THE UNIVERSITY HOSPITAL

EINSTEIN Albert Einstein College of Medicine OF YESHIVA UNIVERSITY

Intra-abdominal Vascular Injury:

- Ensure skin incision wide enough
- If Veress aspirate
- Consider visual obturator
- If bleeding suspected
  - Leave veress/trocar in place
  - Place accessory ports
- Beware of hematoma obscuring injury



Montefiore
THE UNIVERSITY HOSPITAL

EINSTEIN
Albert Einstein College of Medicine
OF YESHIVA UNIVERSITY

Intraoperative Vascular Injuries

Montefiore
THE UNIVERSITY HOSPITAL

EINSTEIN
Albert Einstein College of Medicine
OF YESHIVA UNIVERSITY

Overview:

Incidence: 0.5 – 2.8%

Conversion: 50%

Mortality: 9-17%

Mechanism:

1. Veress needle: 38%
2. Trocar: 45%
3. Intraoperative: 17%

Montefiore
THE UNIVERSITY HOSPITAL

EINSTEIN
Albert Einstein College of Medicine
OF YESHIVA UNIVERSITY

PROBLEM: INTRAOPERATIVE HEMORRHAGE

Prevention:

- 5.5-6 cm. off the midline to avoid the epigastric vessels*
- "In order to operate fast, it is necessary to go slow." G. Vallancien
- Think twice … cut once.
- Liberal use of energy devices (harmonic, Ligasure)
- Blunt ports
- Abdominal inspection at 5 mm Hg: look for "rivulets – red swirls"
- Port removal under vision at 5 mm Hg

*(Hashizume, M.: Japan. Surg. Endosc. 11: 1198, 1997)

Montefiore THE UNIVERSITY HOSPITAL

EINSTEIN Albert Einstein College of Medicine OF YESHIVA UNIVERSITY

TROCAR INJURY: ABDOMINAL WALL

- The most common site is from the inferior and superior epigastric vessels.
- The overall incidence is 0.5%
- Key point: Lateral ports should be at least 5.5-6 cm. off the midline to avoid the epigastric vessels.

(Hashizume, M.: Japan. Surg. Endosc. 11: 1198, 1997)

Intraoperative Vascular Injuries

- Risk 2-3%
- Can occur due to the proximity of the operation to the great vessels in the upper tract
- Proximity to the iliac vessels in the pelvis
- Be prepared (extra suction, open basic laparotomy tray)
- Prompt recognition key
- Cut only what you see
- Gentle handling of instruments
- Control your assistant
- Always orient yourself

Intraoperative Vascular Injuries

Steps:

- **Transient increase in abdominal pressure to 20-25 mmHg and maintain pneumoperitoneum**
- **Direct pressure with gauze (rolled 4x4) or rolled surgicel and suction irrigator**
- **If under control assess extra trocars**
- **Obtain optimal exposure, assess what is bleeding, isolate site**
- **If possible avoid clips or hem-o-locks**
- **Judicious use of : Lapra-Ty, Ligasure, laparoscopic Statinsky, surgical glues**
- **Free hand suturing best!! (just like open)**

Intraoperative Vascular Injuries

- Low treshold to open
- Transfuse as necessary
- Have vascular and abdominal tray available

There is no shame in conversion!

- Exposure
- Pressure, pack, transfuse needed
- Obtain vascular consult if necessary

PROBLEM: INTRAOPERATIVE HEMORRHAGE

Management:

- Raise pneumoperitoneum pressure to 25 mm Hg
- Tamponade (rolled 4 x 4 / Satinsky)
- Hydrate - transfuse
- Identify what is bleeding!
- Small - electrosurgery or harmonic +/- fibrin glue / gelfoam / Floseal
- Large – get blood / call Vascular surgery /suture (EndoStitch/LaparoTy clip/free hand) +/- fibrin glue / gelfoam / Floseal

WHEN AND HOW TO CONVERT:

1. Tamponade site of bleeding.
2. Open set and blood in the room
3. Second suction unit set up
4. Call out for vascular surgery

5(a). Convert to hand-assist

or

5(b). Open: swing endoscope up to underside of abdomen and incise on endoscope; rapidly pack site of bleeding

Montefiore
THE UNIVERSITY HOSPITAL

EINSTEIN
Albert Einstein College of Medicine
OF YESHIVA UNIVERSITY

HEMOSTASIS

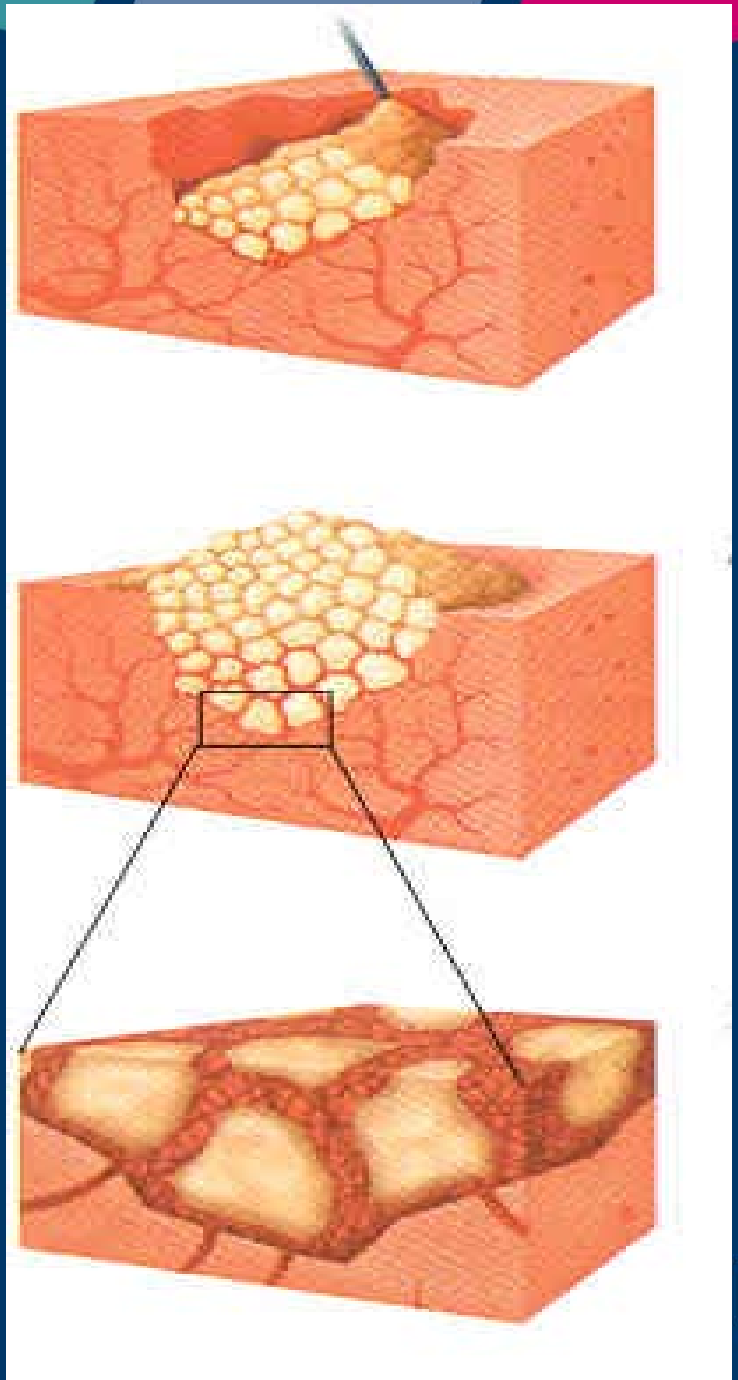
FloSEAL:

Collagen derived granules and topical thrombin.

Indications: capillary to arterial bleeding – works on actively bleeding tissues.

Package to patient: 2 min.

(Baxter BioScience)



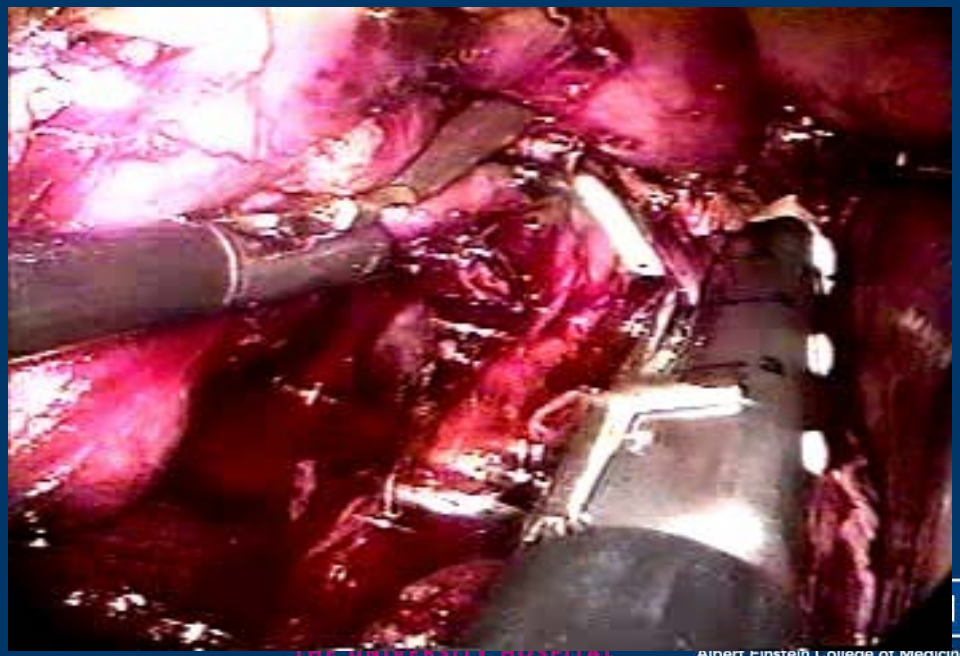
INTRAOPERATIVE COMPLICATIONS: INSTRUMENTATION

<u>Device Malfunction</u>: Stapler Mayhem

1992-2001: FDA databases: Manufacturer and User Facility Device Experience + Alternative Summary Reporting database

Mortalities:	**112**
Injuries:	**2,180**
Malfunction:	**22,804**

(Brown, S. and Woo, E.: J. Am Col. Surg. 199: 375, 2004)

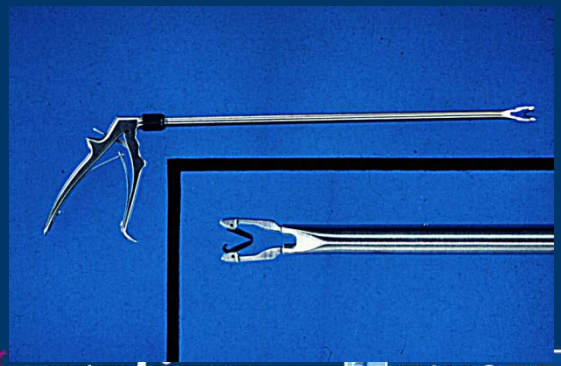


Movies

HEMORRHAGE TRAY

Contents:

- Laparoty clip applier
- Set of LaparoTy clip
- 2 needle holders
- Endostitch 4-0 Vicryl
- Klein bulldogs + Klein applicator
- Satinsky
- Surgicel
- Bolsters
- 4-0 silk on CV needle



Montefiore
THE UNIVERSITY HOSPITAL

EINSTEIN
Albert Einstein College of Medicine
OF YESHIVA UNIVERSITY

Take Home Message:

- Major vascular injury is a rare but serious complication that occurs in 0.11% to 2% of cases, most frequently involving the aorta and common iliac vessels
  - Campbell's Urology, 2002
- Major vascular injury will present with sudden hypotension/ tachycardia and with rapid accumulation of blood in the abdominal cavity, a mesenteric hematoma, or a expanding retroperitoneal hematoma
  - Campbell's Urology, 2002
- **If bleeding is confined to the retroperitoneum, there may be very little blood intraperitoneally or none at all (thus presenting as an expanding retroperitoneal hematoma)**
  - **Usal et al, Surgical Endoscopy, 1998**

Montefiore
THE UNIVERSITY HOSPITAL

EINSTEIN
Albert Einstein College of Medicine
OF YESHIVA UNIVERSITY

Take Home Message:

- Distance from the skin to the great vessels is only a few centimeters, especially in thin pts in a relaxed anesthetic state
  - Nordesgaard et al, Am J Surg, 1995
- When performing laparoscopy, must be aware of the potential for injury to major vascular structures and constantly be prepared to rapidly identify and treat this potentially life-threatening complication, with rapid location and control of site of injury and consideration of prompt exploratory laparotomy
  - Geers and Holden, Am Surg, 1996

PROBLEM: POSTOPERATIVE HEMORRHAGE

Presentation:

1. Two forms:

   a. Acute: Sudden vascular collapse (hypotension (70s) /tachy) abd.distention

   b. Gradual: Mild hypotension (90s) with tachycardia

2. Persistent ↑ pulse / pain

(Bhayani, S., Kavoussi, L., et al.: J. Urol. 175: 2137, 2006)

Diagnostic studies:

1. Hct./Hgb

   a. Acute: ↓ > 10 point drop in hct. from immediate postop

   b. Gradual: > 5 point drop in hct. – / need for 5 unit transfusion within initial 24-36 hrs.

2. CT scan: (only for gradual group)

Treatment:

Exploration (lap. vs. open)

check port site/op. site

Montefiore THE UNIVERSITY HOSPITAL

EINSTEIN Albert Einstein College of Medicine OF YESHIVA UNIVERSITY

PROBLEM: POSTOPERATIVE HEMORRHAGE

Results: "Acute"

1. Incidence: 0.4% (4 out of 1,123 laparoscopic renal cases)
2. Approach: 3 open and 1 laparoscopic exploration - < 10 hrs. postop
3. Cause: 3 adrenal and one renal artery.
4. Hospital stay: 8 days

Results: "Gradual"

1. Incidence: 0.5% (5 out of 1,123 laparoscopic renal cases)
2. Approach: 1 open and 4 laparoscopic exploration – 12-38 hrs postop
3. Cause: No source seen – diffuse oozing.
4. Hospital stay: 12 days

Montefiore
THE UNIVERSITY HOSPITAL

EINSTEIN
Albert Einstein College of Medicine
OF YESHIVA UNIVERSITY

PROBLEM: POSTOPERATIVE HEMORRHAGE

Upper retroperitoneal procedures:

Incidence:	0.4% (3.4% nephrectomy 5.4% adrenalectomy 9.9% partial nephrectomy)
Units transfused:	56% (1-2) 38% (3-6) 6% (11 and 12)
% explored:	12% (2 acute / 2 delayed*)
Risk factors:	Age and ASA classfication Intraoperative injury to spleen or liver
Hosp. stay:	2.7 days

*(patient restarted coumadin – bled on postop day 4 – PTT > 100)

(Rosevear, H., Roberts, W., Wolf, J. et al.: J. Urol. 176: 1458-1462, 2006)

Montefiore THE UNIVERSITY HOSPITAL

EINSTEIN Albert Einstein College of Medicine OF YESHIVA UNIVERSITY

Postoperative Vascular Injuries

- Hct decreases by 7-10 points

(due to oligiuria and excess ressucitation)

Warning signs:

- Postoperative pain
- Abdominal distension and discomfort
- Nausea
- Tachycardia
- Continued fall in Hct

Treat with open or lap re-exploration depending on stability

Assess further with CT scan if stable