LAPAROSCOPIC COMPLICATIONS AND THEIR PREVENTION

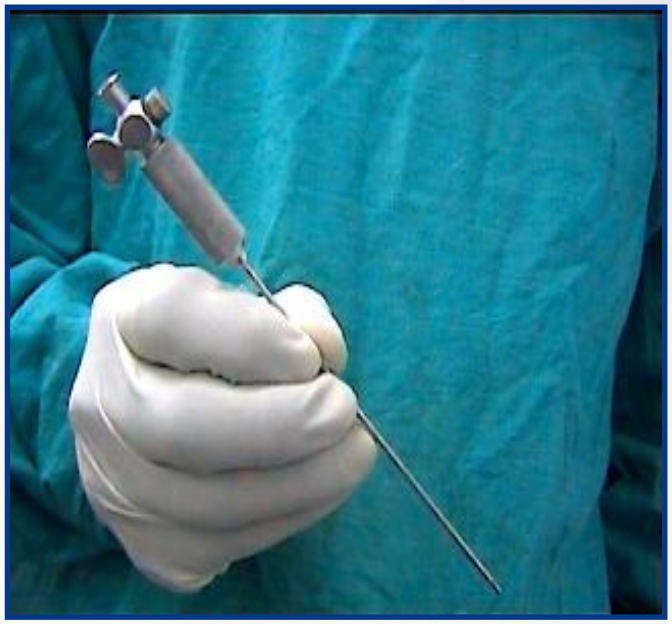
ESHRE Campus course Endoscopy in Reproductive Surgery

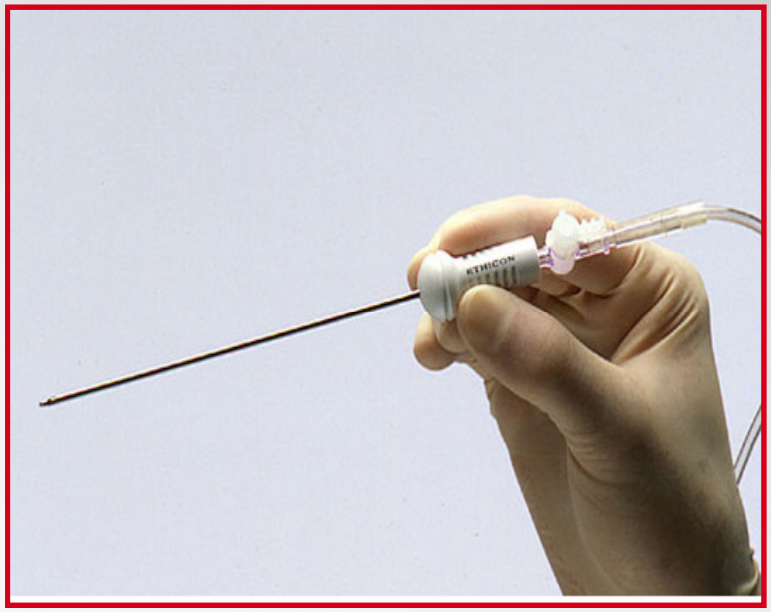
Leuven 25-28 November 2009

Complications

- According to the step of the surgery
  - during the insertion of the first trocar
  - intra-operative technique
  - early post-operative
  - late post operative
- Complications related to the type of Laparoscopic surgery performed
  - diagnostic laparoscopy
  - minor laparoscopic surgery
  - major laparoscopic surgery
  - advanced / complex laparoscopic techniques
- Types
  - anaesthesiological complications
  - abdominal Wall injuries (trocar entry complications)
  - vascular injuries
  - Gastro Intestinal Tract injuries
  - urinary injuries

Veress Needle

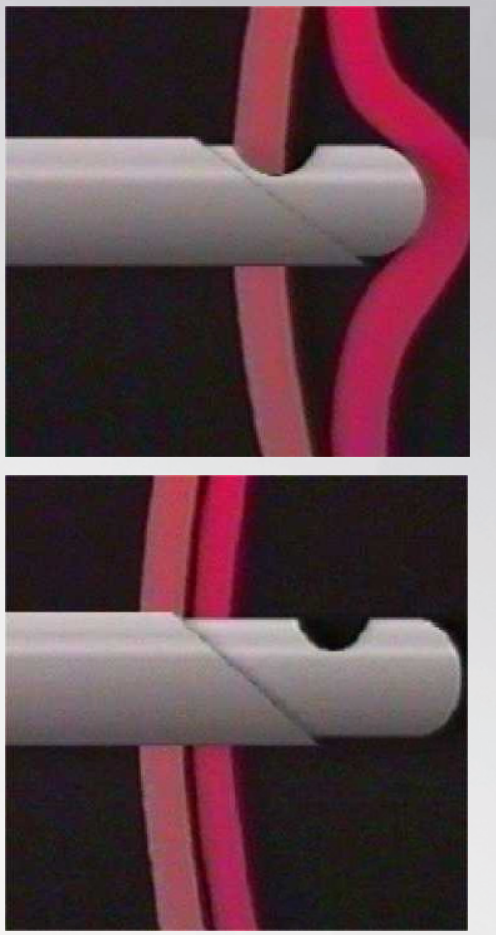




- Injury after Verres needle insertion is 0,8/10000, (Chapron1999)

Veress Needle

- developed in 1930 by Veress
- most commonly used in gynaecology
- sharp outer sheath
- blunt stylet
- retracts when passing through
- springs forward when tissue resistance drops



Check list of steps

- check the spring mechanism, open tap for air entry
- patient flat level on the table
- adequate skin incision
- lift the abdominal wall away from vessels
- insert in the lower part of the umbilicus
- angle depends on BMI
- 2 audible clicks - rectus sheath, peritoneum
- safety tests

Safety checks

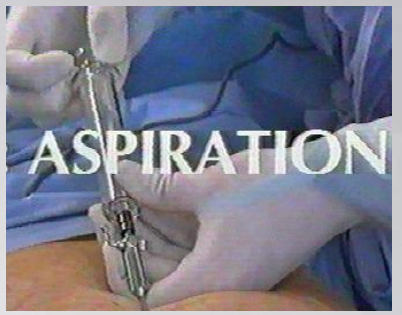
- aspiration test
- hanging drop test
- hissing sound test
- manometer test

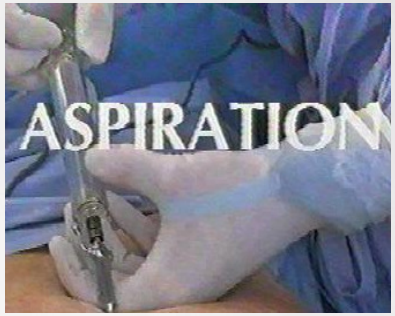
Safety tests

Aspiration test (1)

- syringe with saline (Palmer's test) or air
- aspiration
  - contains bowel contents or urine – remove!

- ***if blood is aspirated*****.....**
  - needle is left in place
  - exploratory laparotomy
  - ? vascular injury

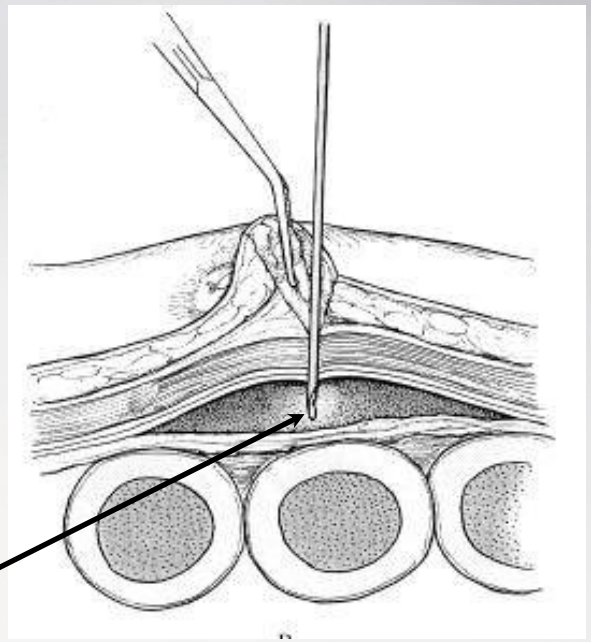




Safety tests

Aspiration test (2)

- no material aspirated
  - 5 mL of saline
  - reattempt to aspirate
  - no fluid-BINGO!!!!
  - if the saline is removed



in case the needle is in pre-peritoneal space – DON´T PANIC!!!

Reposition

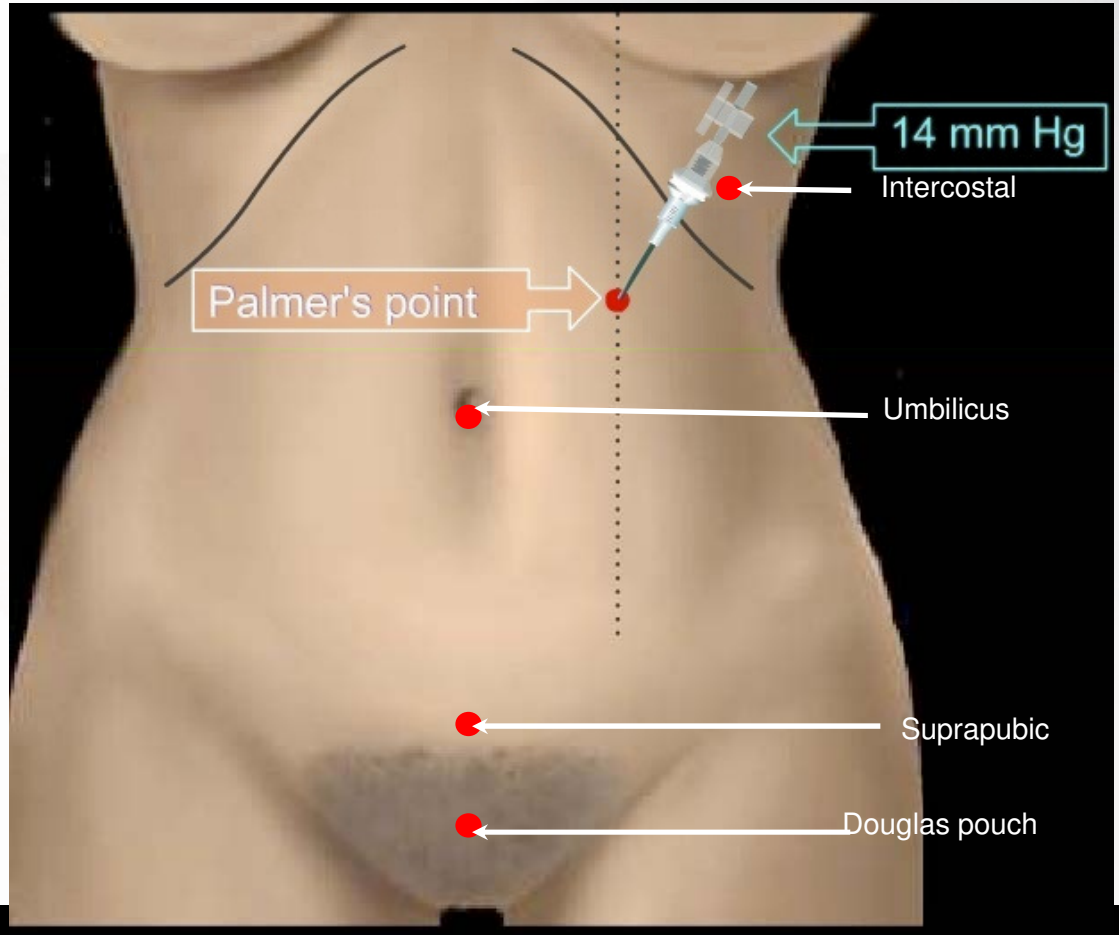
Safety tests

hanging drop test

- drop of water
- abdominal wall is elevated
- water should disappear down the shaft

Modification-using syringe with the plunger out

Modifications of the insertion point

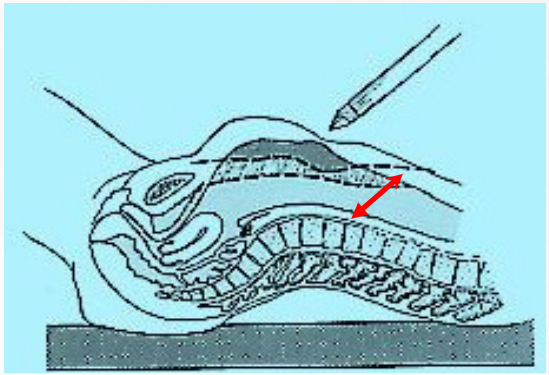


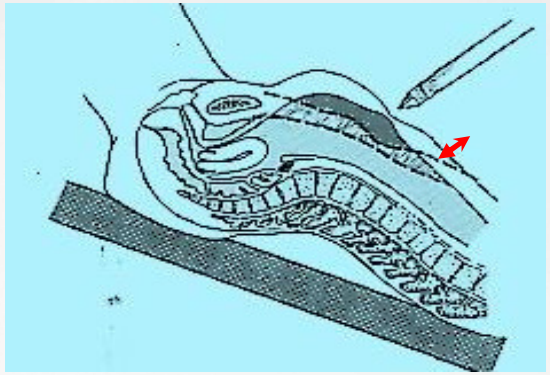
Palmer's point-adhesions are extremely unlikely; even after multiple surger

Percuss for spleen
naso-gastric tube!!!
Microlaparoscopy

NO NO!

- wiggle the tip side to side
- use of Trendelenburg
- modify technique with previous surgery





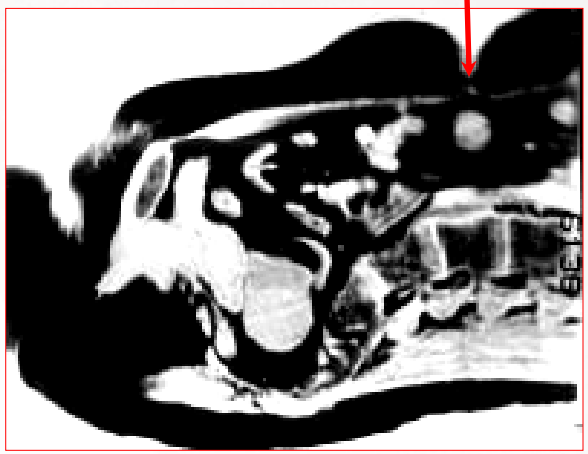
Safety tests

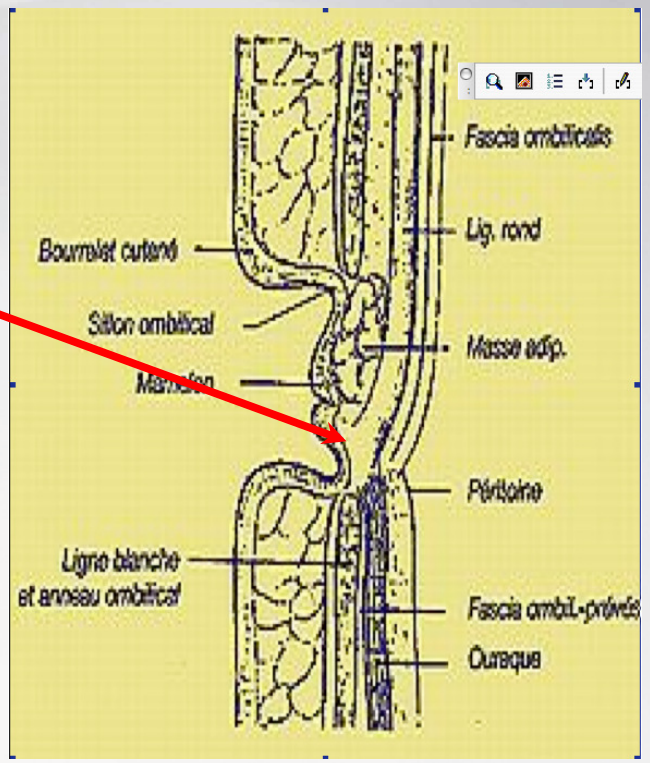
- Manometer test
  - connect gas tubing to the Veress and elevate the abdominal wall to create vacuum-
  - the pressure should drop
  - low flow
- Intra-abdominal pressure less then 10 ! …is the most reliable sign!
- …and the only sign that helps to identify the correct position

Teoh B, Abbott J An evaluation of four tests used to ascetain Veress needle placement at closed laparoscopy J Min Invasive Gynecol 2005: 12: 153-158

Direction of entry

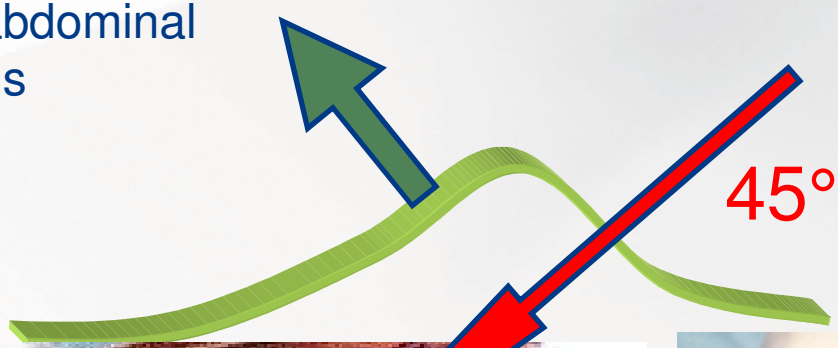
lower edge of umbilicus

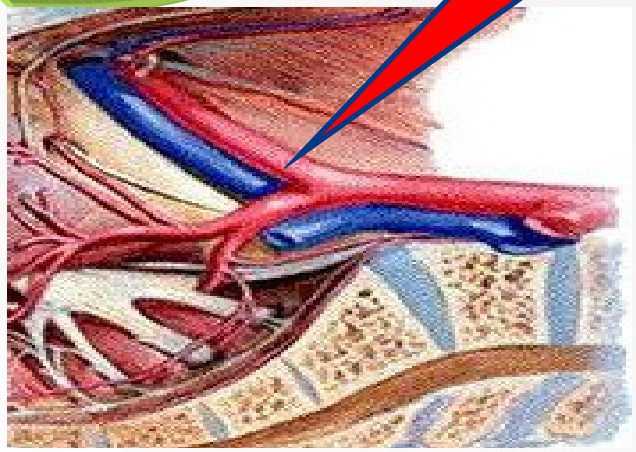




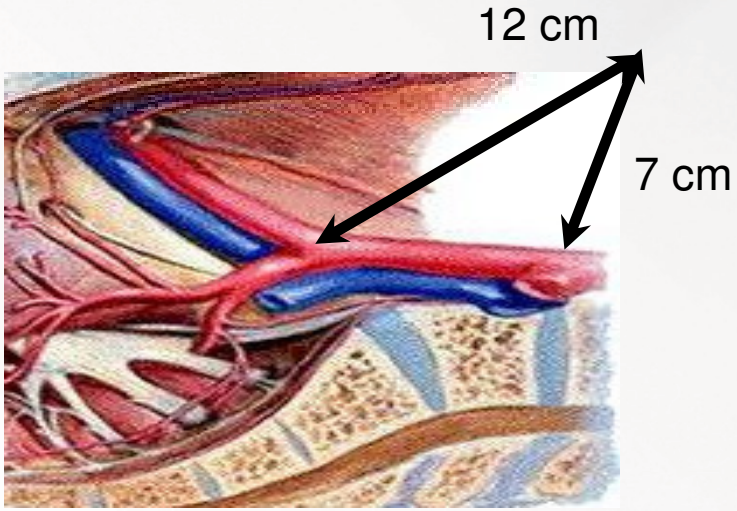
Direction of entry

relaxed abdominal wall is pulled away from abdominal vessels





Direction of entry



elevation increases distance between aorta and umbilicus from 0.1-2.5 cm

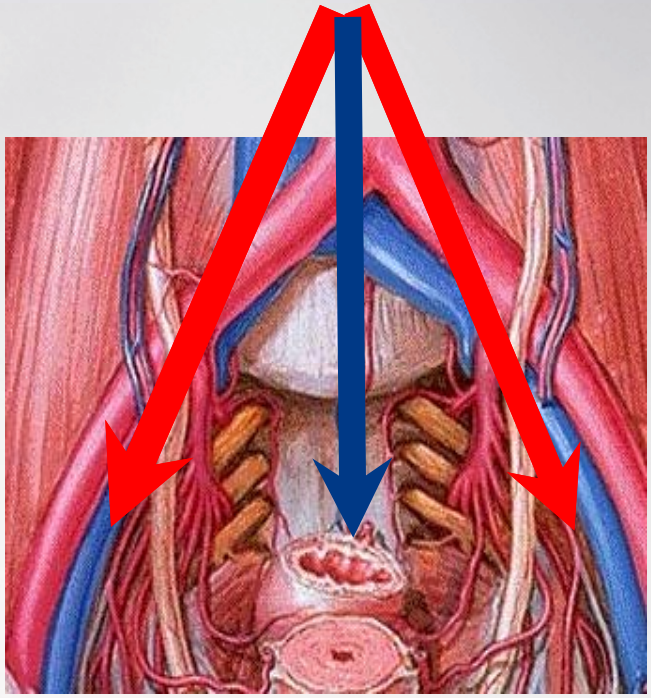
Direction of entry

First trocar 0,84/1000 Bowel injury

1 in every 100.000 (Champault, 1995)

towards sacral hollow

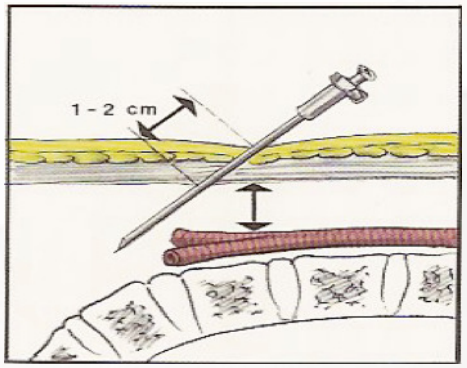
midline



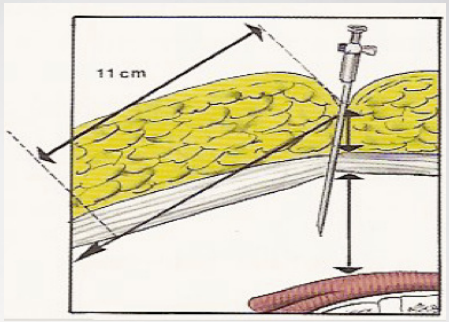
Initial step in laparoscopy is the creation of Pneumoperitoneum – in case of failure…

- Veress needle fails to enter the peritoneal cavity (recognize the incorrect placement leave the needle to empty the CO_2 and reinsert the needle
- Mediastinal emphysema –severe forms causes difficult to ventilate the patient
- Omentum emphysema – usually is self limited. Can make visualization of the abdominal and pelvic structures more difficult
- Pneumothorax is very rare but possible
- Penetrating injury in a blood vessel, if not recognized may lead to gas embolism and death (treatment : 100% O_2 + CVS support)

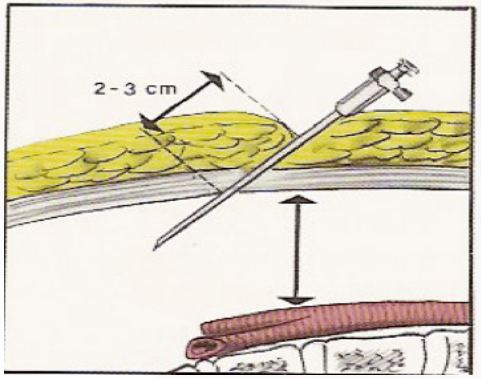
Modifications



BMI < 25



BMI > 30

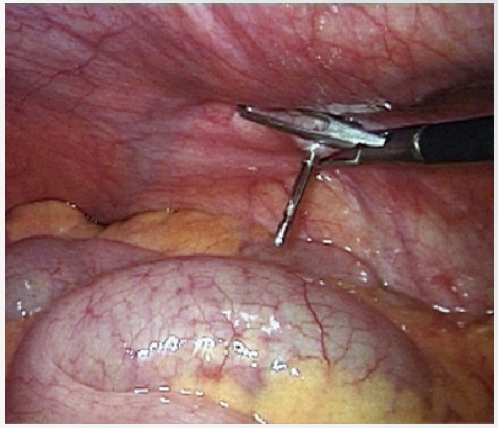


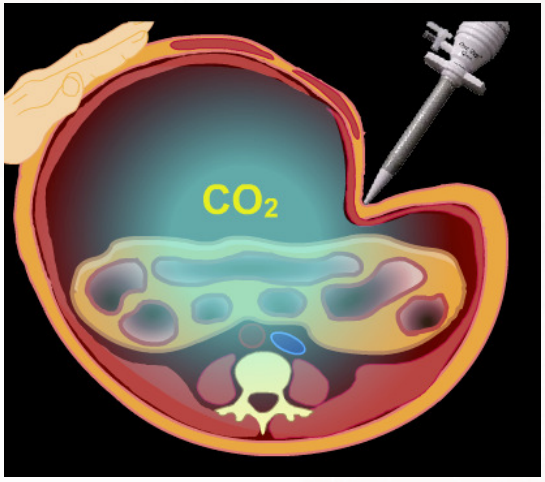
BMI=25-30

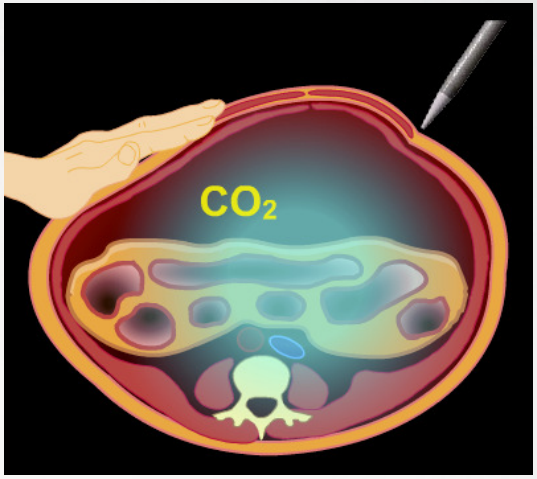
Pressure

- usually preset to 15 mm Hg
- high pressure - 25-30 mm Hg
  - gaining acceptance since first introduced in 1990's
  - short duration<2 min in healthy women has no effect on pulmonary function
  - same lung compliance in horizontal position as in 15 o Trendelenburg

Trocar Tips – Sharp Cone / Pyramidal







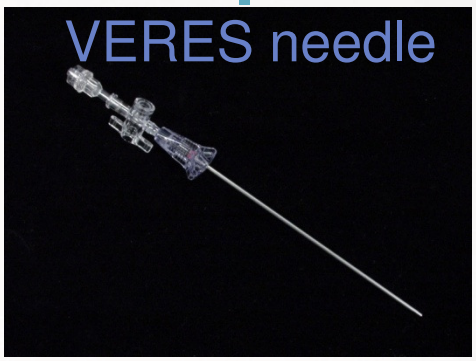
ENTRY TECHNIQUES

CLOSED

OPEN

OTHERS

VERES needle

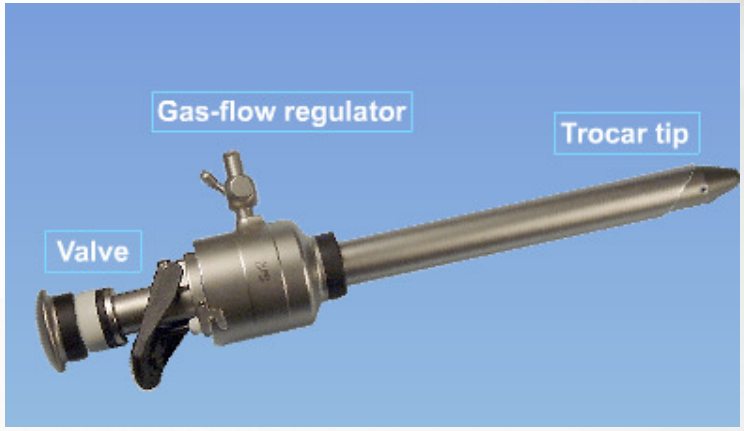


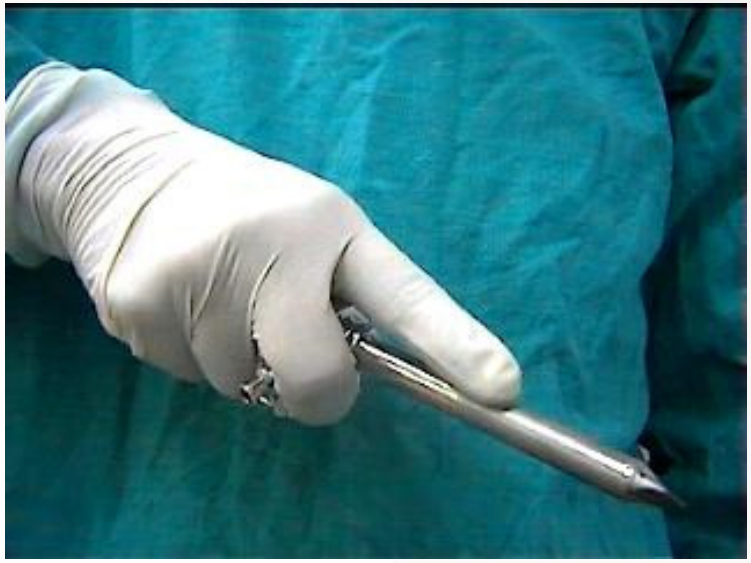
Hasson

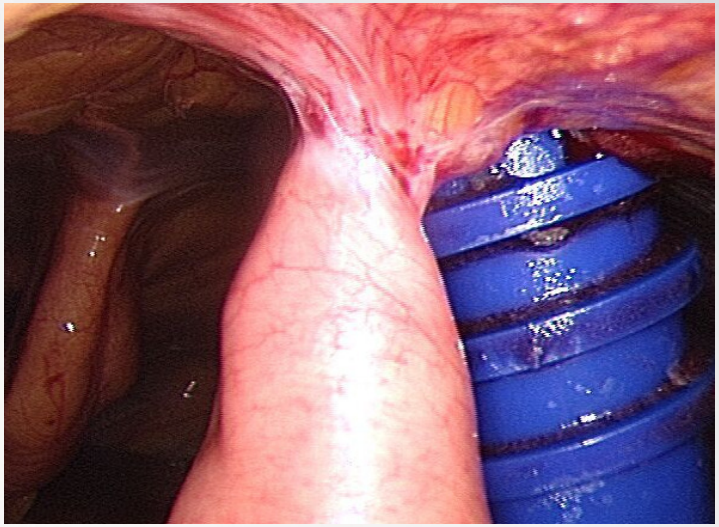
OPTICAL TROCARS
RADICALLY EXPANDING TROCARS
TERNAMIAN TROCARLESS CANNULA

DIRECT ENTRY

Introduction of primary trocar - another crucial step







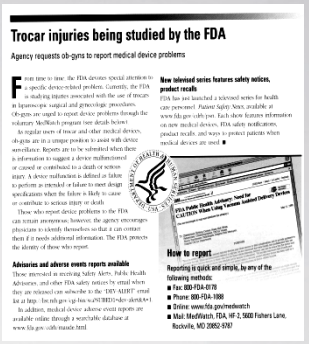
FDA TROCAR INJURY REPORT

Shielded trocar risk injury&hernia X10 higher ***Leibl 1999***

EVIDENCE BASED RECOMMENDATION ***FDA 2005***

Document - Study - Report

Near Miss & Adverse Event


Trocar injuries being studied by the FDA

Agency requests ob-gyns to report medical device problems

New televised series features safety notices, product recalls

How to report

In HIGH RISK CASE use alternate

Palmer's / Open / Visual OR Laparotomy ***Fuller 2005***

>½ reported serious injury are entry related

Deziel 1994 Harkki-Siren 1997 Chapron 1998 Chandler 2001 Jansen 2004

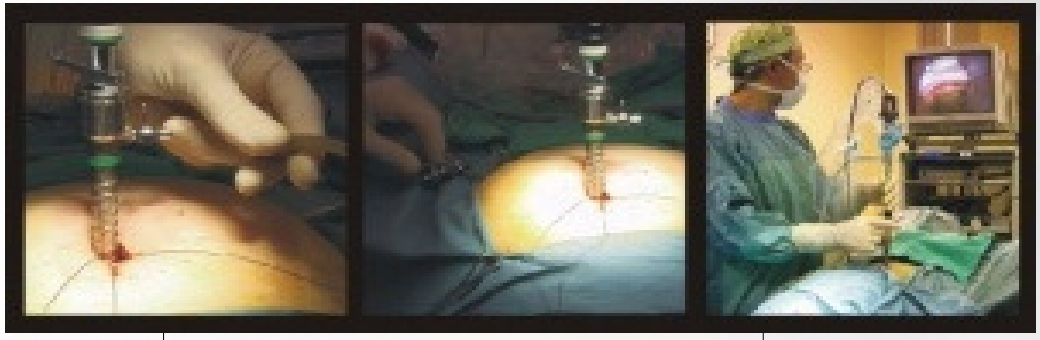
Despite advances serious entry injury remain common avoidable complication ***Hurd 2002***

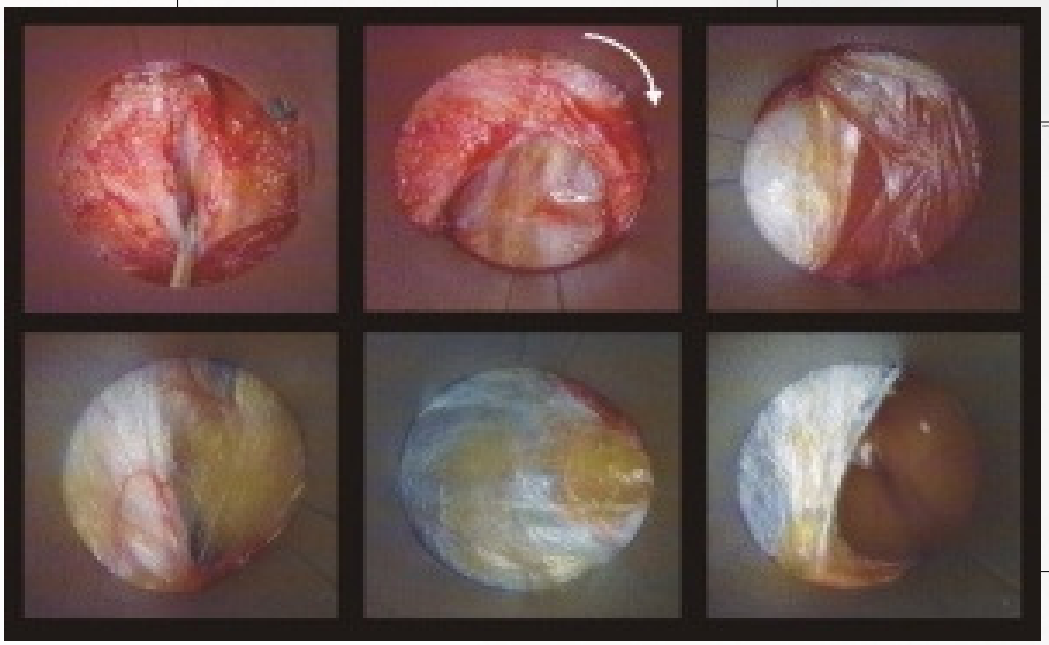
Introduction of primary trocar

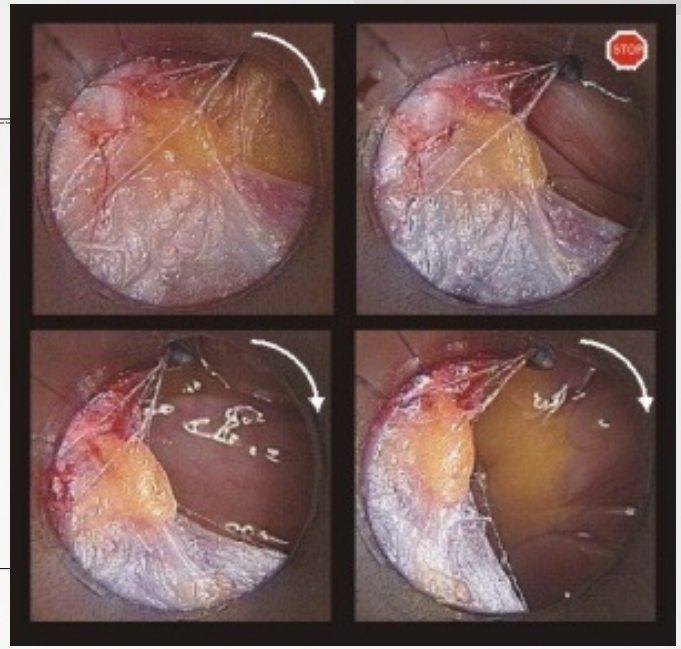
- preset intraabdominal pressure >15 mmHg
- sufficient skin incision
- no wall elevation
- towards the sacral hollow
- full control of the trocar-**speed is constant** until loss of resistance
- less force, more rotation

insert the trocar vertically, change the direction impacting the fascia

Ternamian trocarless cannula

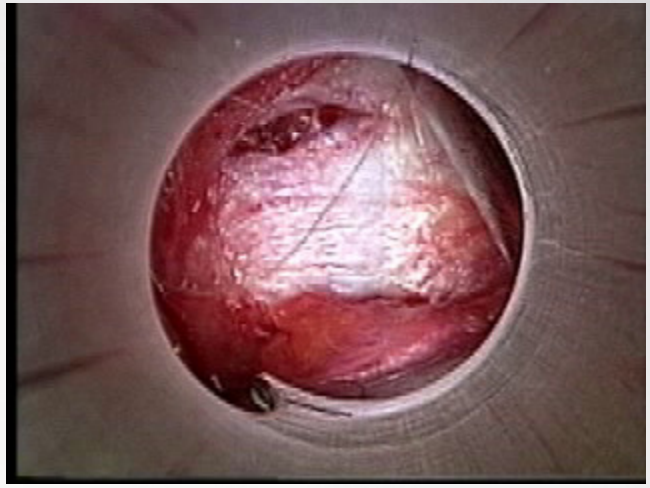






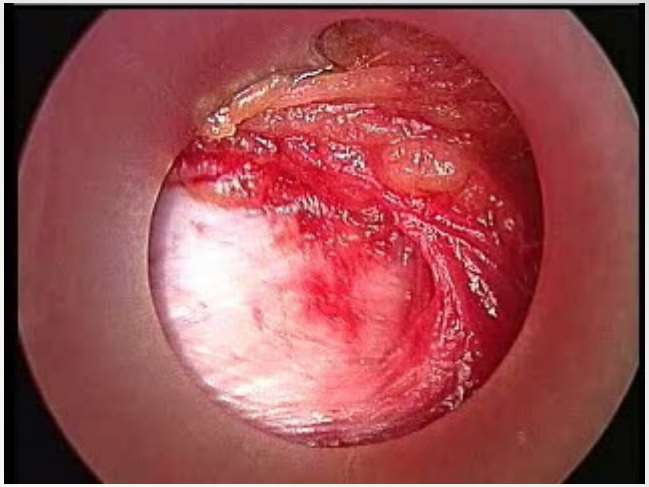
IMPORTANCE OF VISUAL ENTRY

- 1-RECOGNIZE INJURY
- Improves OR team entry **SAFETY AWARENESS**
- Raise error **RECORDING** & **REPORTING** compliance *Wanzel 2002*
- Allows timely repair & Eliminates **HIND-SIGHT BIAS**
- 2-LEARN FROM ERROR
- Human Behavior study show routine
- Video tape improve outcome *Cuschieri 1998*
- Video capture & recall allows detailed
- Causation & Error Analysis *Mackenzie 1995*
- 3-ANTICIPATE MISHAPS
- Vision adds human & technologic redundancy Visual ports
- reduces trocar injuries *Semm 1990 Chapron 1997 Marret 1998 Vilos 2006*



EVIDENCE FOR VISUAL ENTRY

- Requires less ENTRY FORCE Validated RCT
- Applies less intra abdominal pressure *Glass 2003*
- Offers radial & controlled entry *Munro 2002*
- MUSCLE DAMAGE SCORE
- significantly less
- FASCIAL-MUSCLE DEFECT
- smaller *Tarney 2002*
- >2,300 entry+ NO serious
- Entry related complications
- *Ternamian 2008*



Complications during the installation phase of laparoscopy

- risk Factors:
  - surgeon
    - ⇨ inexperience
    - ⇨ negligence
    - ⇨ ignorance
    - ⇨ lack of respect of the procedures
    - ⇨ Trendelenbourg ?
- patient
  - ⇨ history of laparotomy (adhesions into 68%)
  - ⇨ extreme BMI
- independent
  - ⇨ trocar type: single-use or reusable trocars

Important to have a clear picture in mind what lies in the abdomen underneath the trocar

SFEG's register: 1/3 of complications occur at the initial phase of laparoscopy / first entry TROCAR

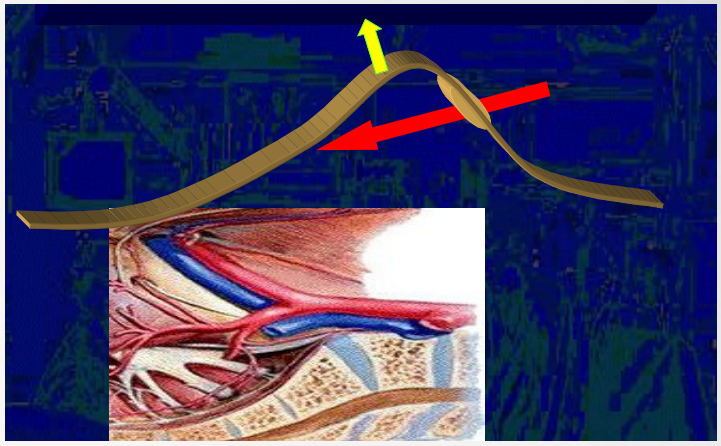
67-83% major vascular injuries

30-75% bladder injuries

57% deaths

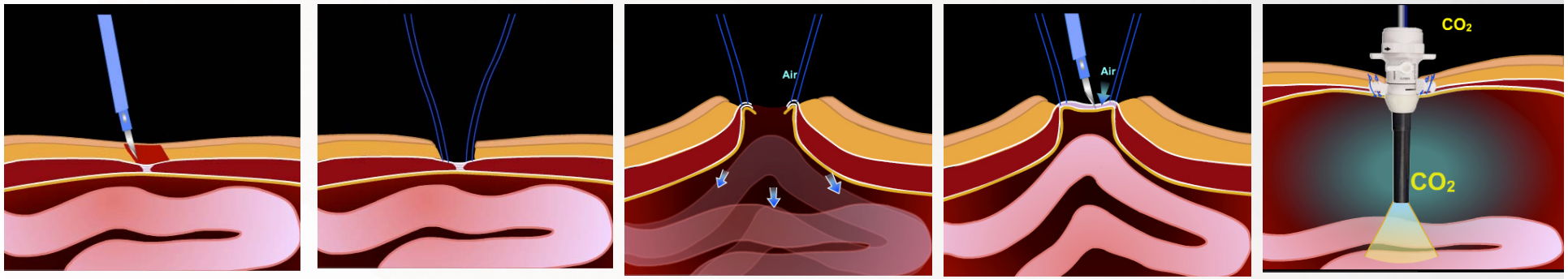
Direct entry

- as safe as other methods, minor complications rate is lower than Veres
- advantage: 1 blind procedure Vs 3 (Lancet, Veress, Trocar)
- always insert parallel to vessels
- lowest entry failure rate (5% vs 0.9%)



Open laparoscopy -Hasson

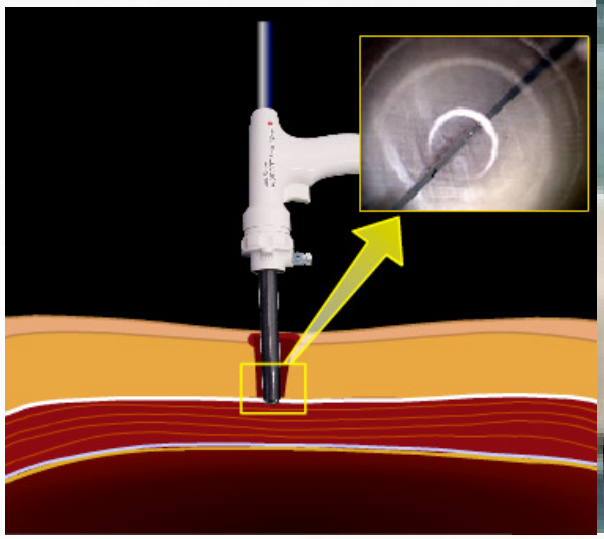
- open visualisation of every layer
- until peritoneum
- anchoring fascia
- securing conical collar
- placing trocar through the collar



HASSON

- place in previous surgery
- midline scar
- drawbacks: loss of CO2, bigger incision, longer time, especially in the obese patients
- does not prevent bowel injury, vascular accidents are less common

Optical trocar



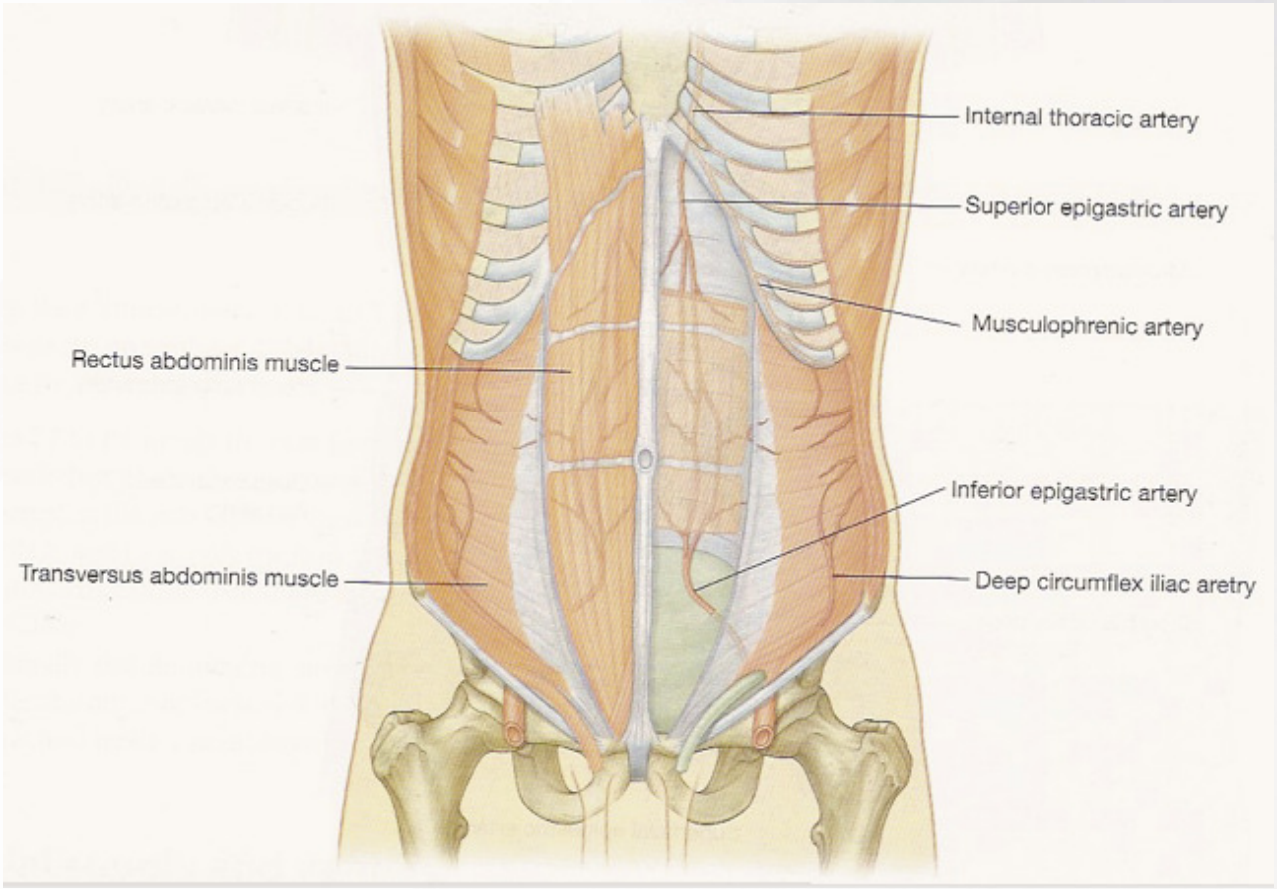
open-laparoscopy

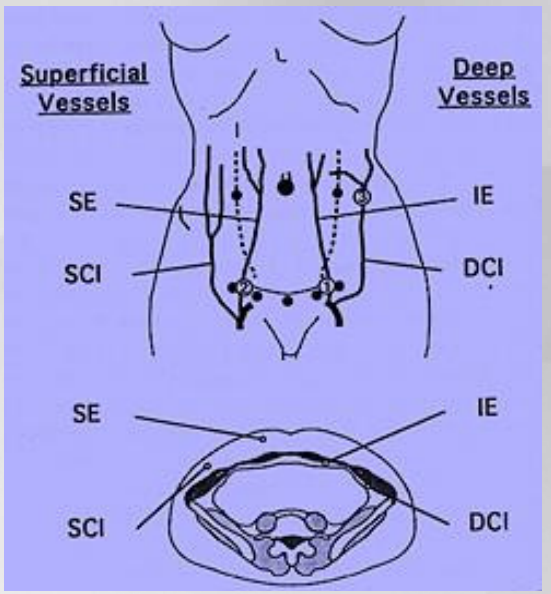
- has its own Complications (= minilaparotomy)
  - infection
  - haematoma
  - adhesions
- the risk of vascular injury is decreased
- doesn't reduce the risk of GIT injury (0,6/1000)
- but lowers the risk of unknown gastrointestinal injury by factor 2
  - late diagnosis in 33% of cases during open versus 64% in needle procedures

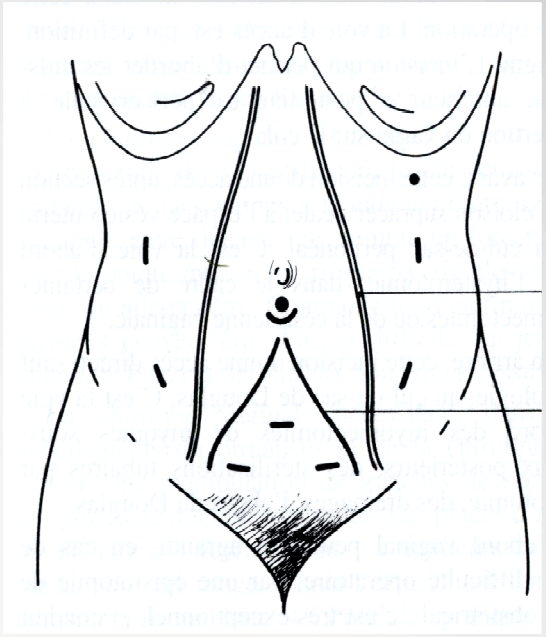
Harchaoui, 1997

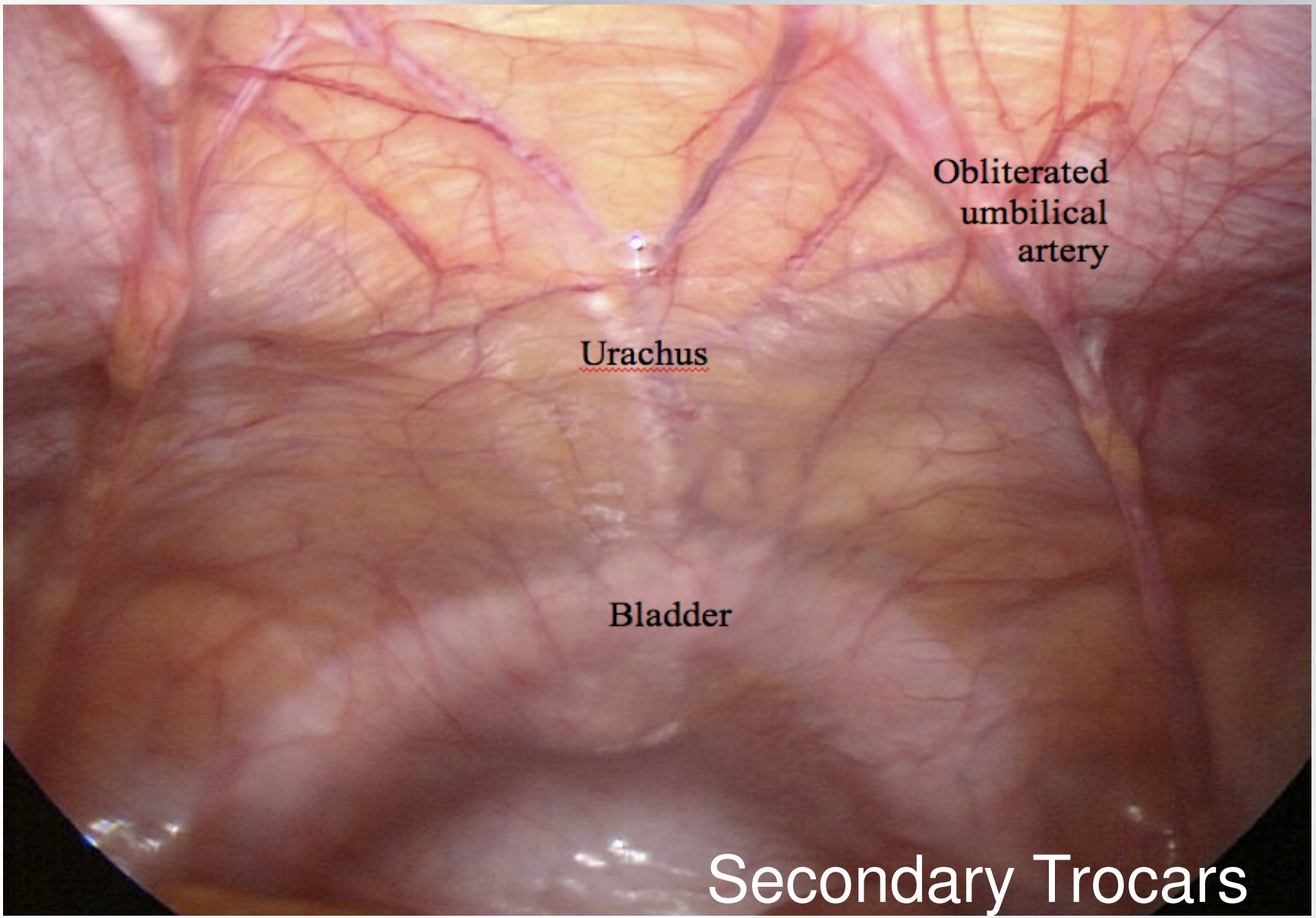
Secondary trocars

Secondary trocars

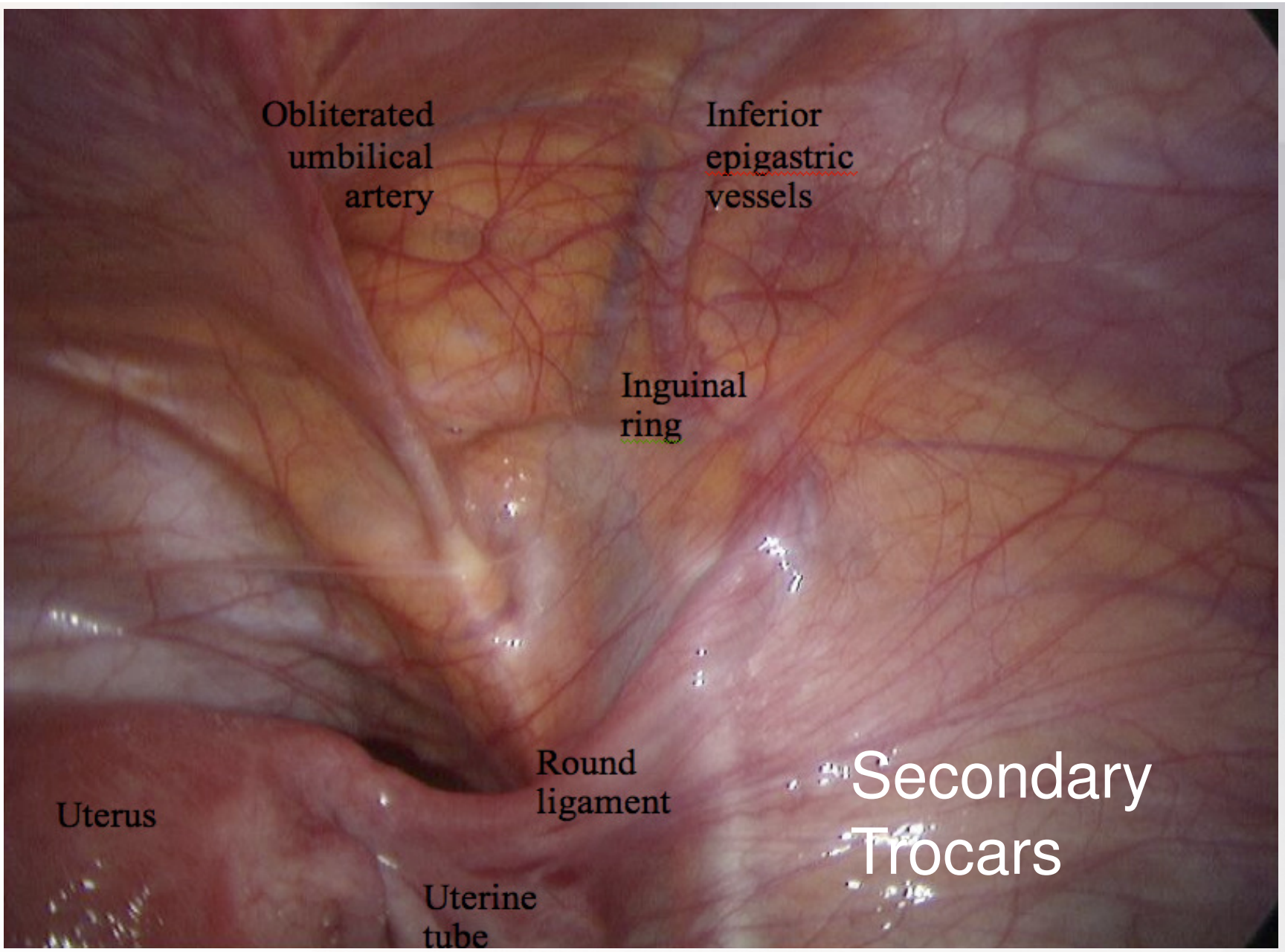








Secondary Trocars



Secondary Trocars

Complications due to entry ports

- Mortality only few data published as 3,33/100000
- Due to major vascular injuries +++
- During installation phase ++

- Infections of the wall about 1% but after major laparoscopic surgery is about 3%
- depends on :
  - hospital hygiene
  - antibiotic prophylaxis
  - drainage and presence of urine catheter

Prevention

- pay respect to the procedures
- technological issues
  - Miniscopes
  - Endotip ®
- technique issues
  - Insufflation in the Palmer's point
  - Open-laparoscopy
  - Direct insertion

Complications during laparoscopic surgery

- Gastro Intestinal Tract injuries
- Urinary tract injuries
- Vascular injuries

Gastrointestinal injury

Table VI. Prevalence of gastrointestinal injuries

Reference	Laparoscopy	Operative laparoscopy		Gastrointestinal injuries during laparoscopy	
	n	*n*	%	*n*	per thousand
Härkki-Sirén and Kurki (1997)	70 607	11 427	16.2	44	0.62
Jansen *et al.* (1997)	25 764	3 967	15.4	29	1.13
Chapron *et al.* (1998)	29 966	18 061	60.3	48	1.60

Risk factors GIT complications

- during the installation phase:

  adhesions and anterior laparotomy are found in 68% of bowel injury

- during the surgery procedure: 65% endometriosis (ISGE 2001)
- the history of pelvic surgery X 10 risk of GIT lesion (Chi, 1982)

Risk Factors

Mechanical injuries to the bowel are ten folds more frequent in patients who underwent PREVIOUS PELVIC SURGERY

Chi IC et al. , 1982

SEVERE ENDOMETRIOSIS is the main contributing factor for bowel injuries in patients with no previous surgery.

Chapron C *et al.* , 2001
Nezhat C, 1992

Mechanism of GIT injuries

- direct trauma (instruments, forceps)
  - manipulation
  - adhesiolysis, enterolysis (bowel adhesions separation)
- thermal trauma
  - bipolar
  - monopolar ++
  - ultracision, thermofusion, sealing methods

Late Diagnosis

in average 4.0 + 5.4 (0-23) days after surgery

mechanical injuries

1.3 days (0-4)

electro-thermal injuries

10,4 days (0-38)

Intestinal complications are responsible for most of morbitity and mortality during laparoscopic surgery

Mortality in the bowel injury group was 21% when the diagnosis was delayed

Bhoyrul S, et al., 2001

Prevention of gastrointestinal complications

- Before surgery:
  - PV / PR examination
  - Trans Vaginal / Trans Rectal ultrasound
  - Imaging dynamic / spiral CTS / MRI
  - bowel preparation?! In high risk cases such in severe endometriosis involving the colon and recto-vaginal space and patients with history of previous GIT operation
  - Nasogastric tube / mask ventilation (avoid stomach distention)
  - Vaginal packing / uterine manipulator
  - To opt for the lateral dissection
  - Attention to the electrical current used

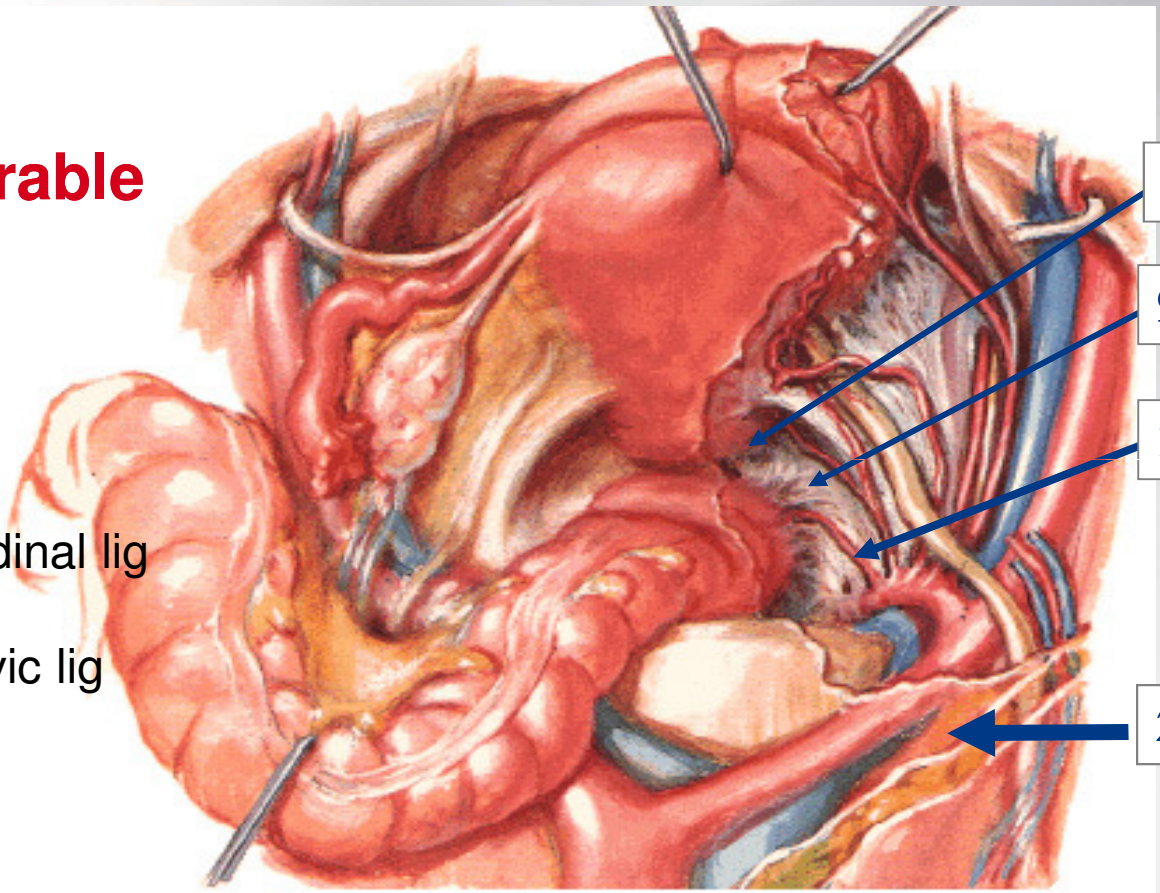
Urinary Tract Complications

- ureteral injuries
- bladder injuries
- fistulas
- bladder injuries are identified more often (87%) than ureteral injuries
- The rate increase with the difficulty of technique
  - 0,027%
  - 1,6% major laparoscopic procedures
  - 3% hysterectomies

Ureteric lesions: sites

Ureter is vulnerable

- at the fossa ovarica
- at the Uterine artery
- at the uterosacral/cardinal lig
- at the Infundibulo-pelvic lig



Bishoff JT et al. 1999

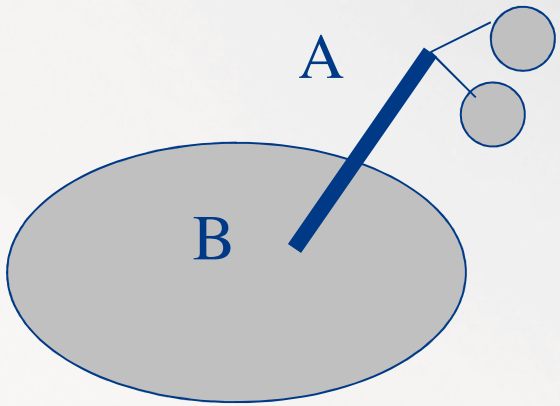
High Risk Conditions

- pelvic endometriosis (65% of ureteric injuries)
- large uterus during hysterectomy
- Oophorectomy for a large ovarian /paraovarian cysts, residual or ovarian remnant syndrome
- cervical or intra-broad ligament myomas
- pelvic adhesions:
  due to previous pelvic inflammatory disease or surgeries
- congenital anomalies: pelvic kidney, ureteral duplication
- 50-75% of ureteral lesions occur during surgery of benign lesions, described as easy surgeries by the surgeon.

Atraumatic dissection: some rules

- no brutal manipulation
- do not pull and do not push the ureter
- do not grasp the ureter with your forceps
- use atraumatic forceps
- control of forces: ergonomics

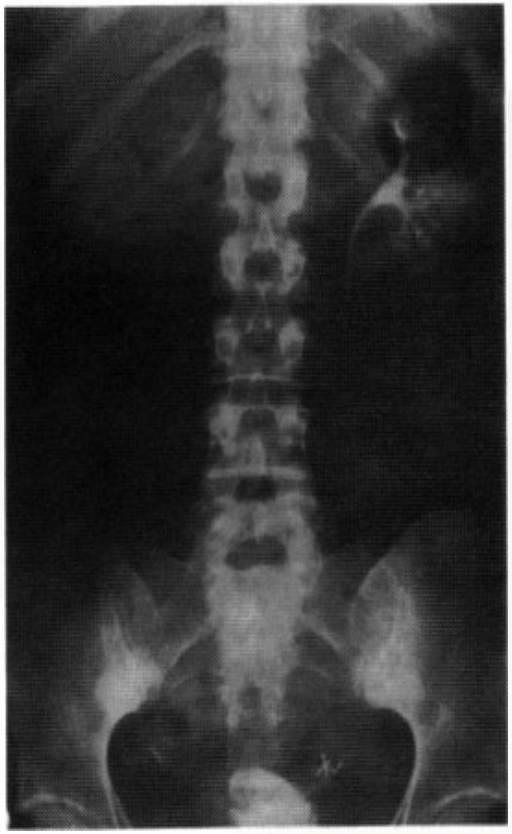
If A=B *precision & force*
If A>B *to much force*
If B>A *no precision*



Prevention

- Ureter must be localized in all moments during the laparoscopy
- by identification under the peritoneum
- by dissection
- by pre-operative catherization (stenting), IVP, cystoscopy
- Ureteral catheter: systematic placement was abandoned because it does not prevent all lesions and has its own morbidity
- at the end of the surgery see ureter peristalsis and absence of dilatation

Postoperative Ureteric injury Symptoms



- Clinical
  - abdominal pain side
  - (flank) pain
  - distended abdomen
  - ileus
  - fever
- IV Ureterogram (IVP)
- Retrograde Ureterogram

Bladder trauma

- 1 to 2,3% in the advanced laparoscopy
- mechanical or electro-thermal trauma

Prevention

- Bladder catheterisation
- Secondary trocars under vision
- Blunt dissection better than electrosurgery

Mechanical trauma to Bladder occurs

- During
  - Adhesiolysis
  - Resection of endometriosis implants
- The history of previous laparotomy increase the risk:
  - Myomectomy
  - Cesarian section

Diagnosis after Bladder injury

- Pneumo sac – swollen bladder – entrapped CO_2
- Hematuria
- presence of urine in the abdominal pelvic cavity
- post-operative Anuria

Hemorrhage Complications

- at the level of the wall
- major vascular injuries
- secondary hemorrhages

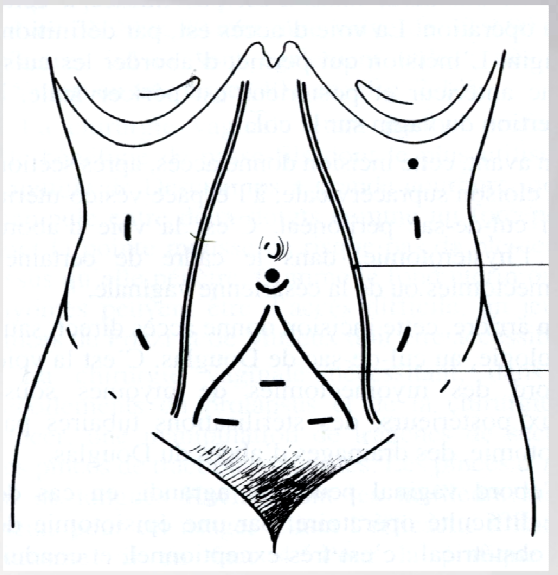
Vascular injuries

- Hypogastic vessels
- External Iliac
- Vena Cava
- Aorta
- Femoral aa/vv

Usually happens during the installation phase

and of course any injury may happens during surgery

Bleeding complications of the Abdominal wall can be avoided



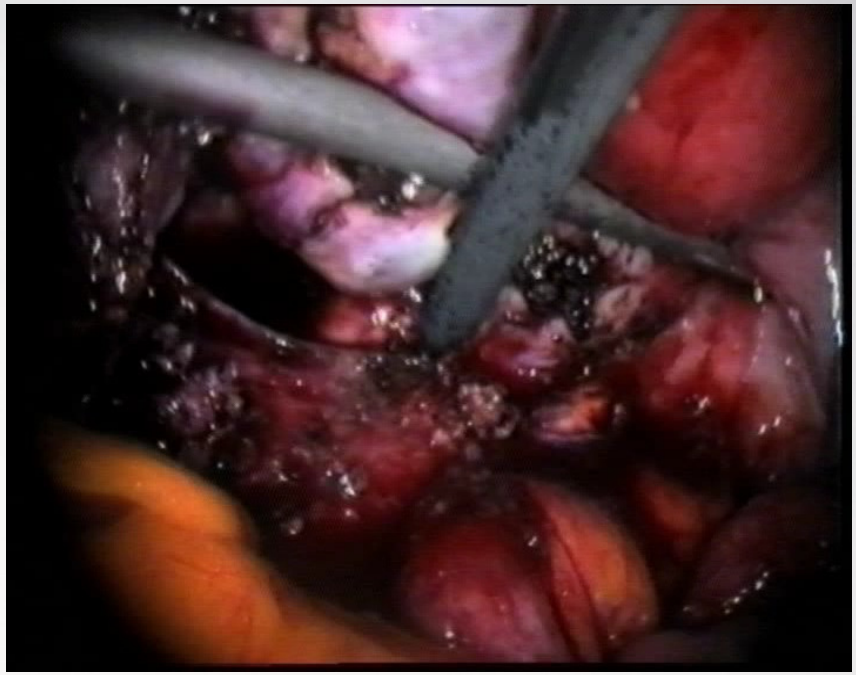
- Prevention
  - inspection
  - anatomical landmarks
  - trans illumination
  - to avoid oblique entry ways
- Treatment
  - direct coagulation
  - transparietal suture (straight needle) and Bourdonnet
  - Folley's catheter
  - Minilap.

Intra-operative vascular injuries

The vessels more likely to be injured are:

Internal iliac artery

Medial rectal artery



Intra-operative vascular injuries: intra-operative management

- In case any vessel is injured, it is of vast importance to control the bleeding as quicky as possible:
- A laparoscopic grasper can occlude the bleeding vessel
- Pressure should be applied if visualization is obscured
- In case of a large vein injury grasping may result in its further laceration
- 11-25% of deaths in case of major vessel injury Nordestgaard 1995 / Chapron 1997

Treatment of Vascular injuries

- Depends
  - on the size
  - on the vessel type
- What to do ?
  - Decision to stop the bleeding or sticking to the success of events
    - avoid to contaminate the optic
    - Suction of the pneumoperitoneum
    - Intestine returns in the pelvis

Treatment of Vascular injuries

- To stop the bleeding with any instrument
- To identify the surrounding vulnerable organs
- To identify the type of the vessel
- To close the vessels
  - Bipolar coagulation
  - Clips
  - Suture
  - Laparotomy….

Treatment of Vascular injuries

- Bipolar
  - Effective at the veins and the arteries
  - Until 7 to 8 mm

  - however it is unaceptable in case of too voluminous vessels and for essential vessels
- clips are effective on the big veins
- endo-loop is effective on extensive arterial bleeding
- if it's necessary suture

Secondary haemorrhage

- role of the positive pressure of pneumoperitoneum
- check final haemostasis under low pressure

Late Complications

- Hernia
  - the risk depends on the trocar's diameter
    - 0,2% for 10 mm
    - 3% for 12 mm
  - umbilical ++
- Trocar metastasis
    - Endometriosis
    - Cancer metastasis
- Prevention
  - Trocar insertion ++++

Conclusion

- The risk of complications depends not only on the surgeon's experience but dramatically on the surgeon's knowledge.
- This emphazises the need of
  - teaching the anatomy
  - teaching the suturing techniques
  - teaching the principles of energies

This presentation has been prepared by the European Academy of Gynaecological Surgery

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