Home Dialysis University

PD Access Issues:

Placement, Complications, Infections

Isaac Teitelbaum, MD
Professor of Medicine
Director, Home Dialysis Program
University of Colorado Hospital
Aurora, Colorado

Jointly provided by USF Health and the International Society for Peritoneal Dialysis.
Funded in part by unrestricted educational grants.

USF Health

INTERNATIONAL SOCIETY FOR PERITONEAL DIALYSIS

Isaac.Teitelbaum@cuanschutz.edu

Potential Conflict of Interest Disclosures:

Advisory Board: Liberdi

Consultant: Triomed

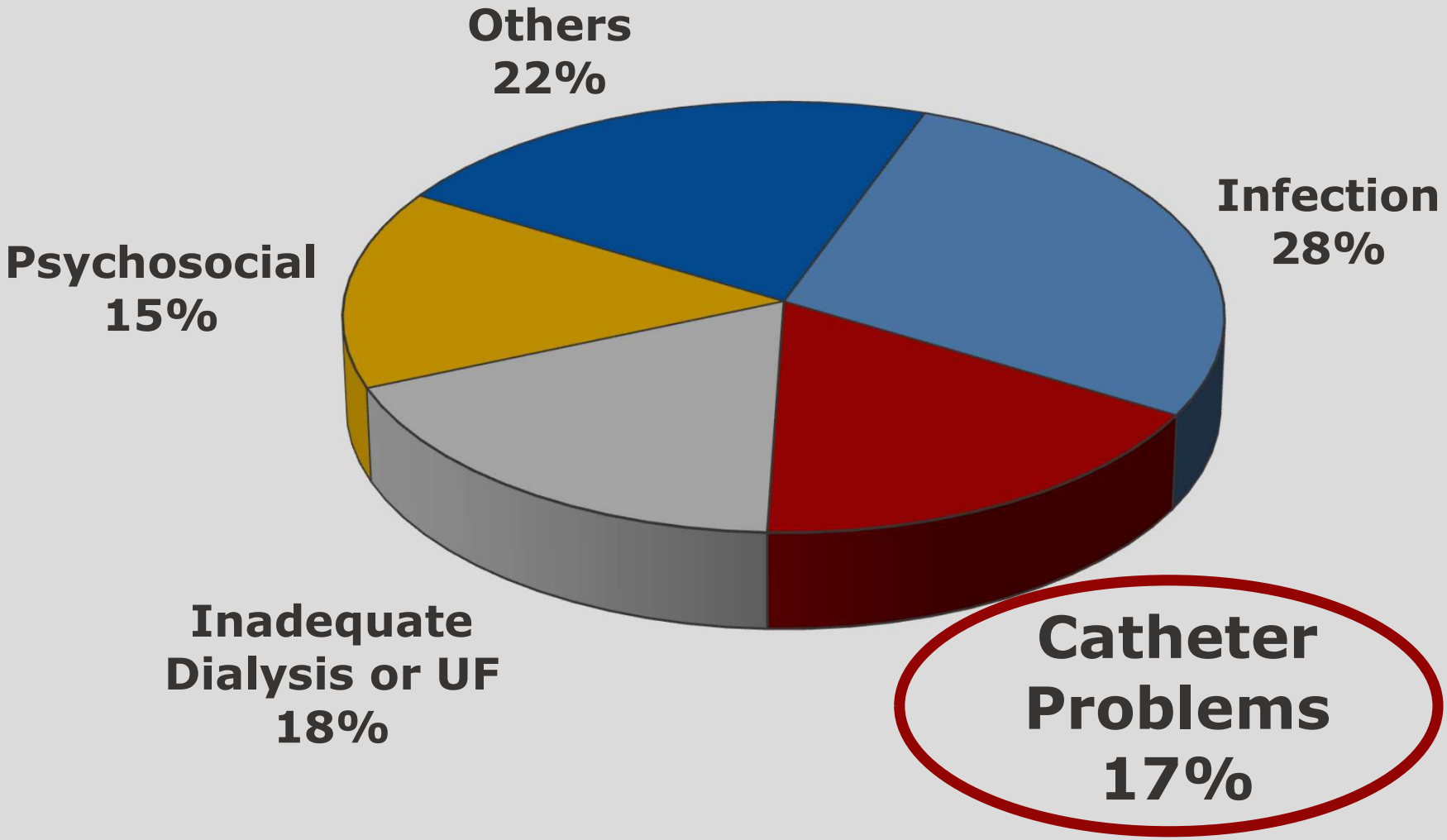
Stock/Shareholder (self-managed): Liberdi

Peritoneal Dialysis Access

As is the case for hemodialysis, the success of peritoneal dialysis as renal replacement therapy depends upon a functional long-term access- the catheter.

Causes of Transfer from PD to HD

Adapted from Mujais S. Kid Int 70: S21, 2006



Outline

- Catheter Design
- Catheter Placement
- Catheter- related Complications
  - Exit Site Infections
  - Mechanical Complications

Considerations Regarding Catheter Design

- Catheter Material
- Number of cuffs: 1vs. 2
- Inter- cuff segment: straight vs. fixed curve (Swan neck)
- Catheter tip: straight vs. coiled

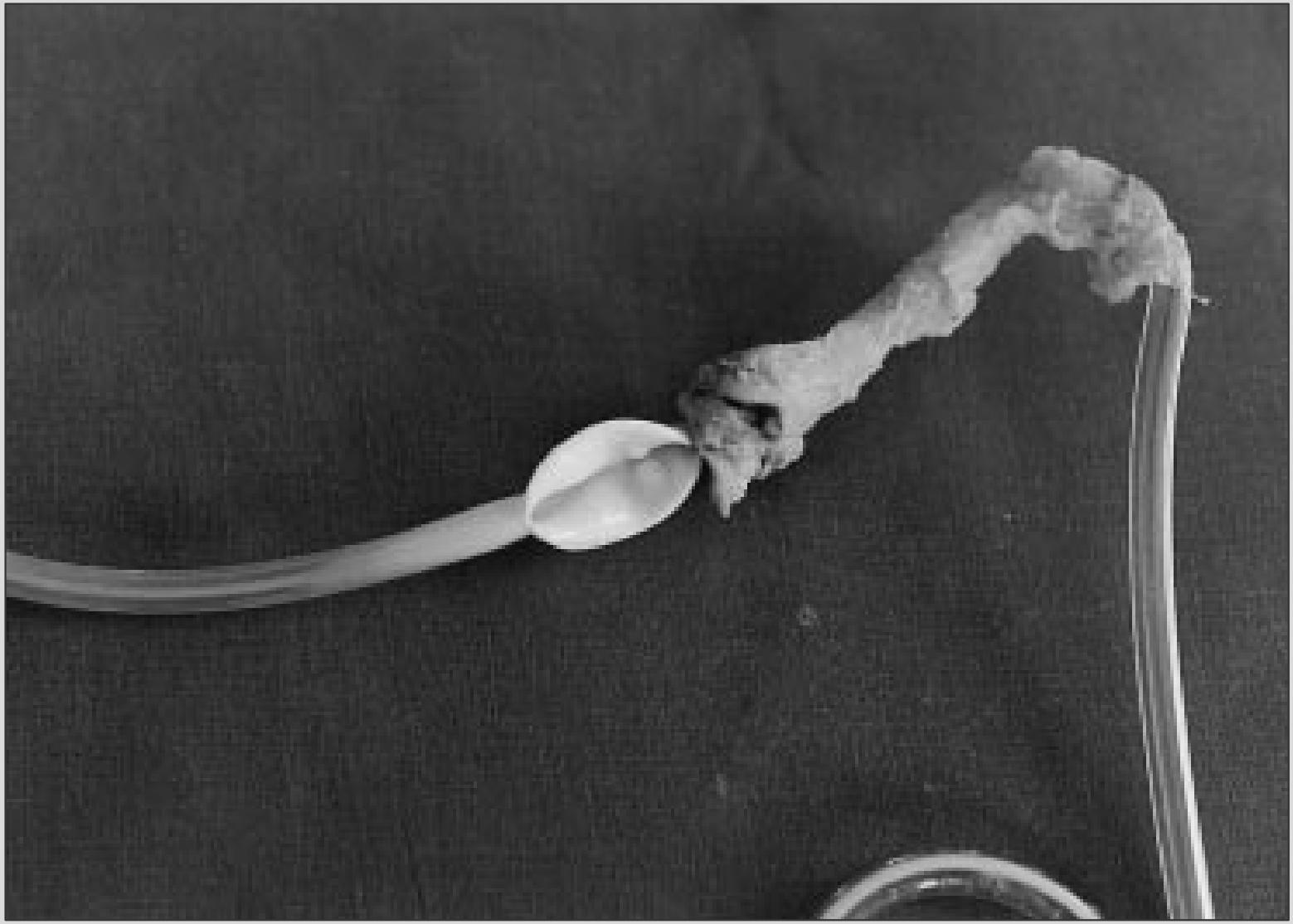
Catheter Materials

- Polyurethane- greater strength with thinner wall and larger internal diameter.

- ***Caution:*** exit- site antibiotics (e.g., mupirocin), polyethylene glycol, or alcohol may cause catheter damage:
  - Opacification
  - Leak and/or rupture

Ballooning and Rupture of Polyurethane Catheter

Riu et al. Nephrol Dial Transpl 13: 1870, 1998



Catheter Materials

- Silicone rubber is now used in most catheters - may be degraded after long term use of povidone iodine or iodine.

Double- Cuffed Catheters Have Long Been Preferred

- There is general consensus that double-cuffed catheters are to be preferred over a single cuff. This is presumably due to superior anchoring of the catheter provided by the second- superficial- cuff.
- Does the second cuff function as a microbiologic barrier?

Use of Double- Cuffed Catheters Reduces *Staph aureus* Peritonitis

Nessim SJ et al. Nephrol Dial Transpl 25:2310, 2010

- Retrospective review of Canadian Baxter Peritonitis Organisms Exit-sites Tunnel infections (POET) database 1996-2005
- 4247 incident patients; 2555 episodes of peritonitis
- 0.364 episodes of peritonitis per patient year at risk
- Data adjusted for age, gender, race, diabetes, cause of ESRD, prior RRT modality (if any), PD modality
- No data available regarding status of S. aureus nasal carriage or prophylactic antibiotic use (nares or exit-site)

Use of Double- Cuffed Catheters Reduces *Staph aureus* Peritonitis

Nessim SJ et al. Nephrol Dial Transpl 25:2310, 2010

	Total number of episodes	Rate ratio	95% CI	*P*-value
Gram positive	1334	0.80	0.69–0.92	0.002
Gram negative	480	1.18	0.94–1.49	0.15
Culture negative	560	1.04	0.84–1.28	0.75
CNS	701	0.86	0.71–1.04	0.12
S. aureus	190	0.46	0.33–0.64	<0.001
Streptococcus species	260	0.80	0.59–1.07	0.14

Overall, a significant decrease in *S. aureus* peritonitis…

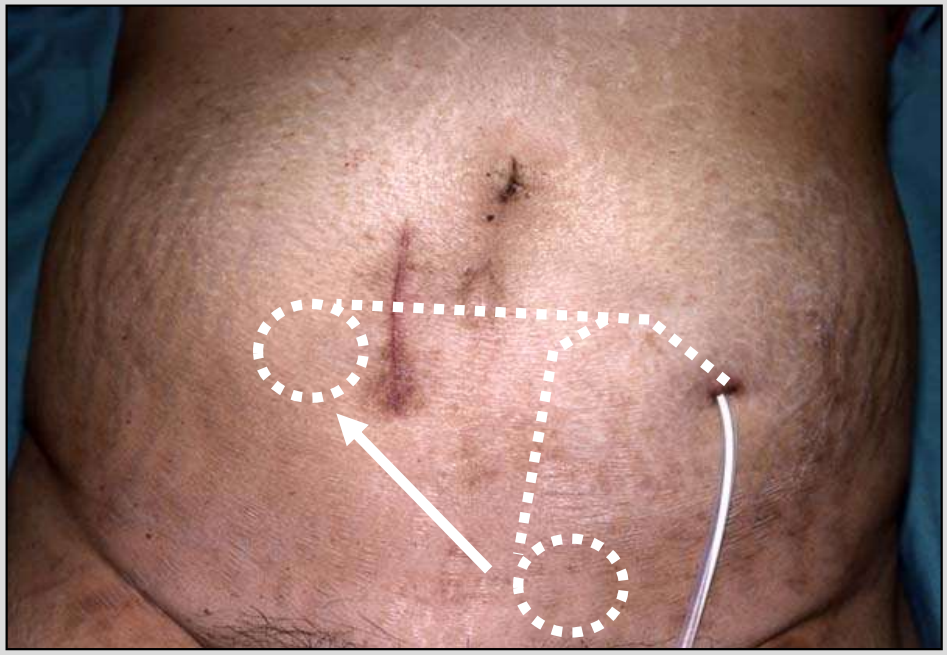
…but only prior to the year 2000. The subsequent lack of benefit may reflect overall improved exit-site care.

	Rate ratio (per decade increase in age)	95% CI	*P*-value
Overall (n = 4247 patients)	0.90	0.80–1.02	0.09
1996–2000 (n = 1494 patients)	0.82	0.71–0.96	0.01
2001–2005 (n = 2753 patients)	1.04	0.90–1.21	0.59

Importance of the Inter-cuff Segment

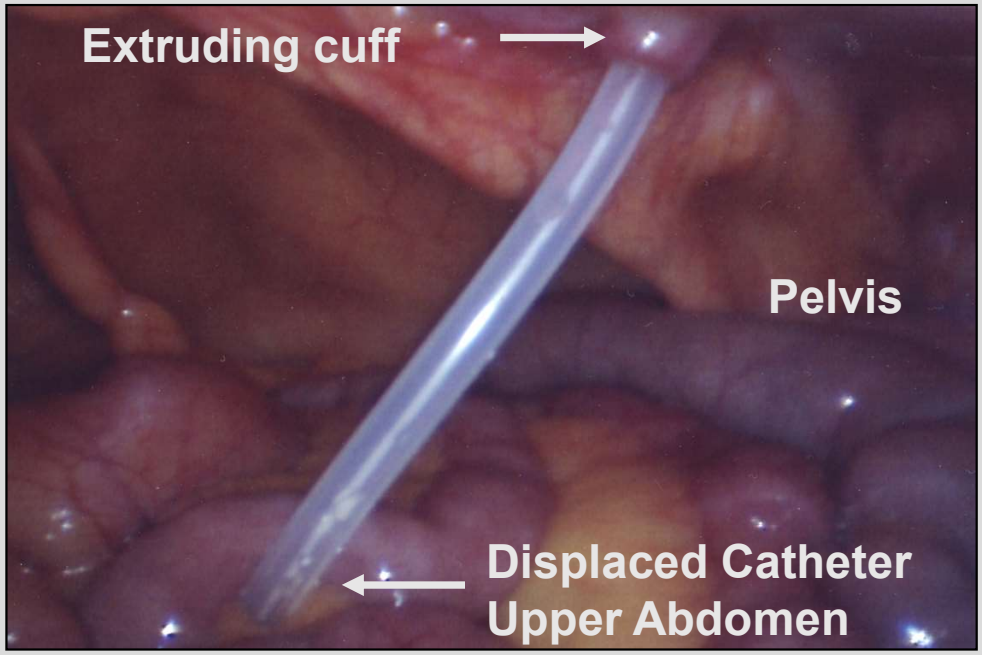
The PD catheter material has “memory”. Therefore, bending a straight inter-cuff segment may result in catheter straightening over time culminating in either migration of the catheter tip or extrusion of the external cuff.

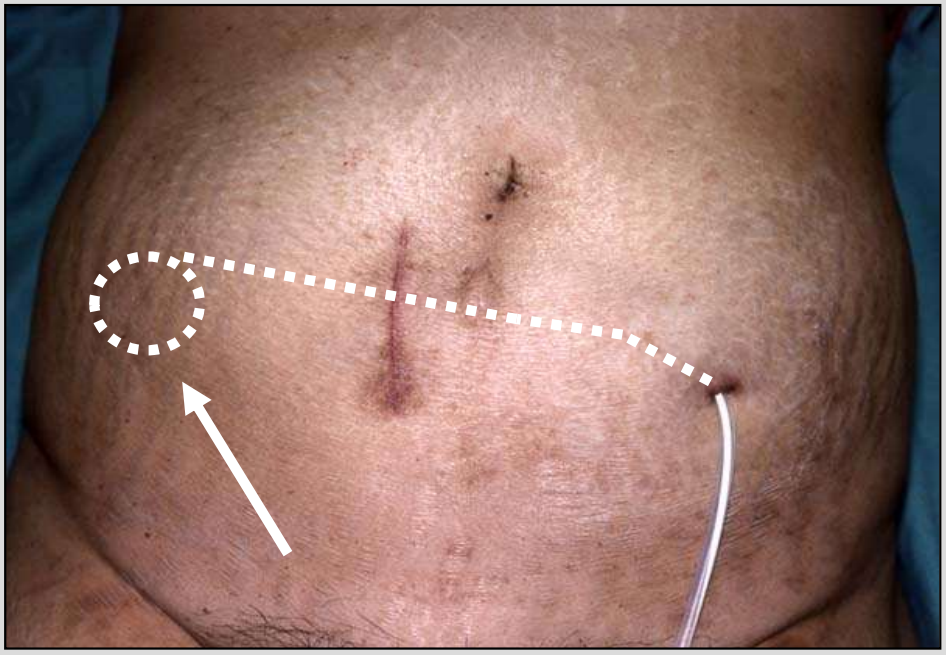
Catheter Tip Migration



Catheter tip migration from tubing shape memory and poor deep cuff fixation.

Catheter Tip Migration

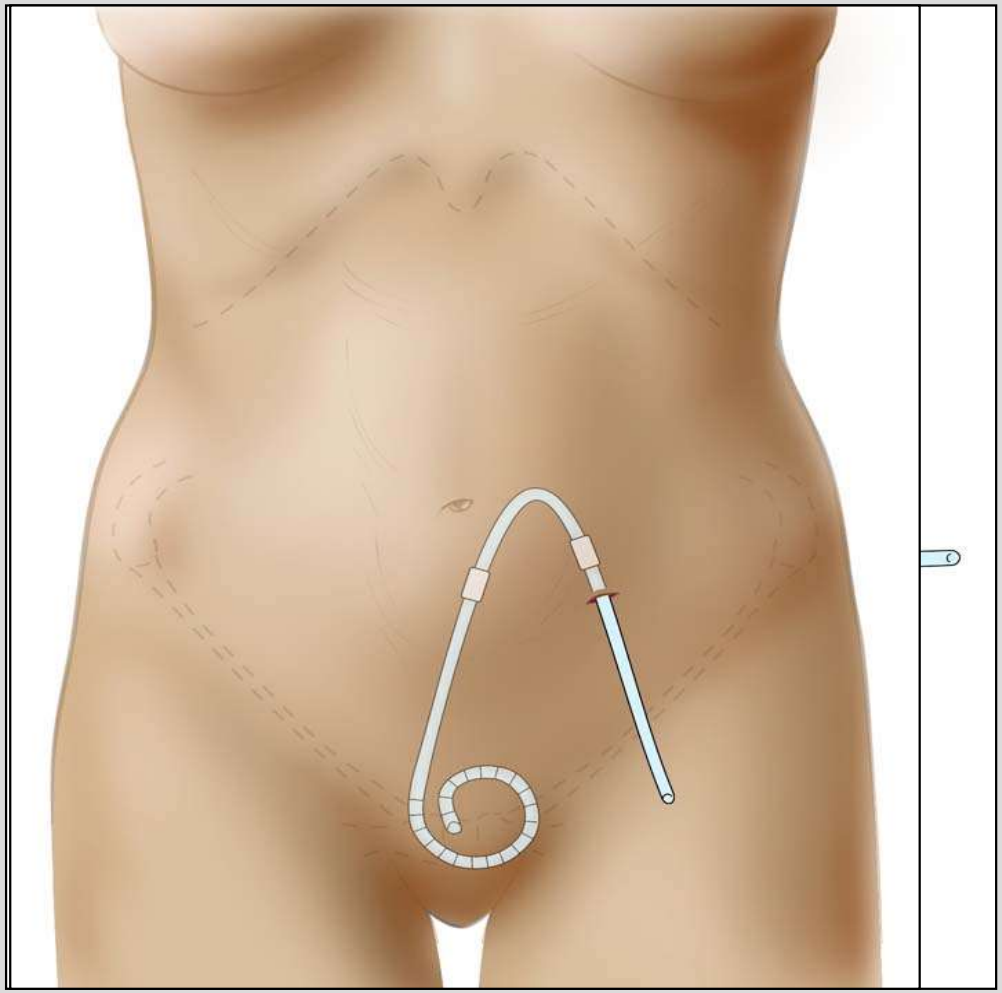




Catheter tip migration from tubing shape memory and poor deep cuff fixation.

Courtesy of Dr. John Crabtree

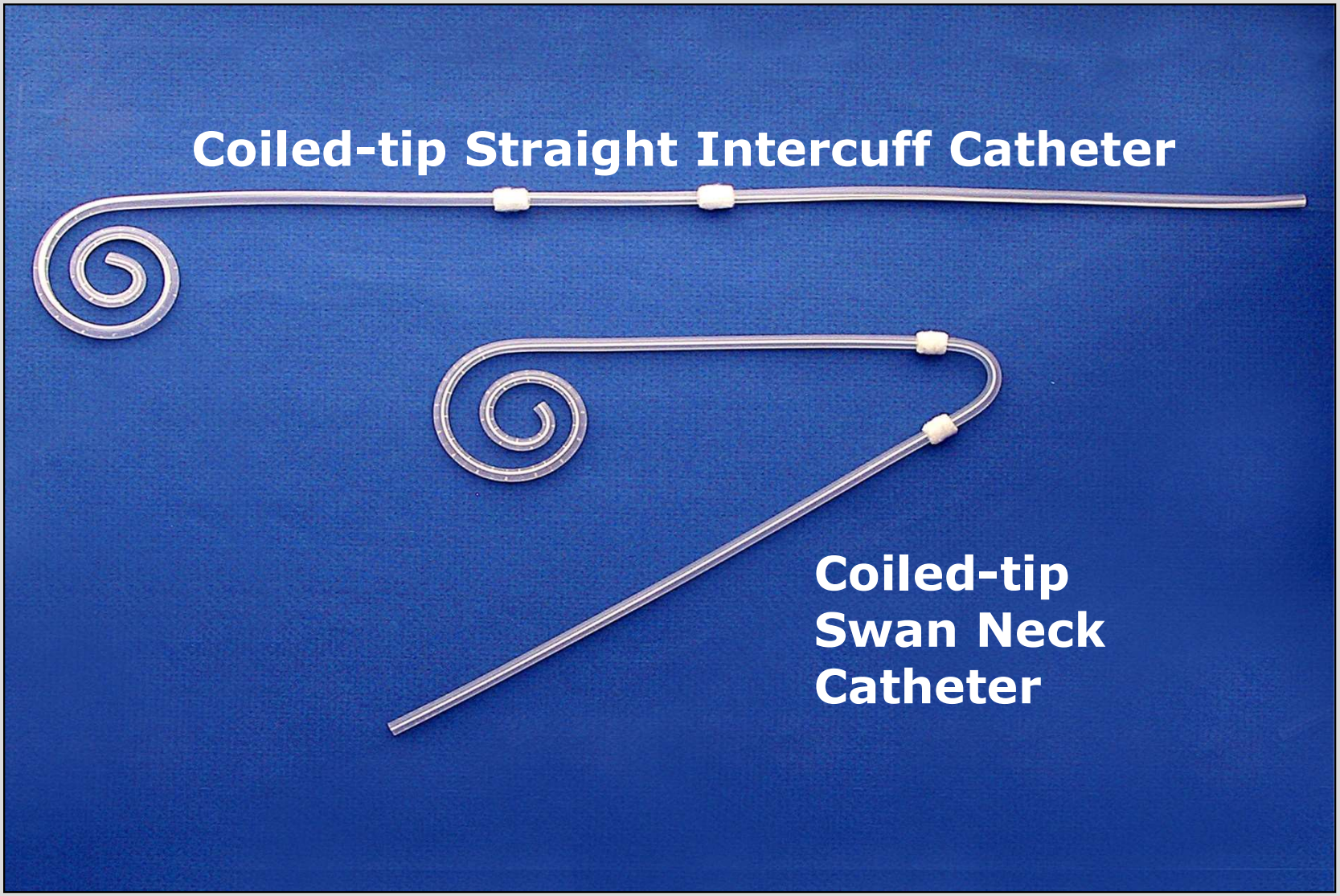
Superficial Cuff Extrusion



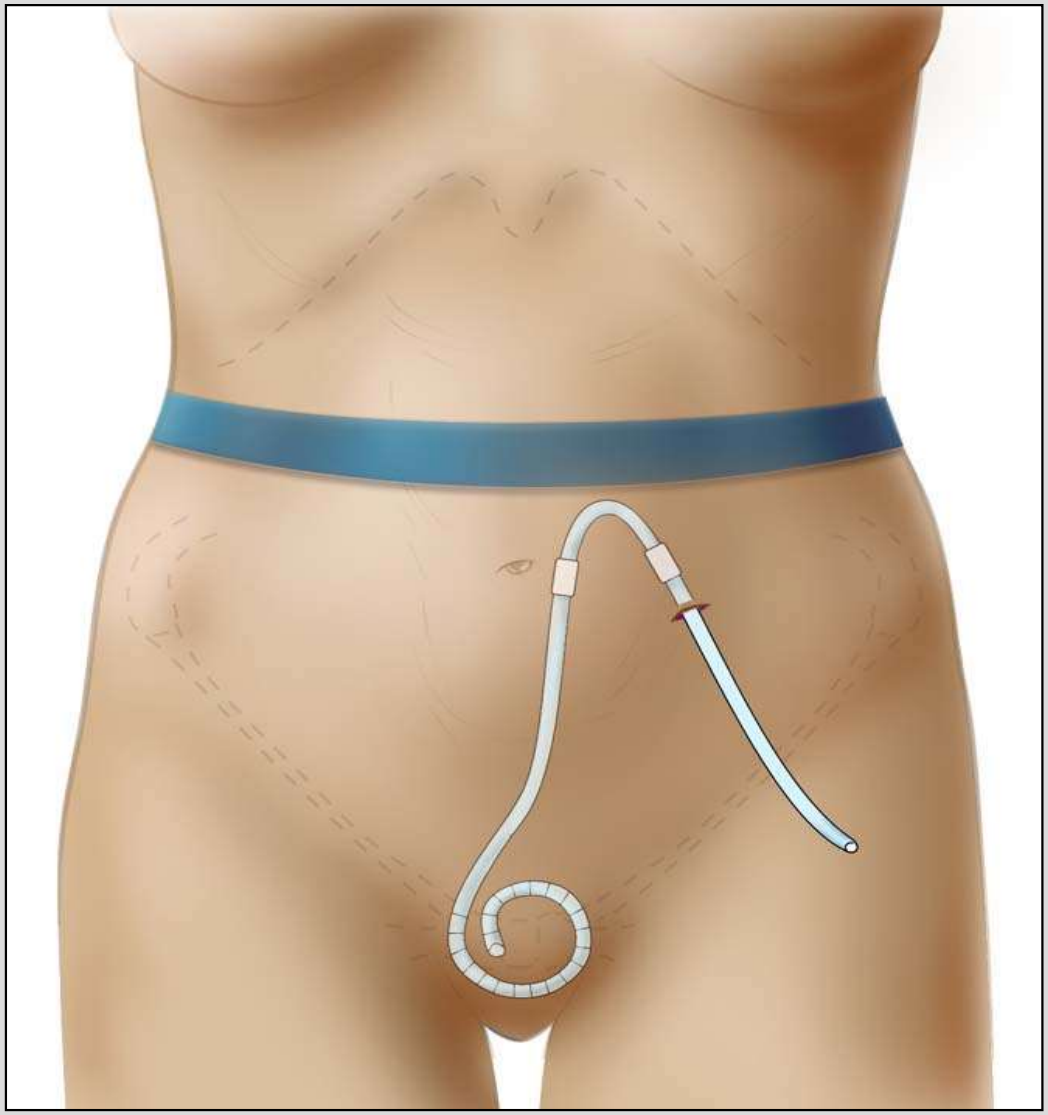
Can we modify the PD catheter to decrease catheter migration?

How?

Standard Abdominal Catheters



Catheters with a Fixed “Swan Neck” are Associated with Decreased Migration



Role of Catheter Neck Configuration in Decreasing Migration

Gadallah MF et al. Advances in Perit Dial 16: 47, 2000

- Retrospective examination of the frequency of catheter migration over a six year period in two large university- based PD populations.
- All patients had double-cuff coiled tip catheters
- 219 patients with straight segment between the cuffs; 243 with fixed “swan neck” bend

Role of Catheter Configuration in Decreasing Migration
Gadallah MF et al. Advances in Perit Dial 16: 47, 2000

	Straight	Swan-neck
Age (years)	49.3 ± 3.1	46.2 ± 1.9
Race (%: C/ AA/ L)	24/ 75/ 1	30/ 69/ 1
Sex (M/ F)	107: 136	103: 116
Body Weight (kg)	81.2 ± 4.3	77.5 ± 2.3
Percent Diabetic	33.7	33.8
Prior Abd. Surgery (%)	45.7	48.0
Number migrated	**33 / 243 (15%)**	**2 / 219 (1%)***

* p= 0.002; others NS

What about the Catheter Tip? Should it be Straight or Coiled?

- The increased bulk of the coiled catheter is felt to enhance catheter outflow by physically separating loops of bowel from one another.

- The curled configuration with numerous side-holes and the end-hole buried within the coil decreases inflow pain associated with the "jet" effect.

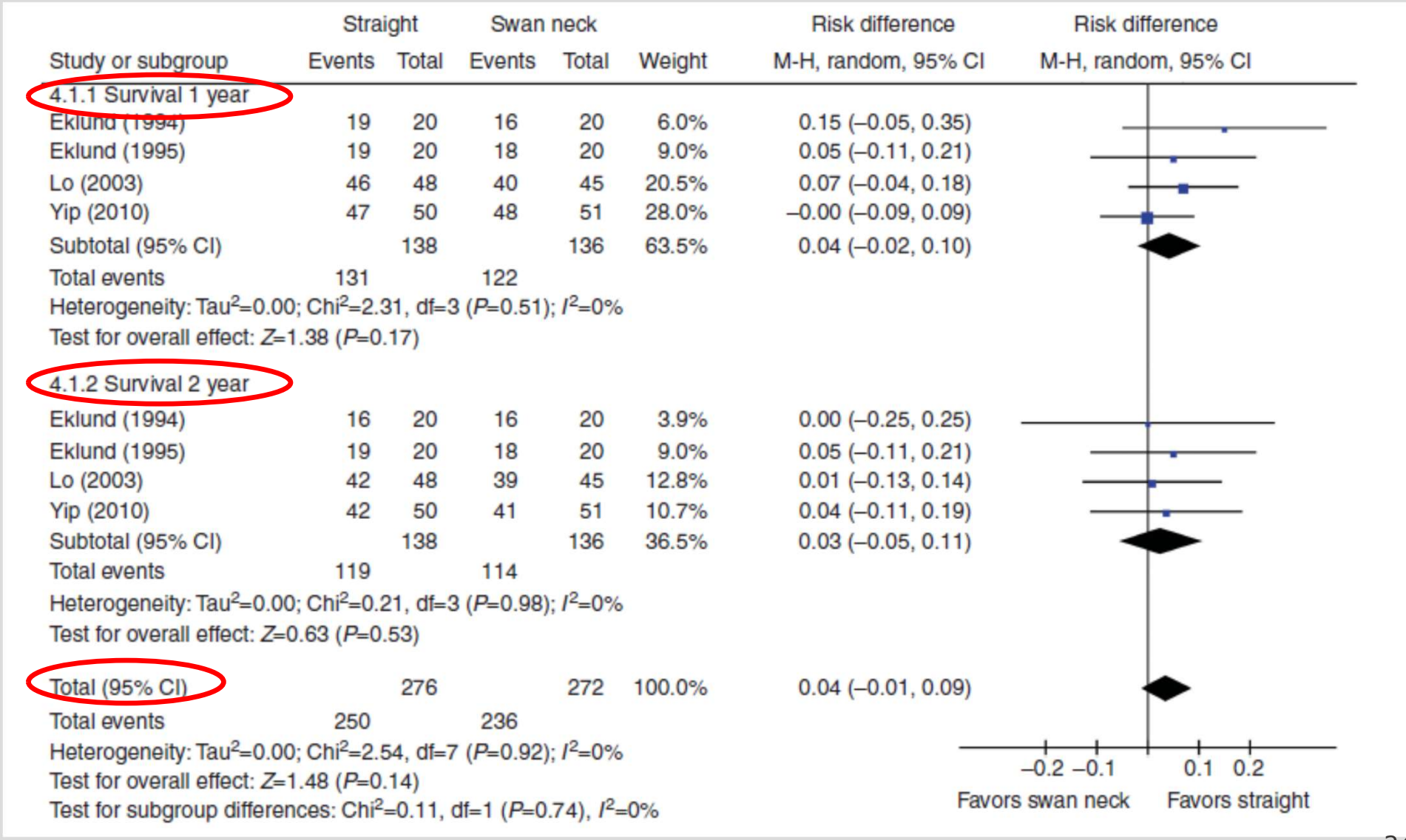
Crabtree JH. Kid Int 70: S27, 2006

"…nothing has been demonstrated to outperform the standard 2-cuff, coiled tip Tenckhoff catheter"

…with a Swan Neck.

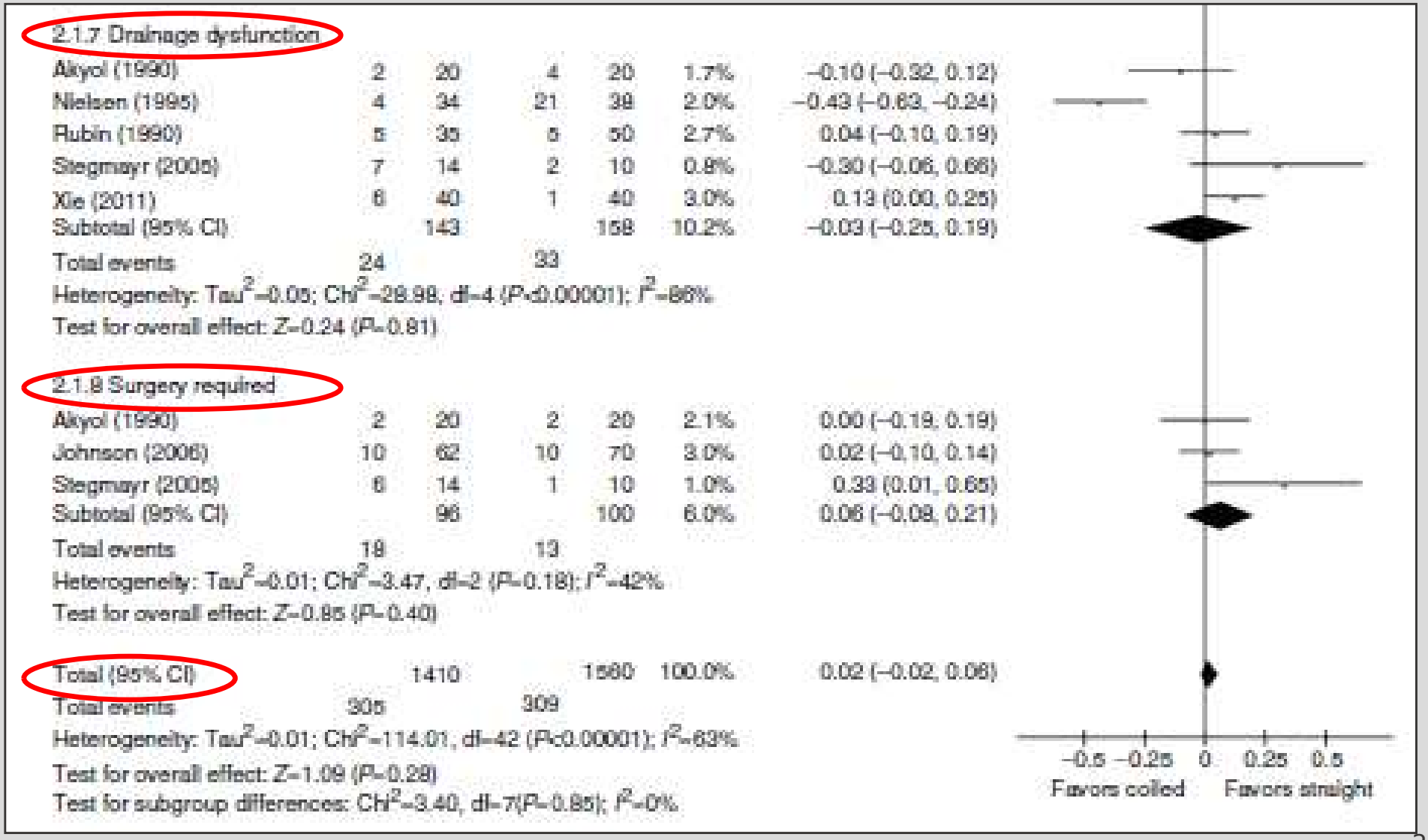
No Effect of Catheter Mid-section Morphology on Catheter Survival

Hagen SM et al. Kid Int 85:920, 2014



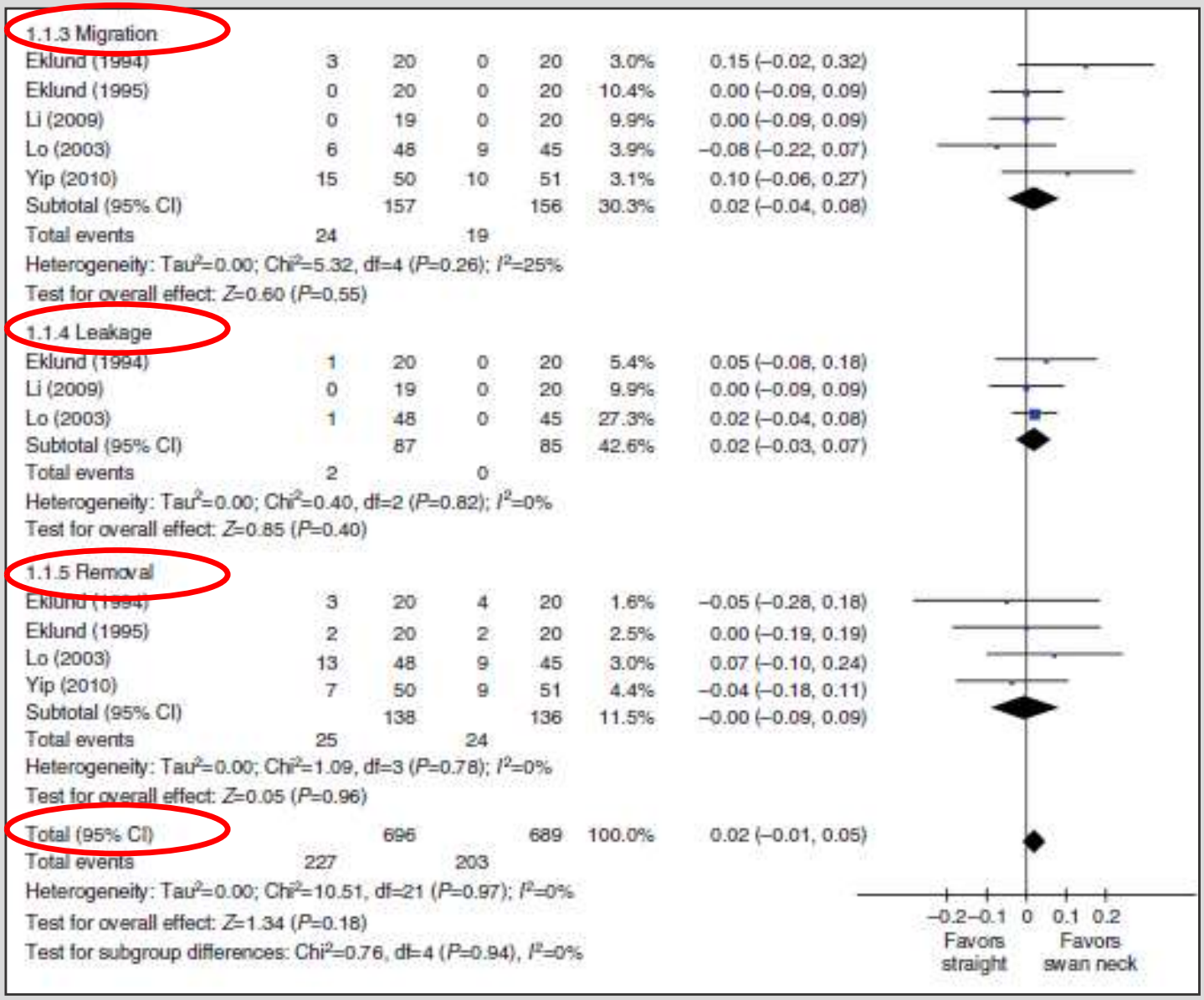
No Effect of Catheter Tip Morphology on Catheter Function- 1

Hagen SM et al. Kid Int 85:920, 2014



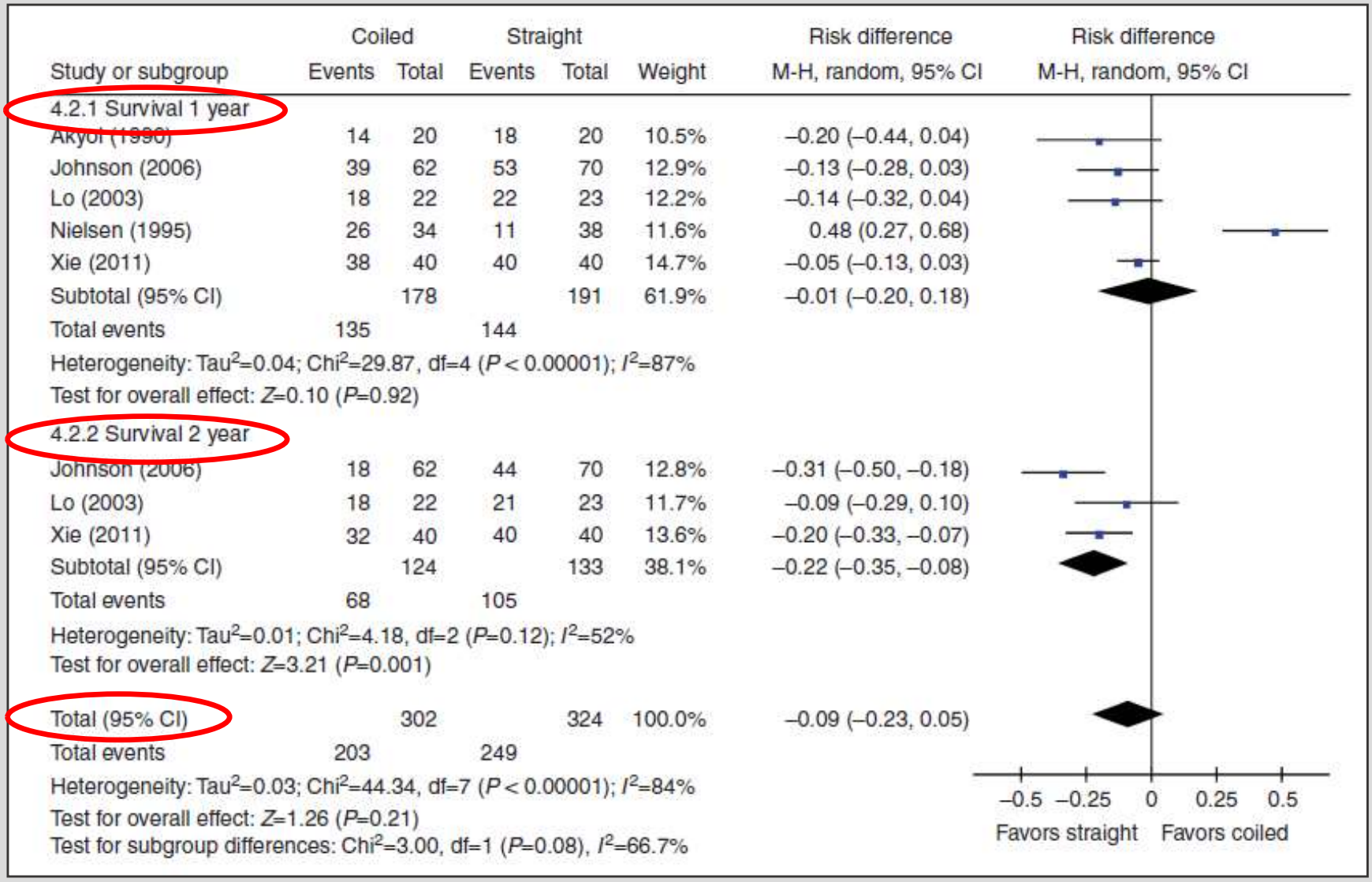
No Effect of Catheter Tip Morphology on Catheter Function- 2

Hagen SM et al. Kid Int 85:920, 2014



No Effect of Catheter Tip Morphology on Catheter Survival

Hagen SM et al. Kid Int 85:920, 2014



Study or subgroup	Coiled Events	Coiled Total	Straight Events	Straight Total	Weight	Risk difference M-H, random, 95% CI
4.2.1 Survival 1 year						
Akyol (1990)	14	20	18	20	10.5%	−0.20 (−0.44, 0.04)
Johnson (2006)	39	62	53	70	12.9%	−0.13 (−0.28, 0.03)
Lo (2003)	18	22	22	23	12.2%	−0.14 (−0.32, 0.04)
Nielsen (1995)	26	34	11	38	11.6%	0.48 (0.27, 0.68)
Xie (2011)	38	40	40	40	14.7%	−0.05 (−0.13, 0.03)
Subtotal (95% CI)		178		191	61.9%	−0.01 (−0.20, 0.18)
Total events	135		144			
Heterogeneity: Tau^2=0.04; Chi^2=29.87, df=4 ($P < 0.00001$); I^2=87%						
Test for overall effect: Z=0.10 (P=0.92)						
4.2.2 Survival 2 year						
Johnson (2006)	18	62	44	70	12.8%	−0.31 (−0.50, −0.18)
Lo (2003)	18	22	21	23	11.7%	−0.09 (−0.29, 0.10)
Xie (2011)	32	40	40	40	13.6%	−0.20 (−0.33, −0.07)
Subtotal (95% CI)		124		133	38.1%	−0.22 (−0.35, −0.08)
Total events	68		105			
Heterogeneity: Tau^2=0.01; Chi^2=4.18, df=2 (P=0.12); I^2=52%						
Test for overall effect: Z=3.21 (P=0.001)						
Total (95% CI)		302		324	100.0%	−0.09 (−0.23, 0.05)
Total events	203		249			
Heterogeneity: Tau^2=0.03; Chi^2=44.34, df=7 ($P < 0.00001$); I^2=84%						
Test for overall effect: Z=1.26 (P=0.21)						
Test for subgroup differences: Chi^2=3.00, df=1 (P=0.08), I^2=66.7%						

Summary

There is no demonstrable difference in outcomes whether the PD catheter has:

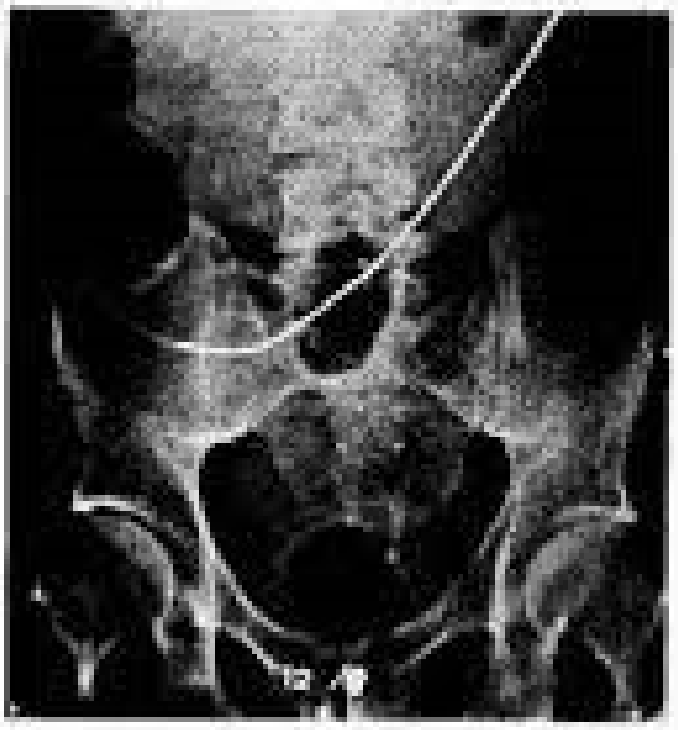
- A single cuff or two cuffs
- A straight inter-cuff segment or a swan neck
- A straight tip or a curled tip

Considerations Regarding Catheter Placement

- Position of catheter tip: iliac fossa vs. deep pelvis
- Insertion site: midline vs. lateral
- Direction of exit-site: up vs. down or lateral
- Location of exit-site: abdomen vs. chest
- Superficial Segment: externalized or embedded?
- Placement technique: closed, open, laparoscopic
- Operator: surgeon, interventionalist (IR or Renal)

Proper Catheter Tip Location

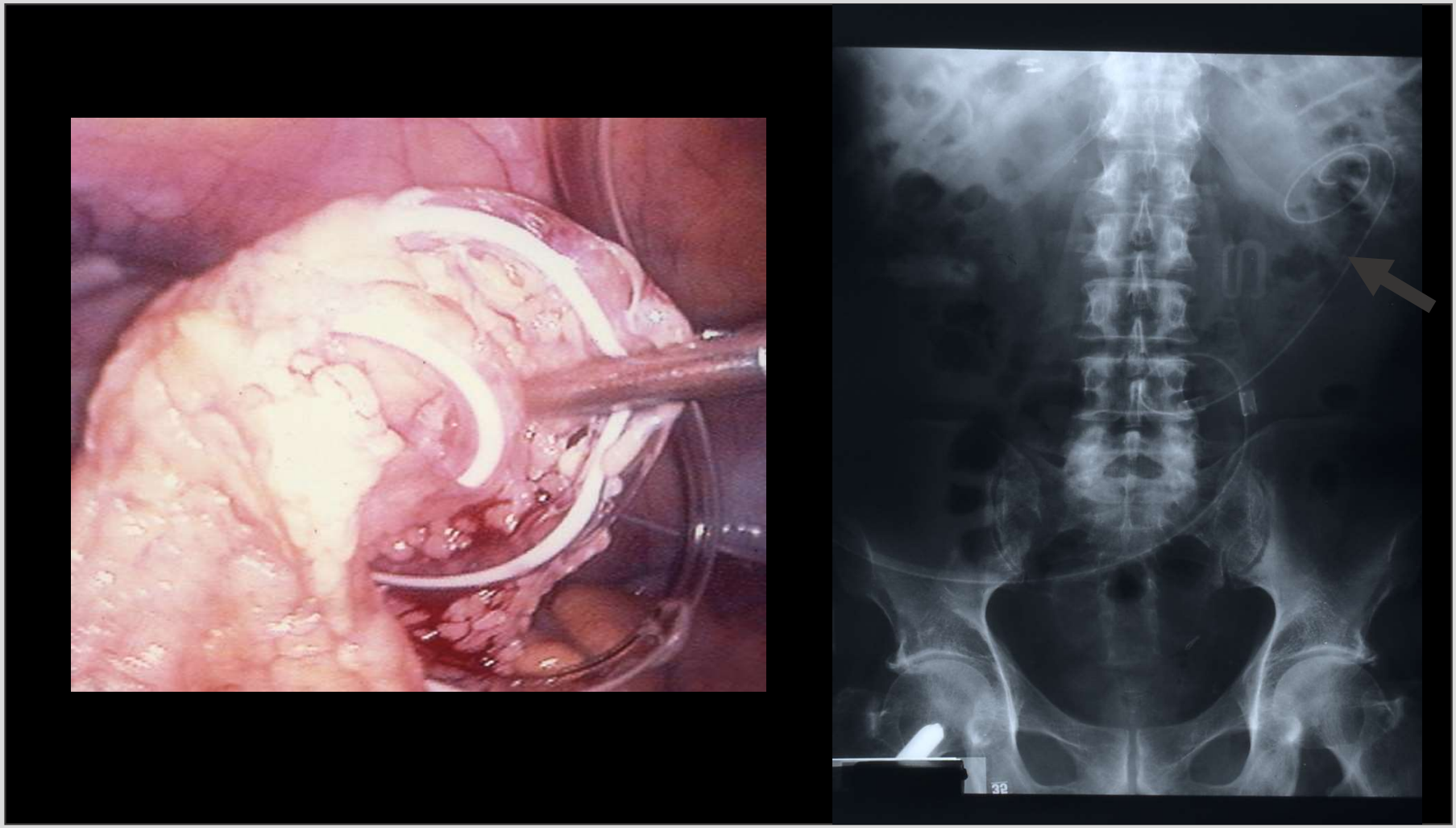
- The tip of the PD catheter should be in the true pelvis, not in the false (minor) pelvis overlying the iliac wings.



Proper Catheter Tip Location

- It should not be in the upper abdomen; that is associated with:
  - Difficulty with outflow
  - Risk of entrapment in omentum

Omental Wrap with Displacement



Courtesy of Dr. John Crabtree

Proper Catheter Tip Location

- Placement in the left pelvis is preferred (modestly) as peristalsis will tend to keep the catheter directed downward rather than move it upward, as may occur on the right side.

A 54-Year-Old Woman with Poor Outflow and Drain Pain (649321)

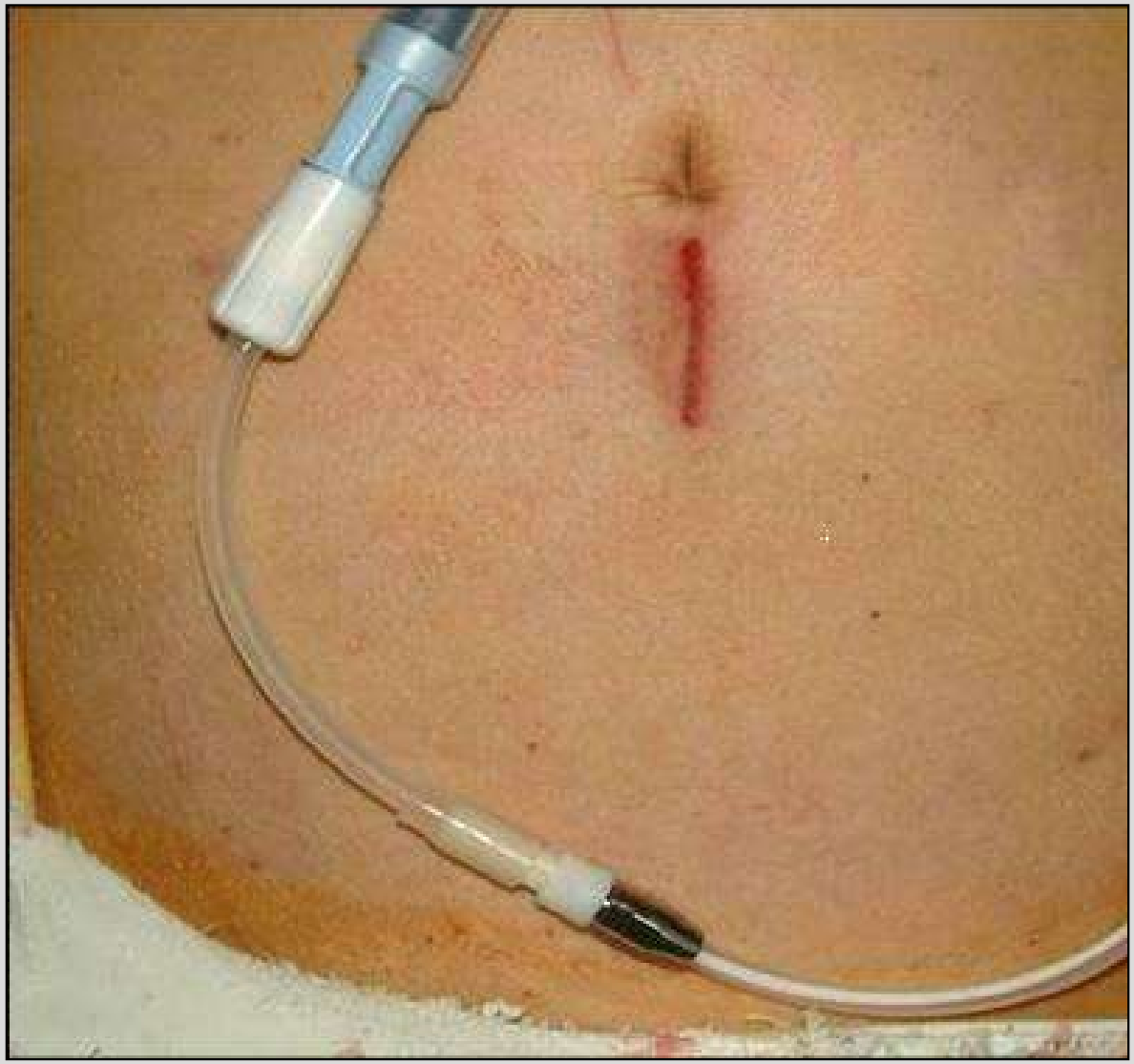
10/24/11

“Spontaneous” Repositioning of PD Catheter with Lactulose

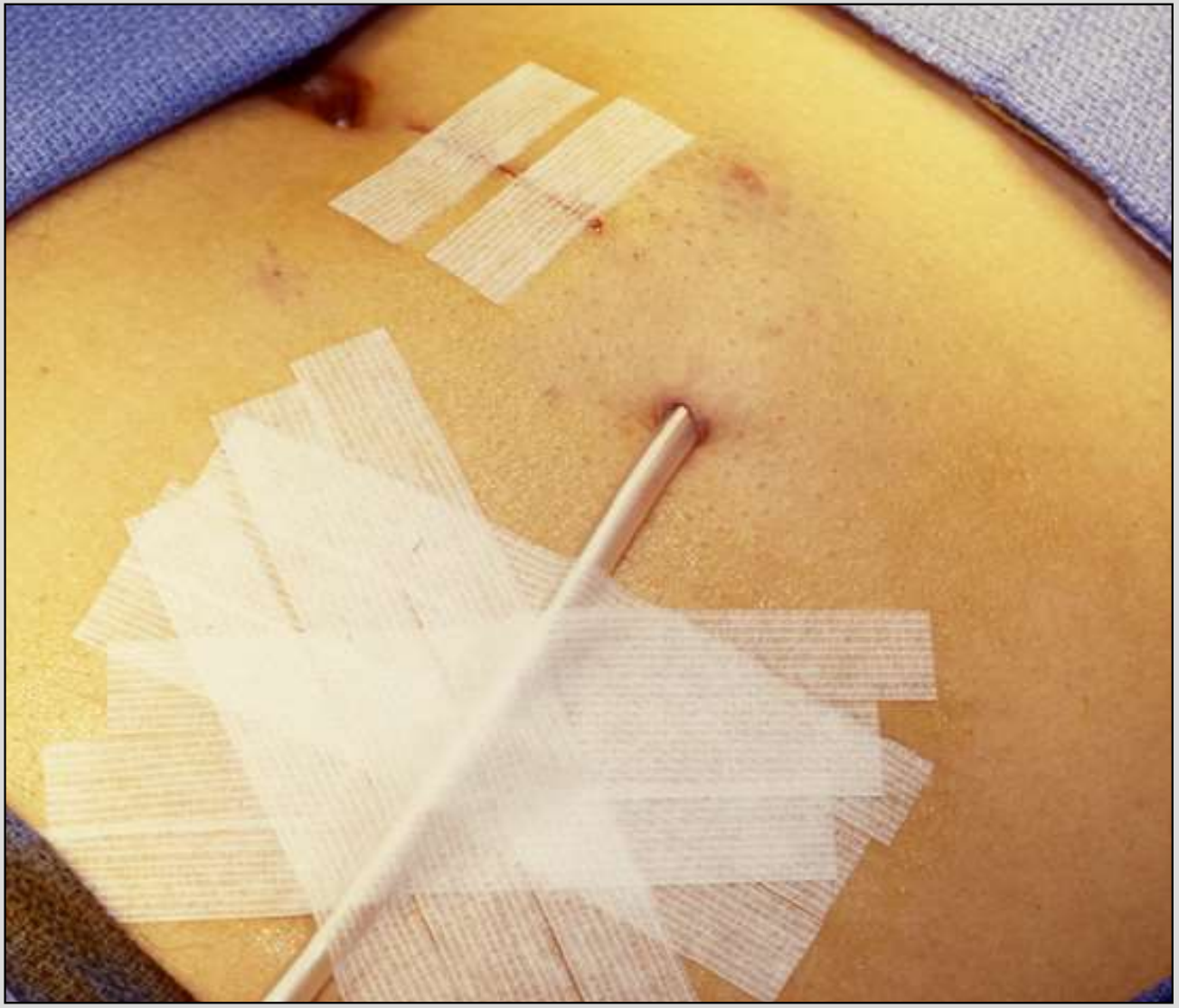
10/27/11

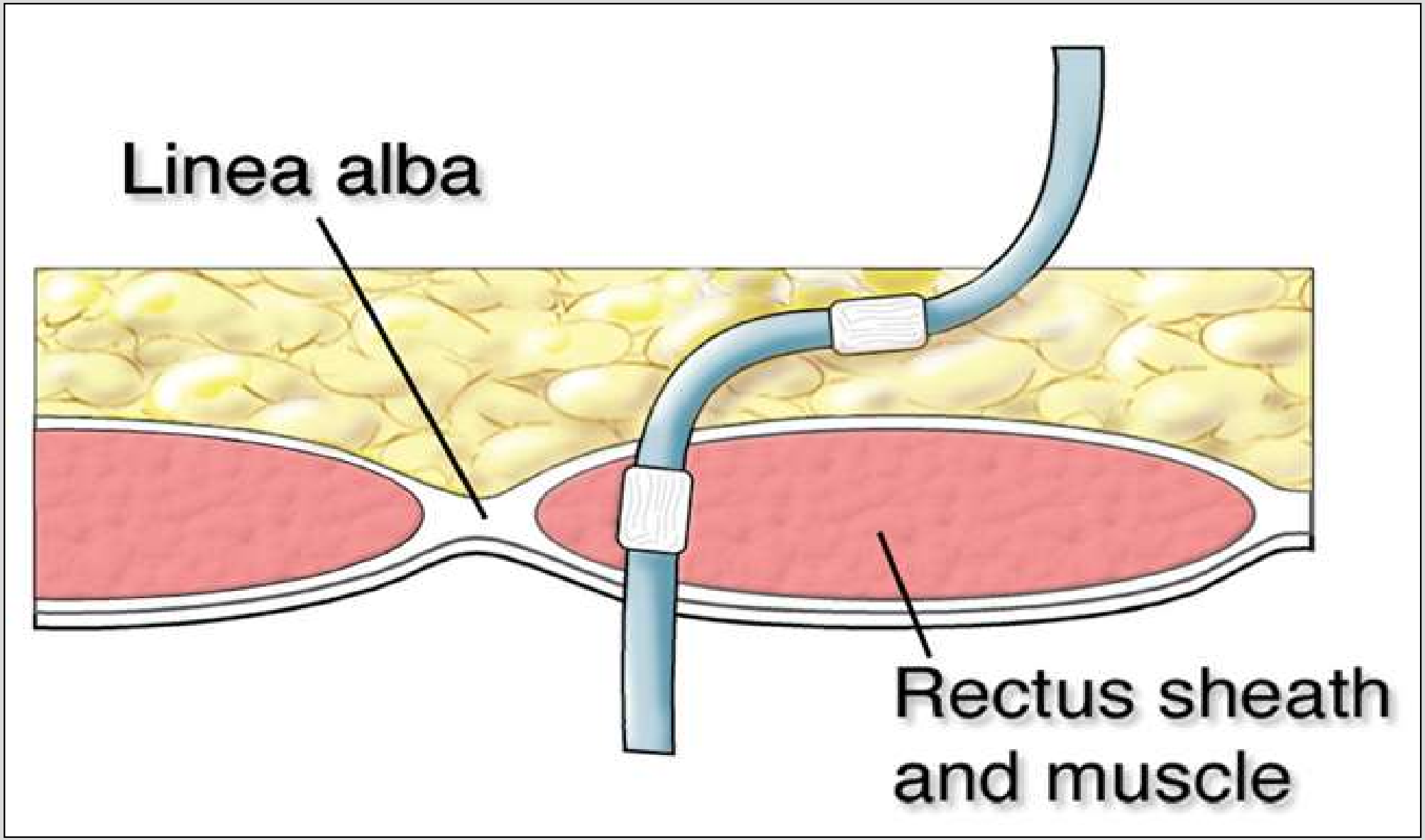
- After lactulose
- No pain; good outflow

Avoid Midline Insertion…

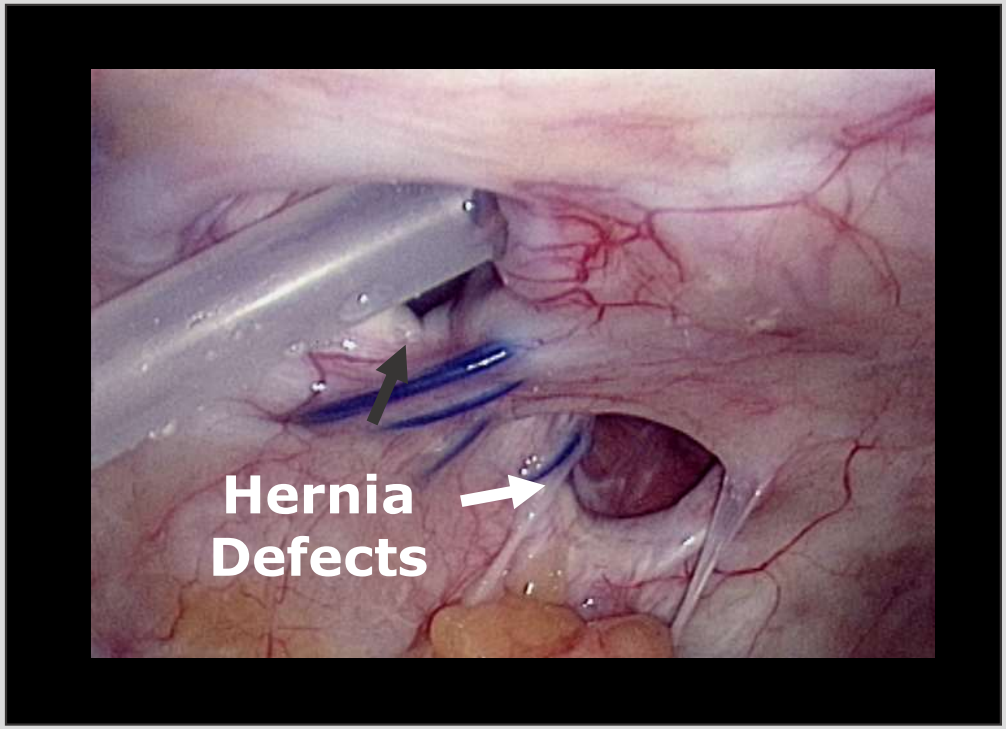


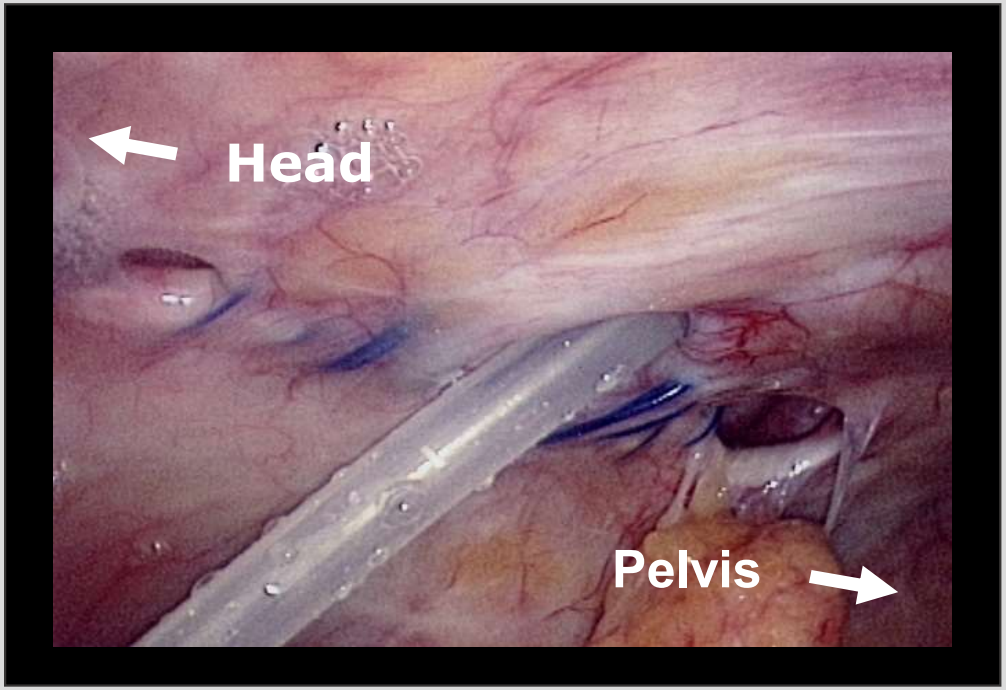
…Rather, Place the Catheter Lateral to the Midline, Through the Rectus Muscle




Linea alba
Rectus sheath
and muscle

Midline Insertion with Pericatheter Leak, Hernia, and Catheter Migration

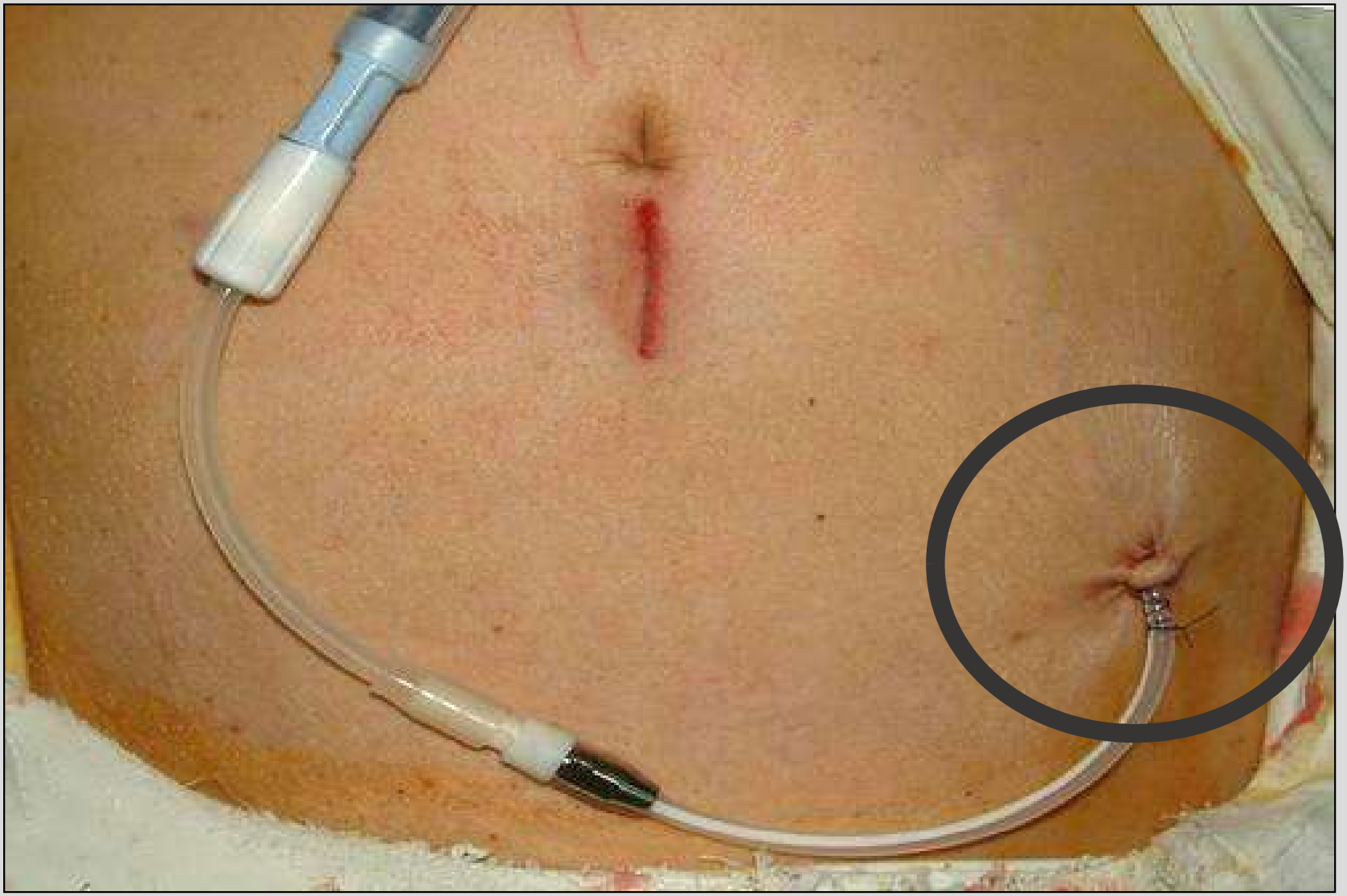




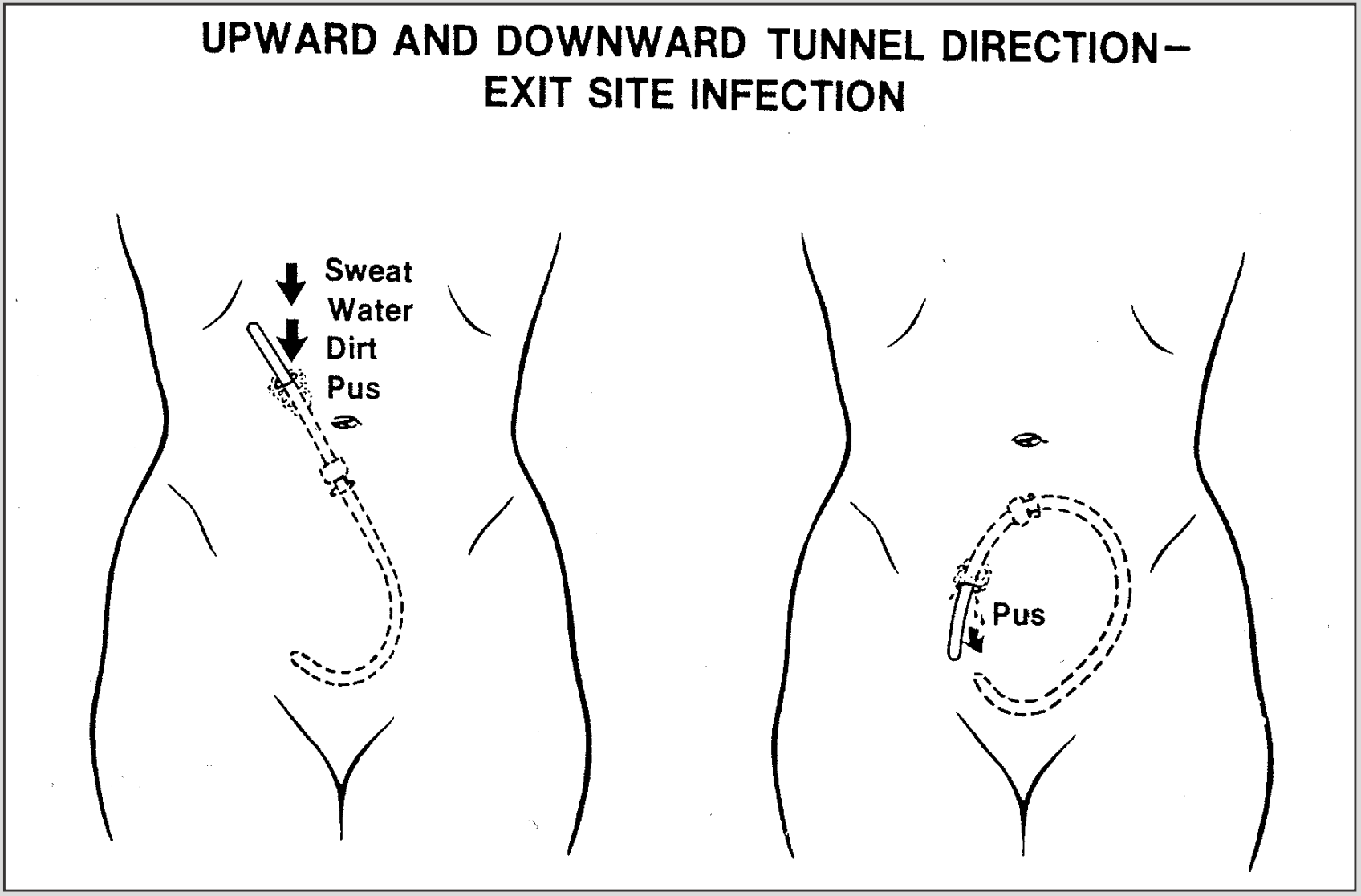
The Exit-Site is of Paramount Importance

- Wound Closure
- Orientation
- Location

Do Not Place an Anchoring Stitch at the Exit- Site…Use Steri- Strips



Never Create an Upwardly Directed Exit-Site



Laterally Directed and Downwardly Directed Exit-Sites Have Comparable Outcomes

Crabtree JH and Burchette R. Perit Dial Int 26:677, 2006

n= 85 **n= 93**

Results of Poisson Regression Comparing Event Rates Between Catheter Groups with Downward and Lateral Exit-Site Directions

Event	Downward exit site (episodes/patient-year)	Lateral exit site (episodes/patient-year)	Poisson regression (*p* value)
Exit-site infection	0.26	0.27	0.86
Tunnel infection	0.02	0.03	0.79
Peritonitis	0.42	0.43	0.87
Catheter loss	0.06	0.09	0.29

Whether directed inferiorly or laterally, be sure that the exit-site is at least 2 cm from the external cuff.

The Exit-Site is Prime Real Estate…

Location, Location, Location

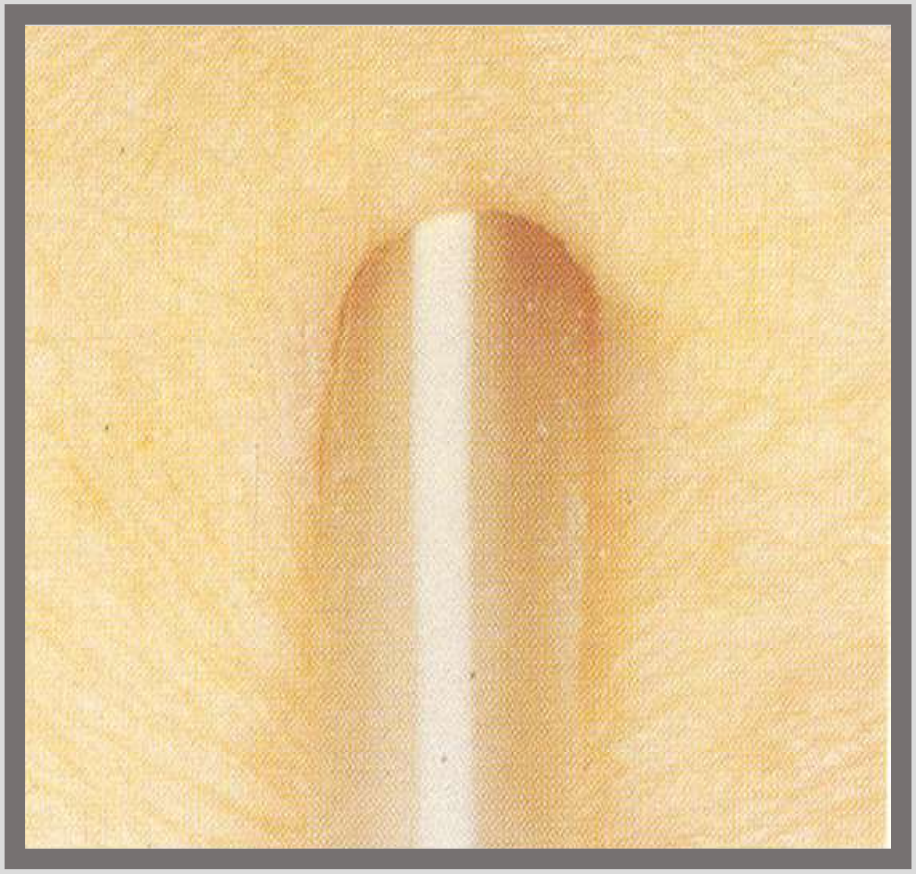
Principles Guiding Exit-site Location

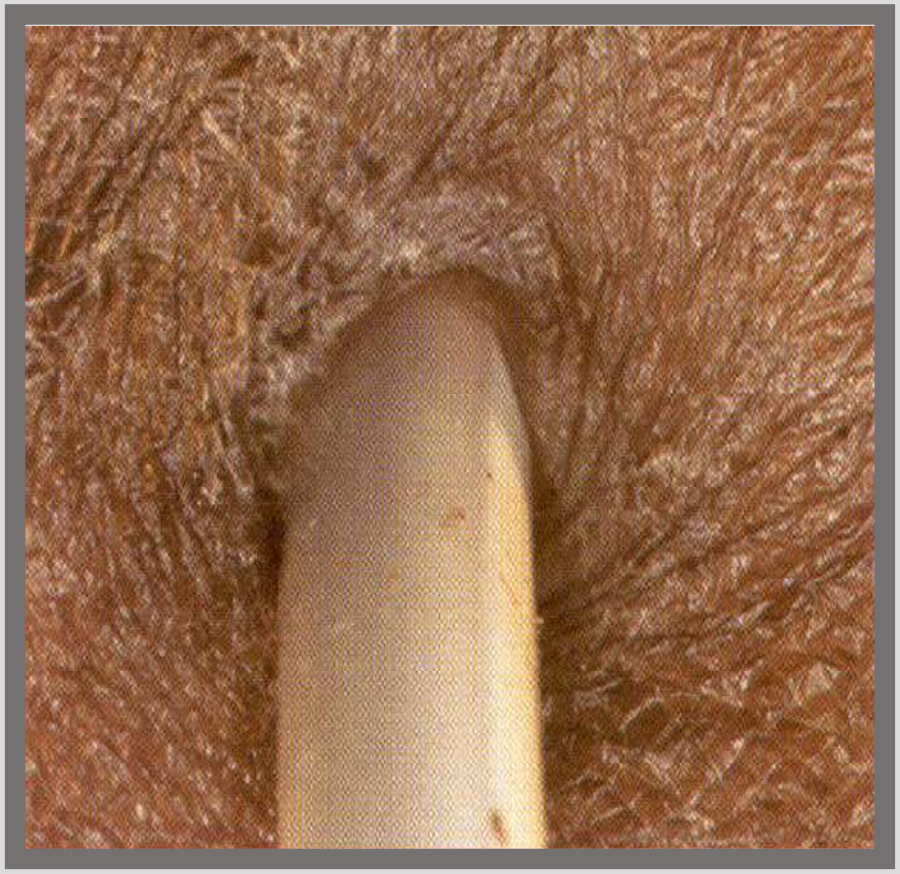
- Patient must be able to see it to provide proper care.
- Minimize stress on tubing within the abdominal wall.
- Avoid belt line, skin folds/ creases.
- Exit- site should be at least 2 cm distal to the superficial cuff.
- Plan location with the patient upright.

Remember, The Patient Must Be Able to Perform Exit-Site Care

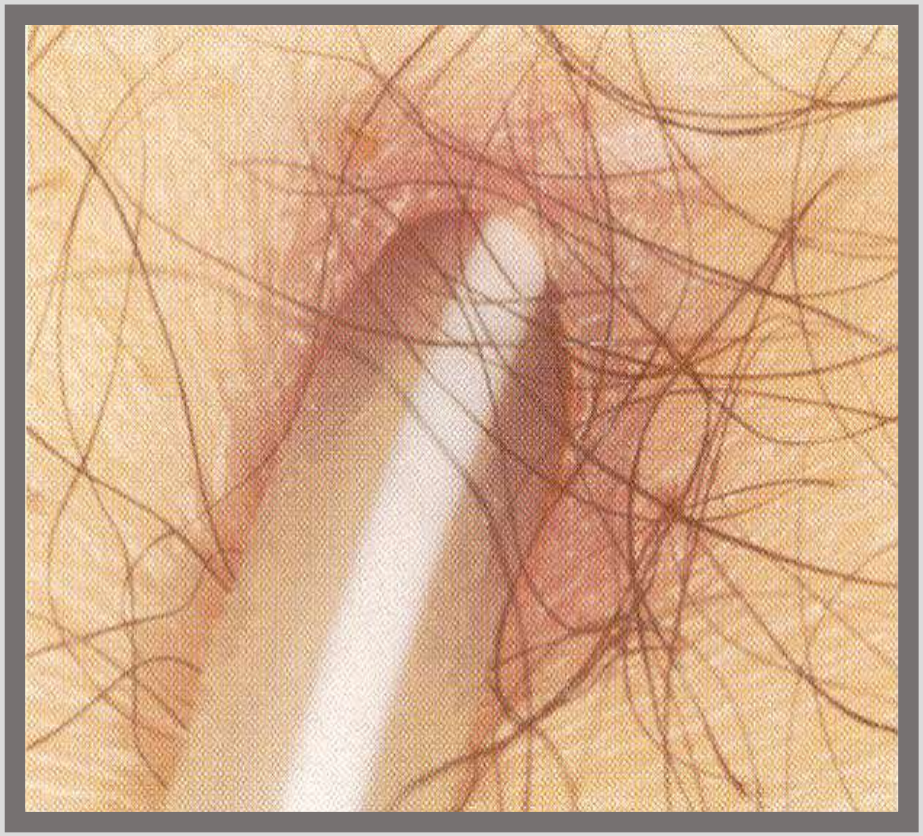
Exit-Site Infections in PD

Healthy Exit Sites



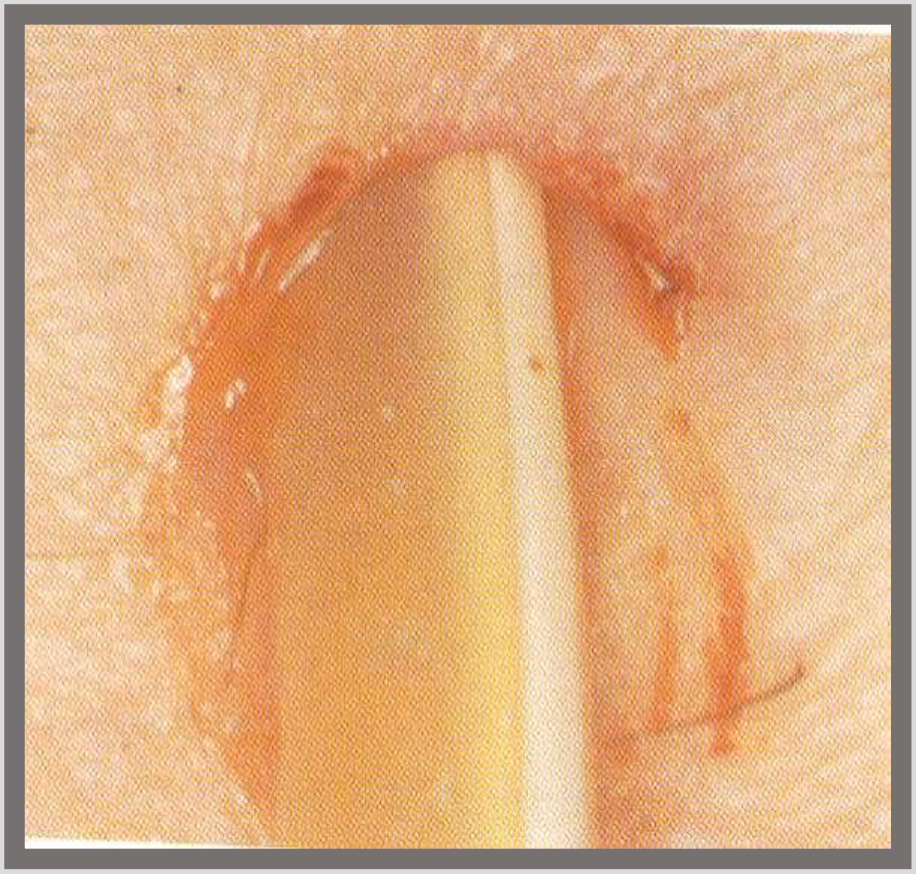


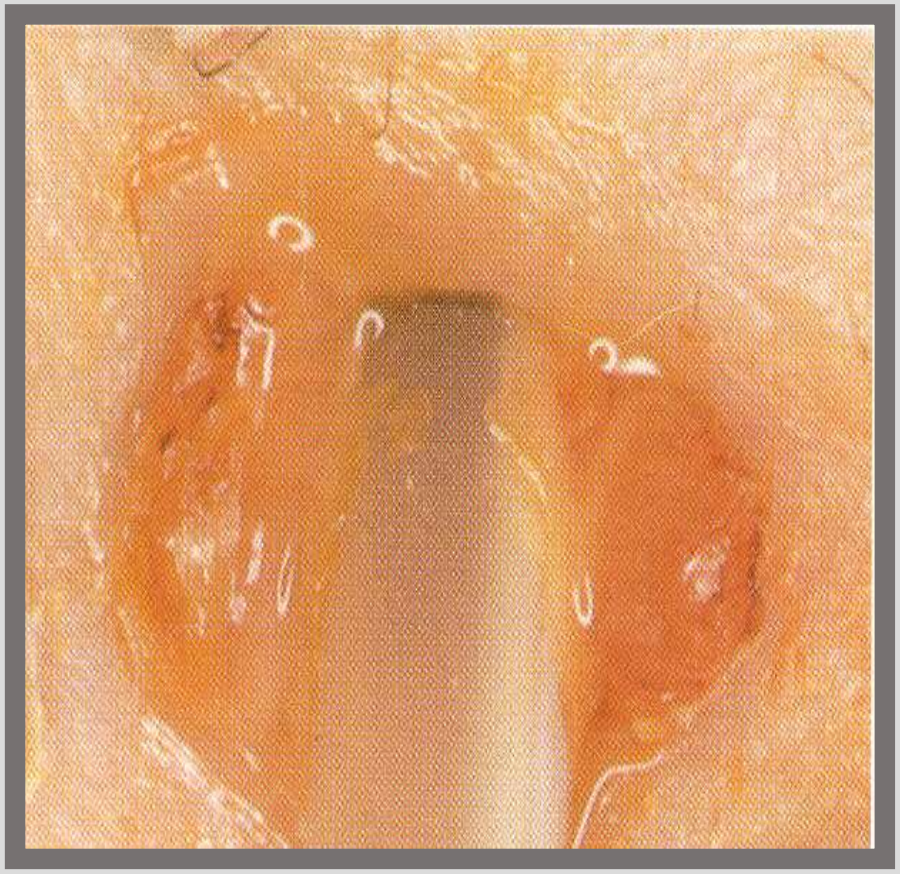
Normal Variant



Infected Exit Site

Acute Exit Site Infection



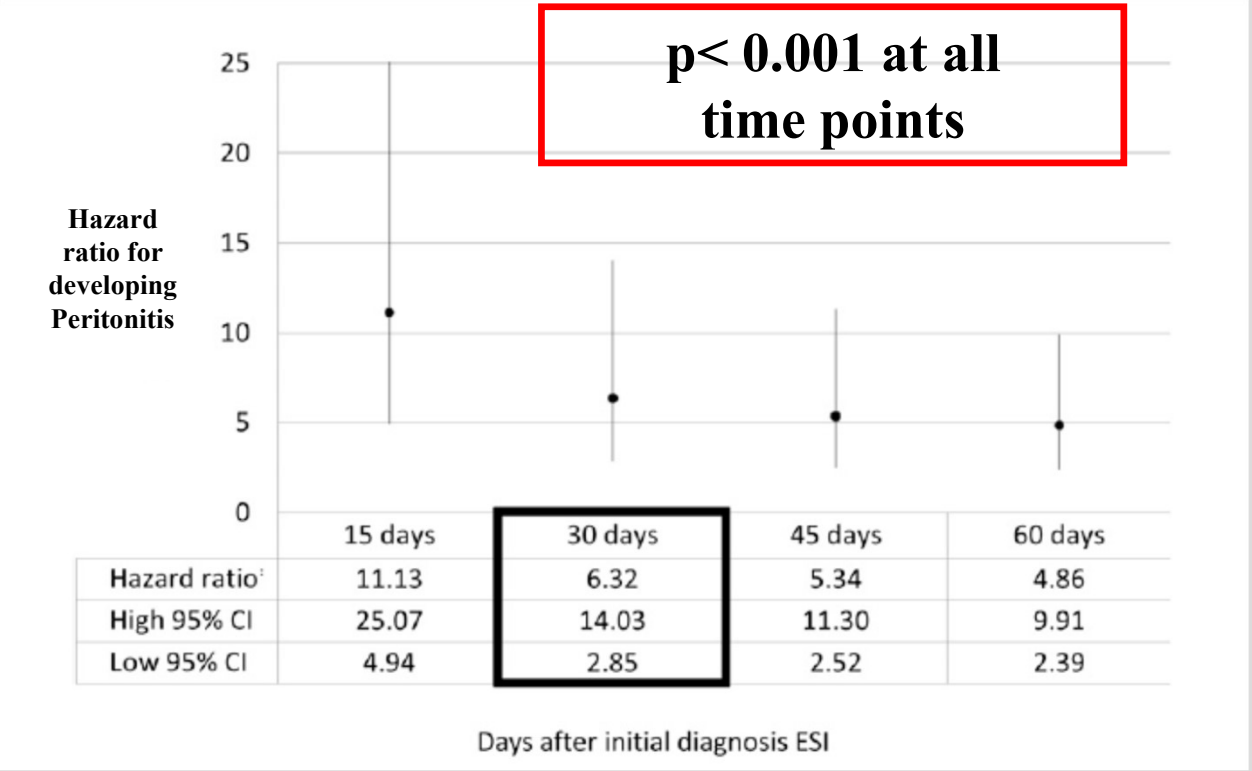


Chronic Exit-site Infection due to Partially Extruded Distal Cuff

ESI is a Risk for Subsequent Peritonitis

van Diepen ATN et al. Clin J Am Soc Nephrol 7:1266, 2012

- PD catheter-related infections are a major predisposing factor to PD-related peritonitis.
- The primary objective of preventing and treating catheter-related infections is to prevent peritonitis.

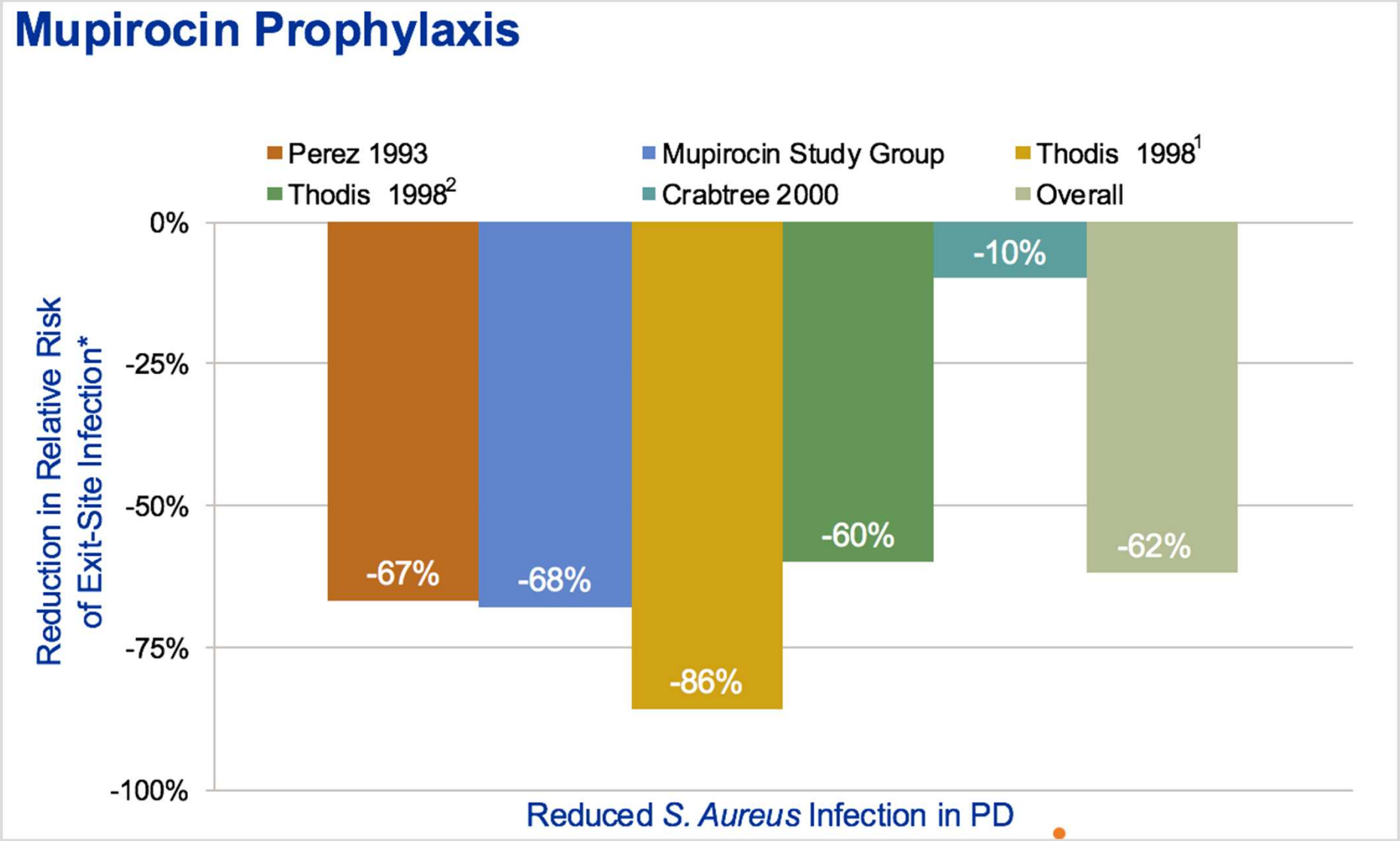


	15 days	30 days	45 days	60 days
Hazard ratio	11.13	6.32	5.34	4.86
High 95% CI	25.07	14.03	11.30	9.91
Low 95% CI	4.94	2.85	2.52	2.39

Preventing Catheter- Related Infections
Szeto CC et al. Perit Dial Int 37:141, 2017

We recommend daily topical application of antibiotic cream or ointment to the catheter exit site (1A).

Topical Application of Mupirocin Lowers the Rate of ESI



Gentamicin *vs.* Mupirocin
Bernardini J et al. J Am Soc Nephrol 16:539, 2005

- Significantly Lower Rate of Gm + and Gm - exit-site infection (ESI) with Gentamicin (0.23 vs. 0.54 per patient-year)
- Same rate of S. aureus ESI between groups
- No Pseudomonas aeruginosa ESI
- Lower rate of peritonitis with Gentamicin: 0.34/yr vs. 0.52/yr (p=0.03)
    - Reduced Gm neg peritonitis (1 vs. 8)
    - No P. aeruginosa peritonitis (0 vs. 2)

Topical Agents for the Prevention of Catheter- Related Infection

- Povidone- iodine
- Chlorhexidine
- Na Hypochlorite
- Polyhexanide
- Antibacterial honey
- Mupirocin cream
- Gentamicin cream or ointment
- Ciprofloxacin otologic solution
- Polysporin triple ointment

Preventing Catheter- Related Infections
Szeto CC et al. Perit Dial Int 37:141, 2017

We suggest that no cleansing agent has been shown to be superior with respect to preventing catheter-related infections (2B).

Assessment of the Exit Site

Twardowski and Prowant, 1996 Perit Dial Int Vol 16, Supplement 3

- Visual inspection of the exit site and sinus (using magnification ??) with good lighting should be part of the routine physical exam of all PD patients.
- Palpate the tunnel, especially the cuff.
- Gently press on the external cuff in an effort to express exudate externally.

Treatment of Exit Site Infections - 1

- Start empiric therapy promptly; culture if possible
- Most serious and common exit-site pathogens are Staph aureus and Pseudomonas aeruginosa
- Oral antibiotics generally recommended for at least 2 weeks
- Empiric antibiotics should cover Staph aureus

Oral Antibiotics for Exit- Site or Tunnel Infections

Szeto CC et al. Perit Dial Int 37:141, 2017

Amoxicillin	250–500 mg BD (182)
Amoxicillin/clavulanate	875 mg/125 mg BD (183)
Cephalexin	500 mg BD to TID (86)
Ciprofloxacin	250 mg BD (164) or 500 mg daily (184)
Clarithromycin	500 mg loading, then 250 mg BD (165)
Clindamycin	300–450 mg TID (185)
Cloxacillin/flucloxacillin	500 mg QID (186)
Erythromycin	250 mg QID (187)
Fluconazole	oral 200 mg loading, then 50–100 mg daily (188)
Levofloxacin	300 mg daily (189)
Linezolid	300–450 mg BD (190–192)
Metronidazole	400 mg TID (193)
Moxifloxacin	400 mg daily (194)
Rifampicin	450 mg daily for BW <50 kg; 600 mg daily for BW ≥50 kg (144,145)
Trimethoprim/ sulfamethoxazole	80 mg/400 mg daily (8) to 160 mg/800 mg BD (195)

Treatment of Exit Site Infections due to Pseudomonas

- Pseudomonas ESI need prolonged Rx for at least 3 weeks- perhaps even longer- usually with 2 antibiotics
  - Quinolones to be taken at least 2 hours apart from phosphate binders
  - For recurrent pseudomonas consider IP Rx (+/- catheter exchange)

Exit Site and Tunnel Infections in PD: When to Remove the Catheter

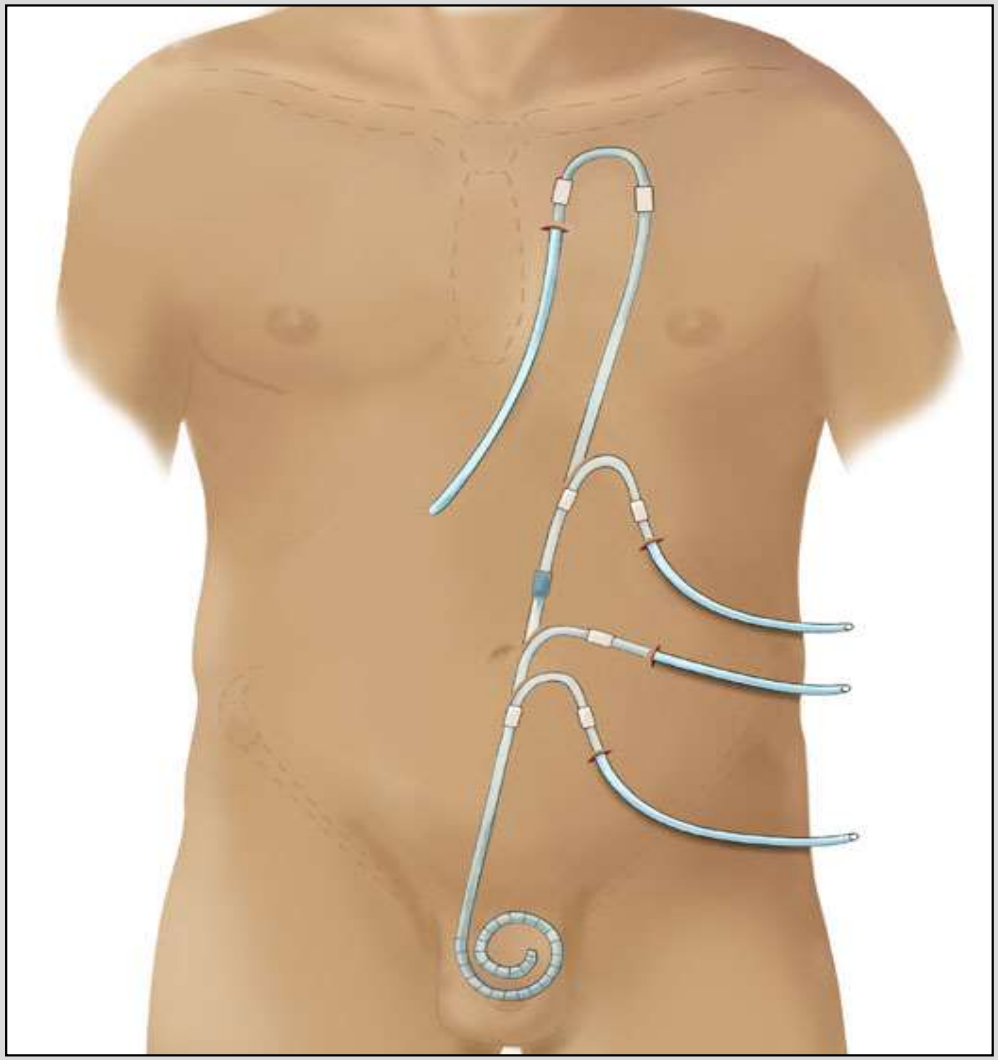
- Therapeutic failures
  - No improvement after prolonged therapy (> 3 weeks)
- Internal cuff involvement
- If associated with peritonitis
- Pseudomonas, especially recurrent
- Evidence of abscess, e.g. sono-lucent zone > 1mm around external cuff, after a course of antibiotics
- Removal and replacement under antibiotic coverage may be performed if there is no simultaneous peritonitis

Back to Catheter Placement…

One Size Does Not Fit All!
Must Have Flexibility in Exit-Site Placement

The options are:

- Lower abdomen
- Mid abdomen
- Upper Abdomen
- Presternal area- avoid crossing the midline

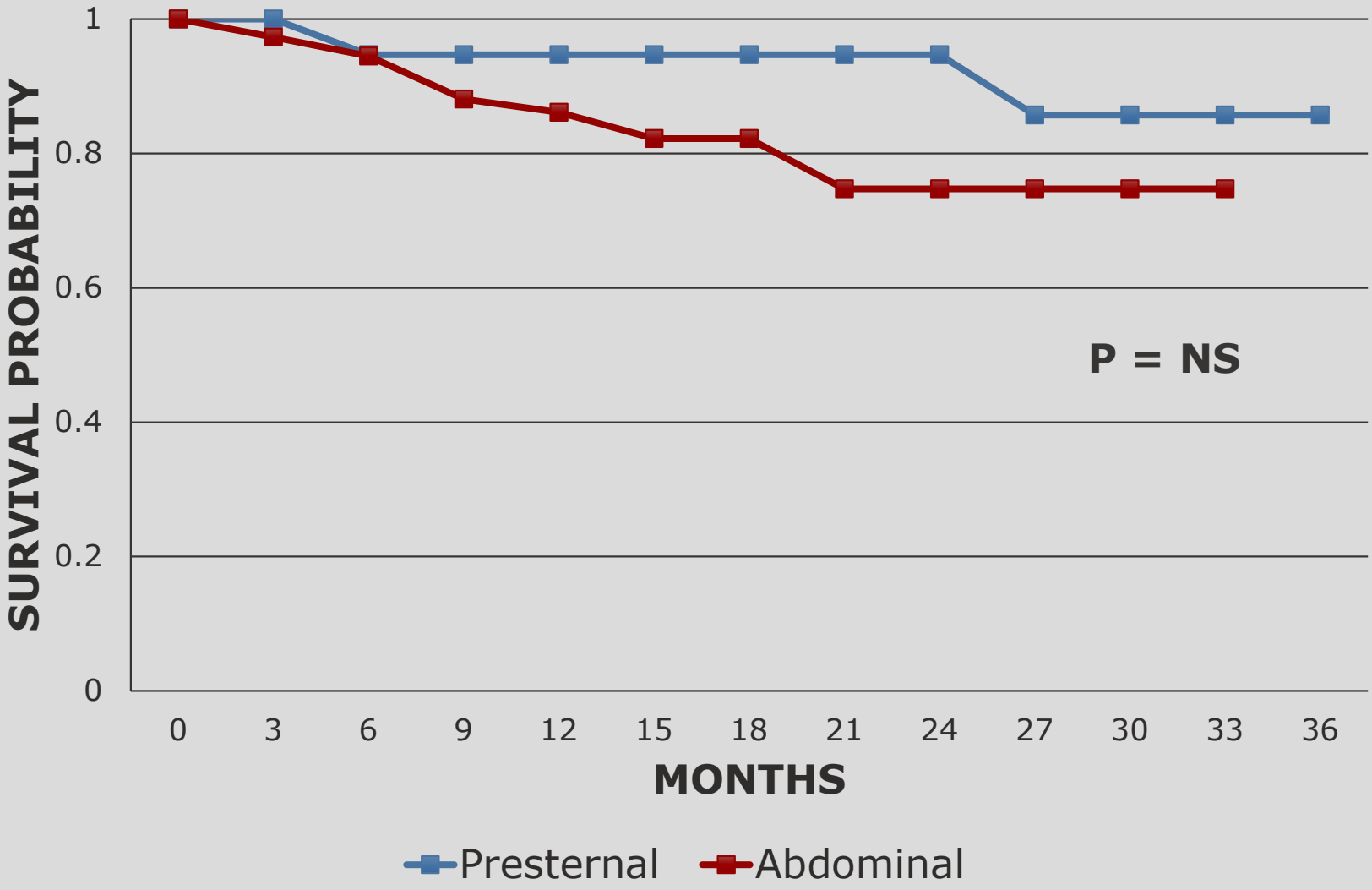


Indications for Presternal Peritoneal Dialysis Catheter

- Morbid obesity
- Multiple loose skin folds, scars, or other abdominal wall deformities
- Abdominal stomas (colostomy, ileostomy, urostomy)
- Urinary or fecal incontinence
- Desire to be able to take deep tub bath

Presternal and Abdominal Catheters have Comparable Survival Rates

Twardowski et al. Perit Dial Int 18:598, 1998



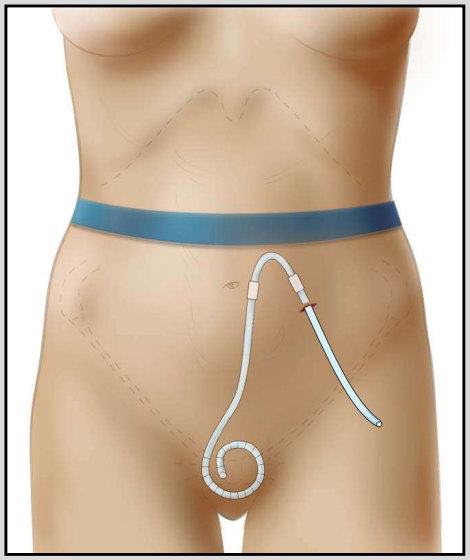
Presternal and Abdominal Catheters have (at least) Comparable Infection Rates

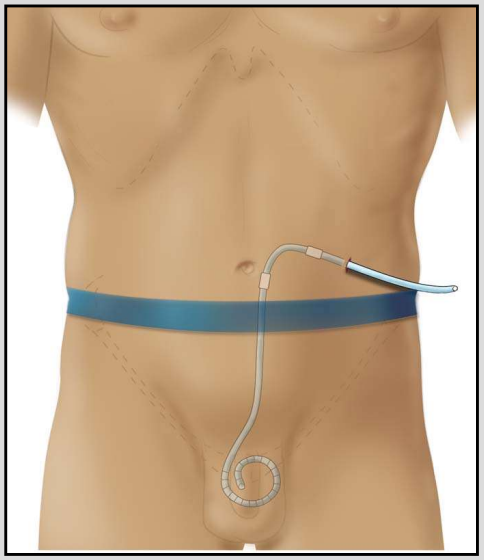
Twardowski Z et al. Perit Dial Int 18: 598, 1998

	Abdominal	Presternal	p value
n =	86	58	–
Observation time (months)	880.7	747.6	–
Catheters removed due to infection	13	4	0.201
Peritonitis episodes	43	21	–
Peritonitis rate (patient-months)	1/ 20.5 (0.59/pt- yr)	1/ 37.4 (0.32/pt- yr)	0.04

Catheter Type and Exit-Site Location Must Be Patient-Specific

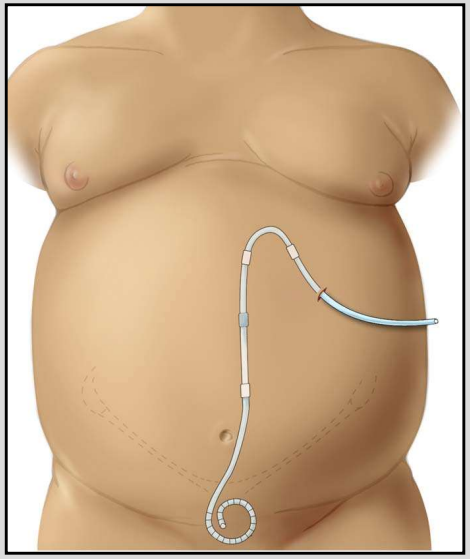
Lower Abdominal for High Belt Line

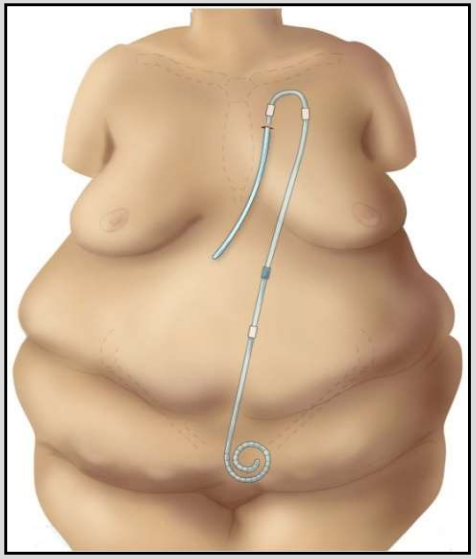




Mid-Abdominal for Low Belt Line or Low Skin Fold

Upper Abdominal for Obesity or Floppy Skin Folds

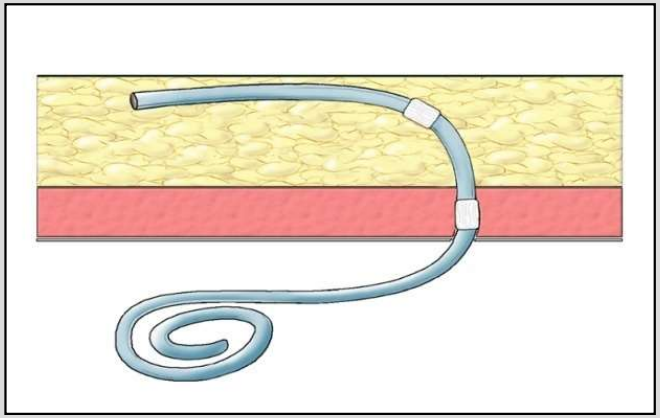




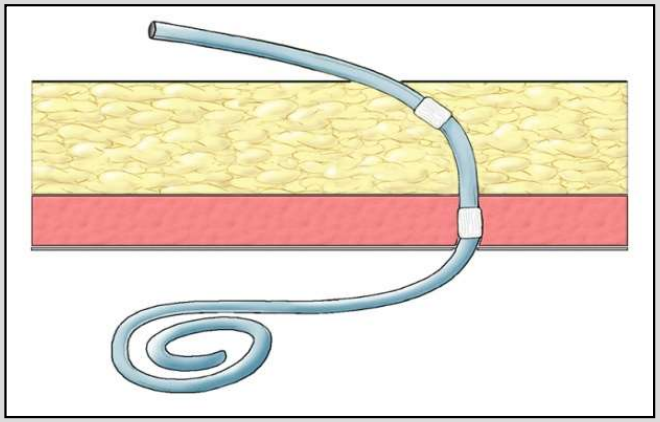
Presternal for Morbid Obesity, Incontinence, Desire To Bathe, Or Stomas

Catheter Embedding Procedure
(Moncrief-Popovich Technique)

- External limb of catheter is buried under the skin at the time of implantation.



- External limb is exteriorized weeks to months later when dialysis needed.



Potential Advantages of "Burying" the External Limb of the Catheter

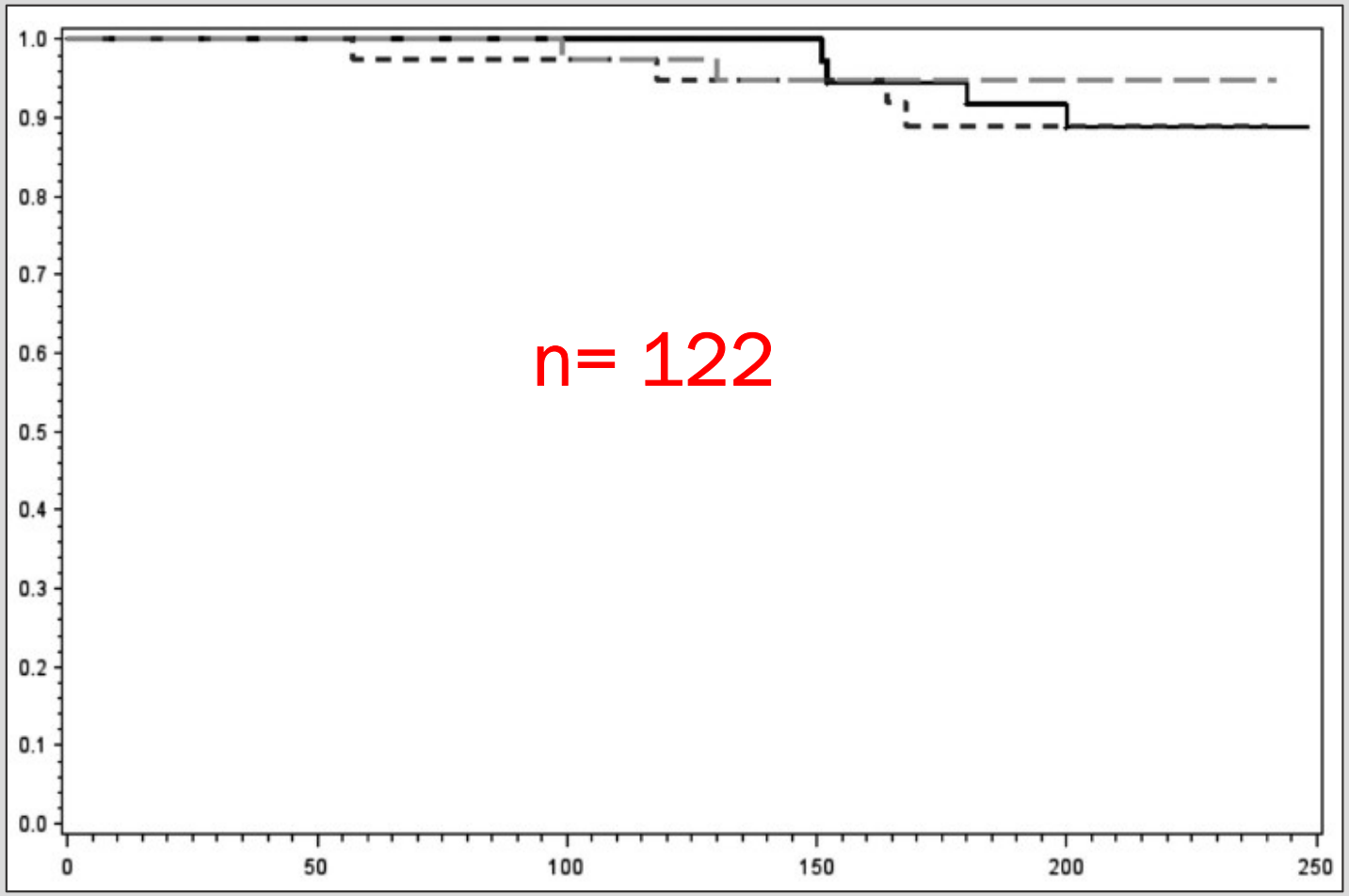
- Catheter heals in an environment without exposure to contamination from exit-site. No evidence, however, for reduced incidence of peritonitis.
- Avoids traction on newly- placed catheter.
- Greater patient acceptance for earlier commitment to peritoneal dialysis by catheter placement ahead of time.
- Applies fistula concept to peritoneal dialysis.

Potential Advantages of "Burying" the External Limb of the Catheter- 2

- Reduces PD Unit nursing workload and cost of supplies- don't need to flush!
- Start full dose peritoneal dialysis without break-in period after exteriorization.
- Avoids urgent temporary hemodialysis and the dreaded "perm"cath.

Catheter Survival by Tertiles of Embedment Duration

Elhassan et al. Perit Dial Int. 31:558, 2011



p ≥ 0.33 for all comparisons

Buried Catheter Outcomes

Author, yr	N	Mean/ Median (wks)	Range (wks)	%Futile	%Drain problem	%Not functional
Prischl, 1997	26	11.4	4- 96	19%	29%	0%
Danielsson, 2002	30	7.1	1-170	0%	3%	0%
McCormick, 2006	266	13.1	5-42	11%	15%	7%
Junejo, 2008	20	15.7	5-127	10%	5%	-
Elhassan, 2011	122	5.8	0.3-113	NA	10.7%	0.8%
Crabtree, 2015	107	37.6	2-274	13.1%	14.3%	0%

Preoperative Patient Preparation

- Shower on day of surgery with chlorhexidine soap abdominal wash
- Enema or stimulant suppository administered the night before surgery
- Removal of body hair in preoperative holding area, preferably with electric clippers- **do not use a razor**.
- Empty bladder before surgery; otherwise, Foley catheter is inserted
- **Single preoperative dose of prophylactic antibiotic to provide antistaphylococcal coverage**

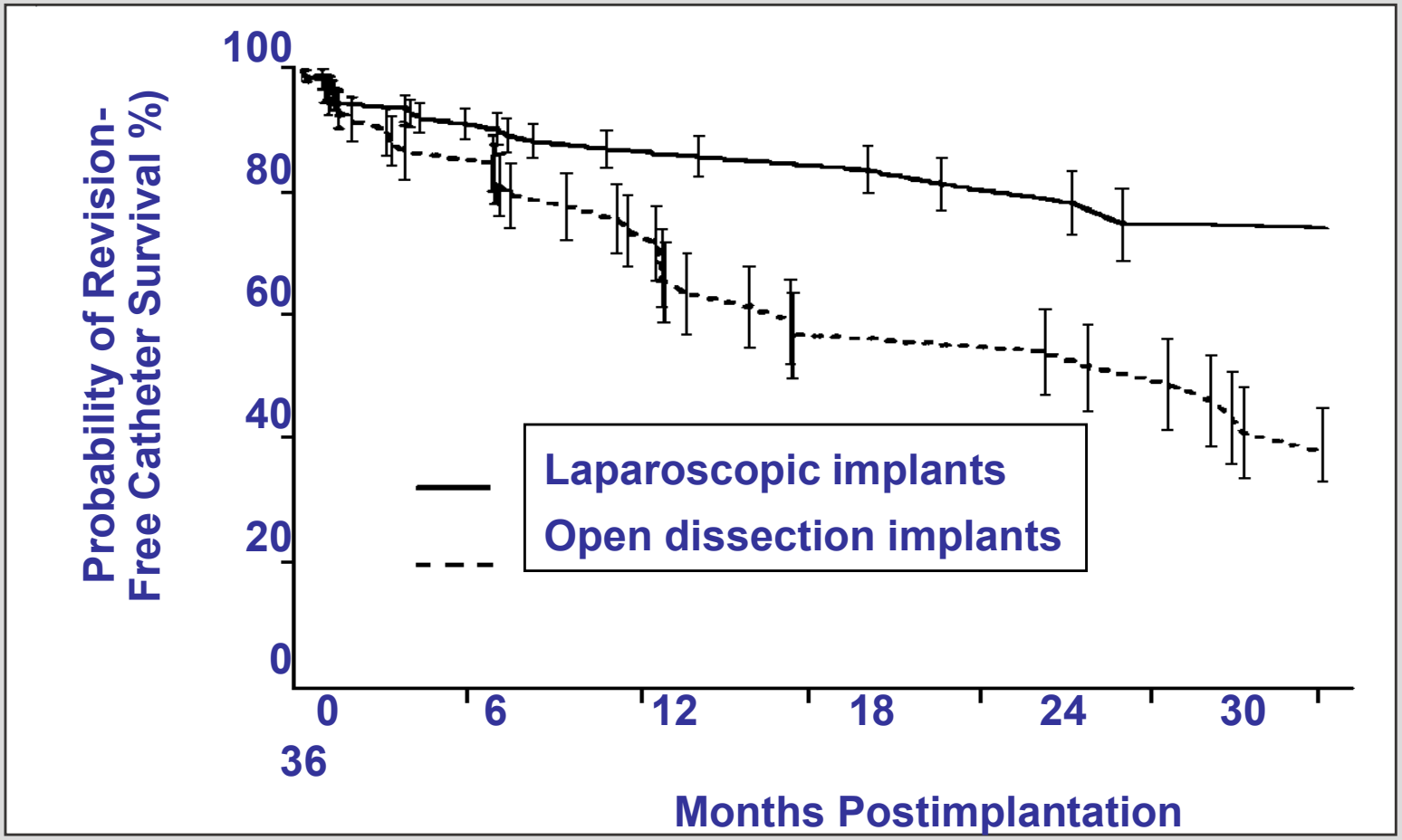
Catheter Implantation Techniques

- Open Surgical Dissection

- Percutaneous Puncture
  - Blind Seldinger Technique
  - Fluoroscopic Seldinger Technique
  - Y-Tec® Approach (Laparosc Assisted)
  - Surgical Laparoscopy

Laparoscopic Approach to PD Catheter Placement

Crabtree JH et al. Perit Dial Int 22:757, 2000.

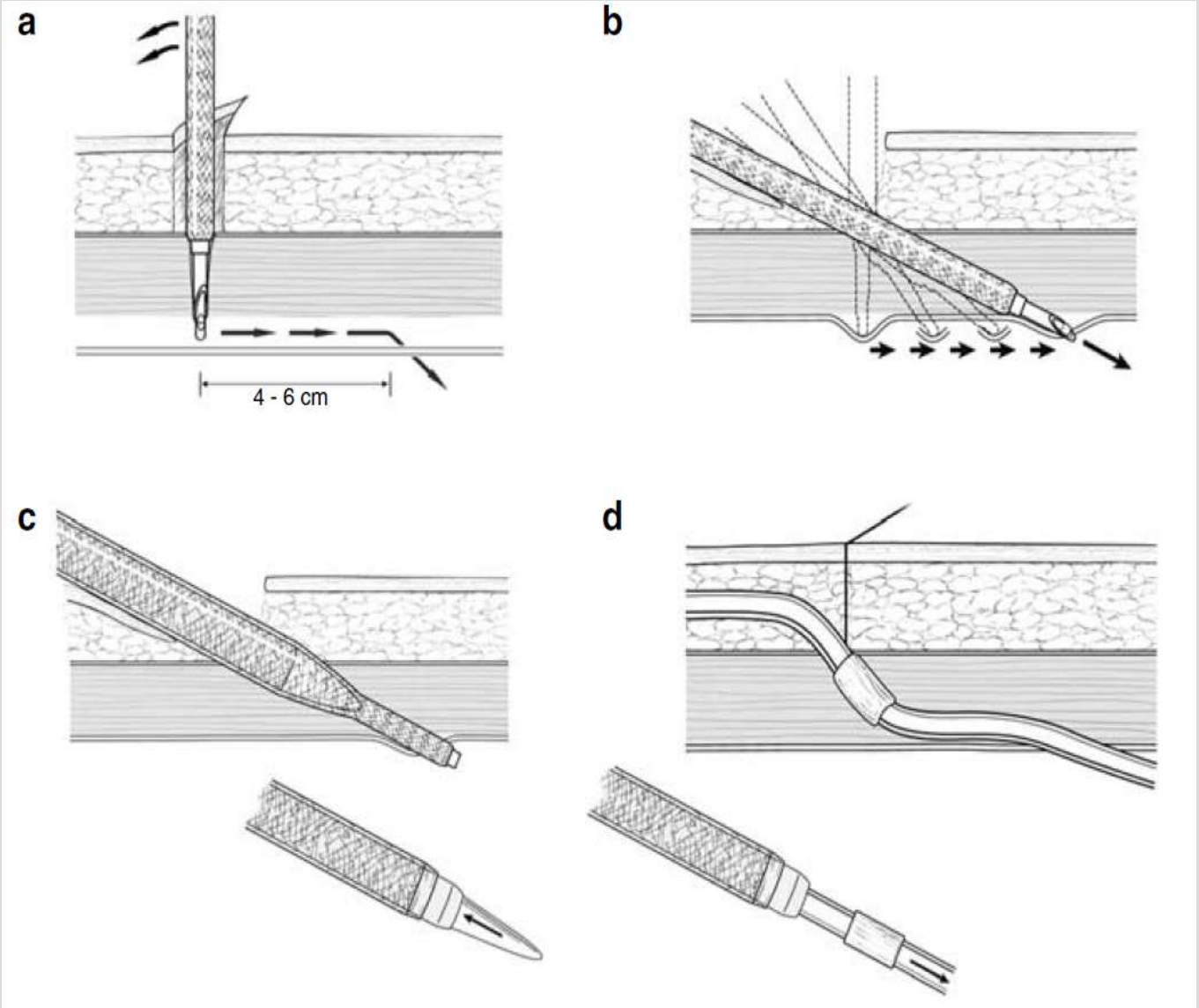


Adjunctive Procedures to Laparoscopic Implantation

- **Rectus sheath tunneling** to promote pelvic orientation of catheter tip.
- Selective prophylactic **omentopexy** (omental tacking procedure) to prevent catheter obstruction.
- Selective **adhesiolysis** to eliminate compartmentalization of peritoneal cavity.
- Resection of redundant **epiploic appendices** to prevent catheter obstruction.
- Diagnosis and treatment of previously **unsuspected hernias**.

Rectus Sheath Tunneling

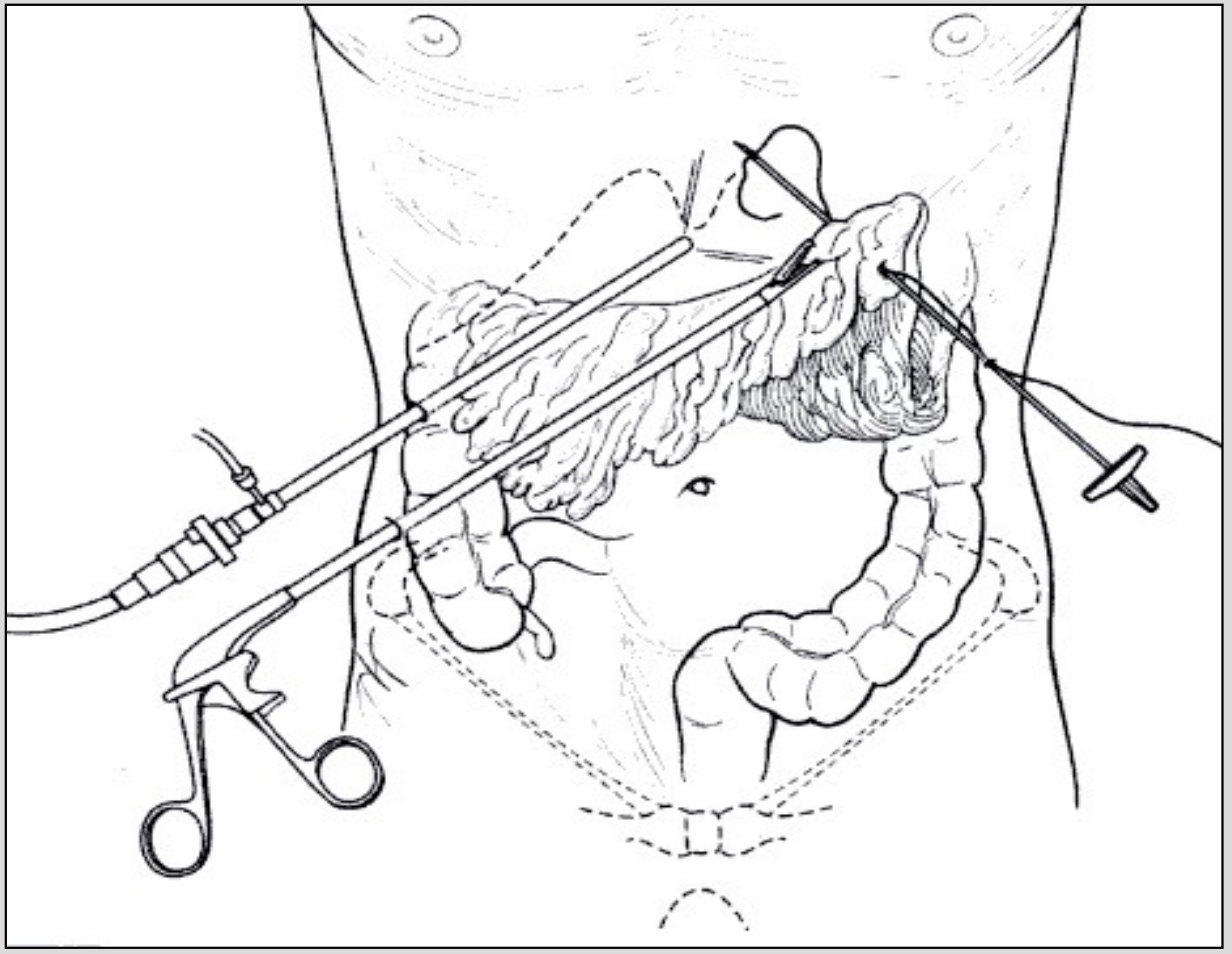
Head



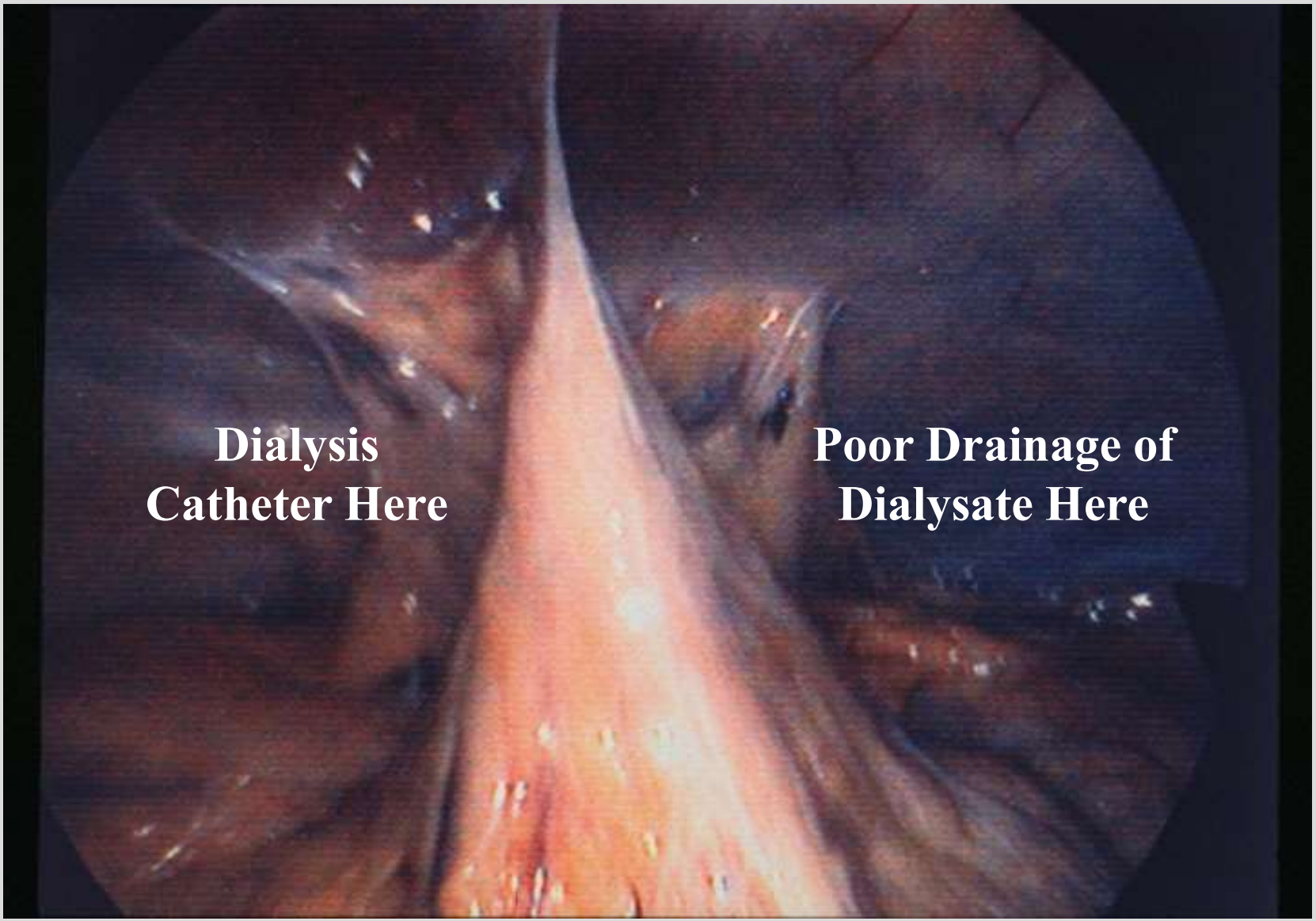
Pelvis

Selective Prophylactic Omentopexy

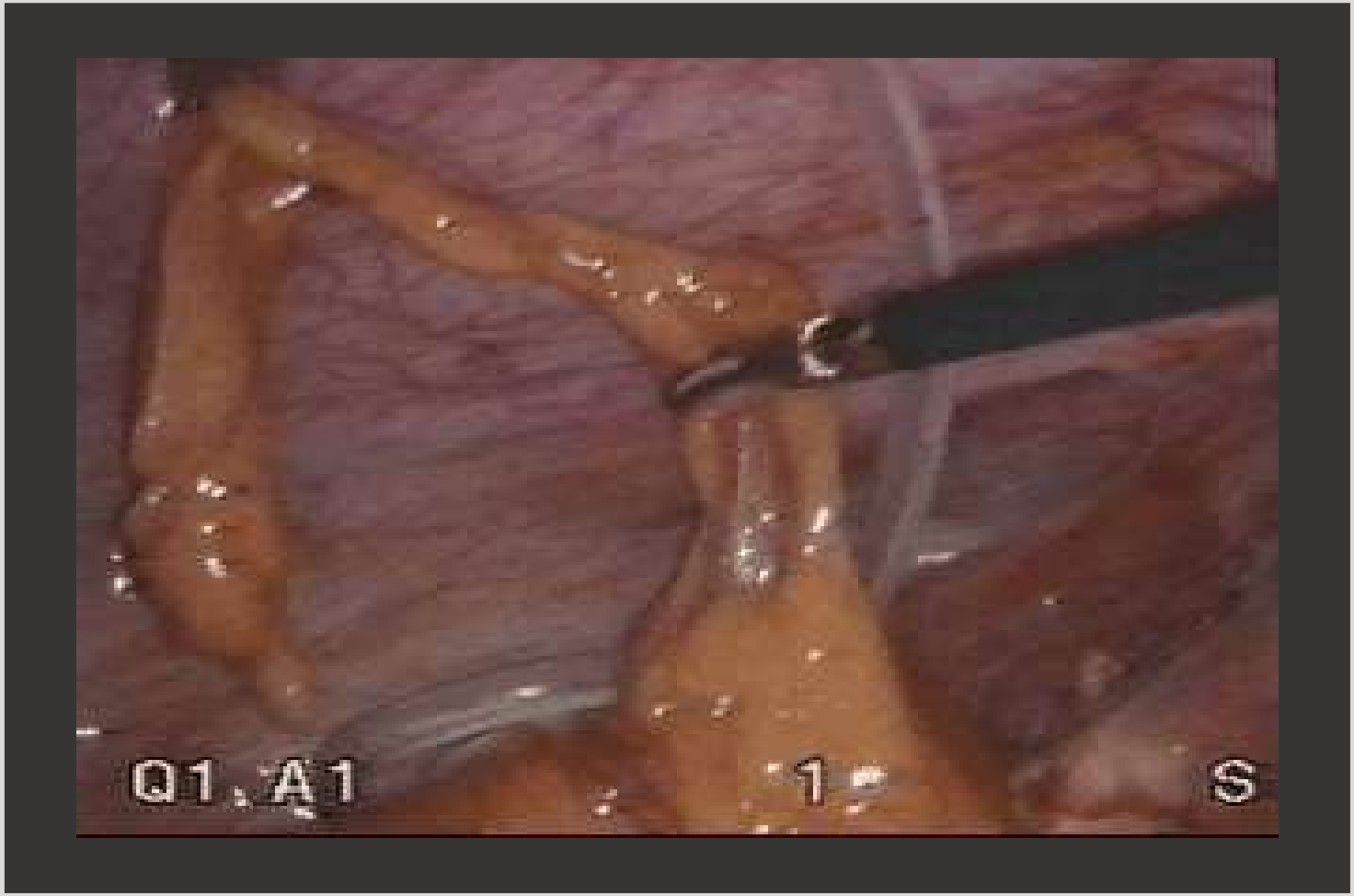
Omentum is displaced into upper abdomen and tacked to abdominal wall.



Adhesiolysis for Compartmentalization

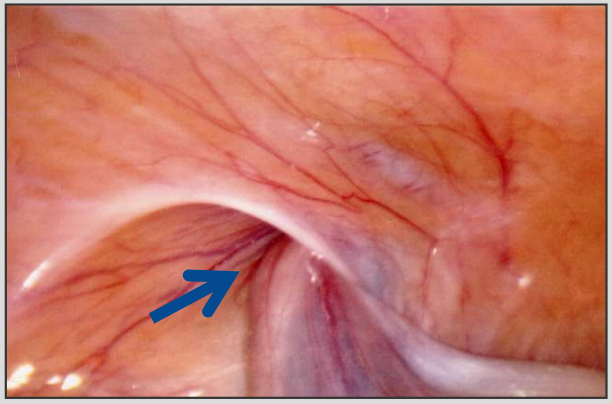


Resection of Epiploic Appendices

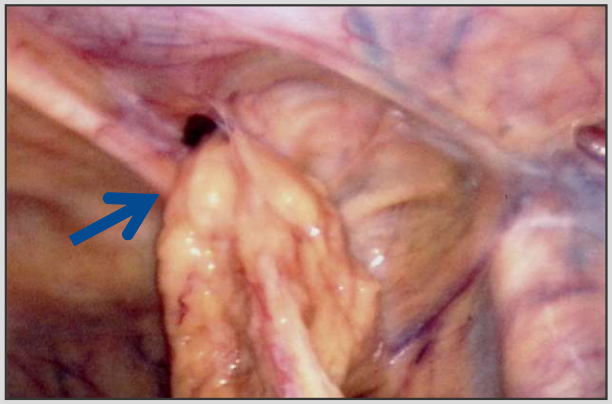


Fat-filled tabs, or pendants, of peritoneum that project from the serous coat of the colon.

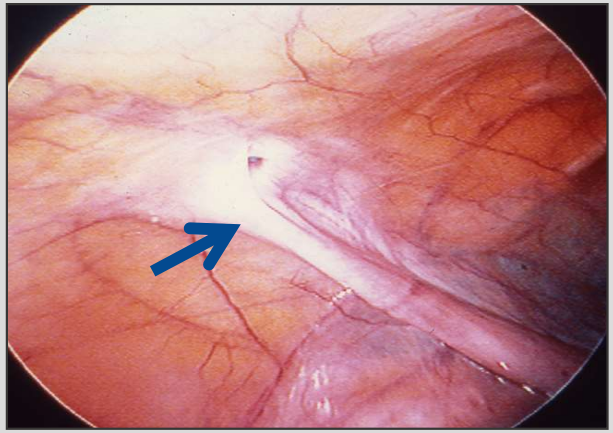
Diagnosis and Repair of Unsuspected Hernias



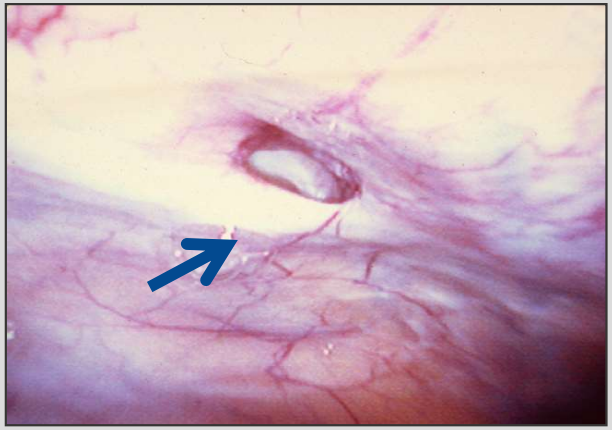
Patent Processus Vaginalis (Male)



Recurrent Direct Inguinal Hernia



Patent Processus Vaginalis (Female)

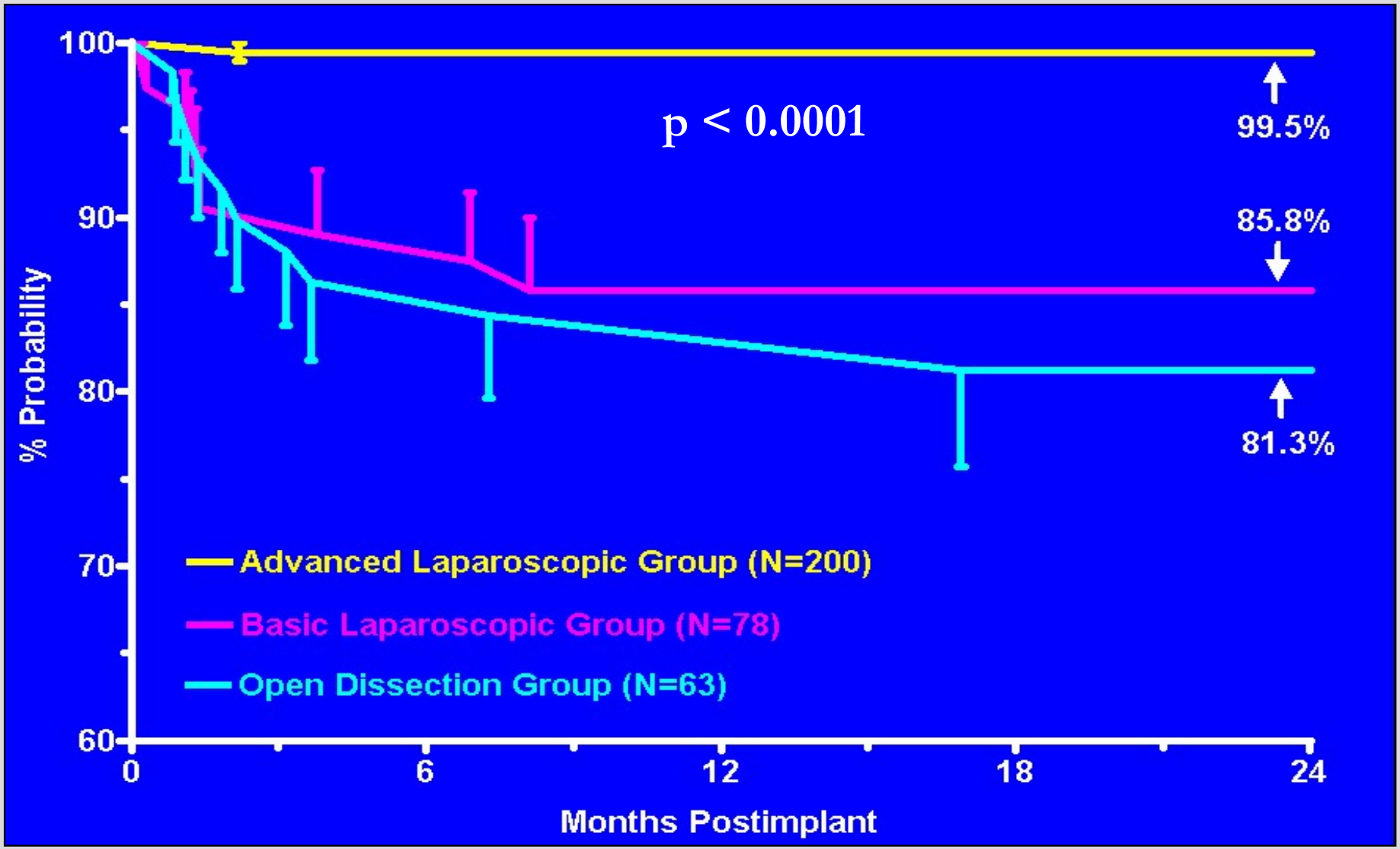


Spigelian Hernia

Courtesy of Dr. John Crabtree

Probability of Remaining Free of Mechanical Flow Obstruction

Crabtree JH et al. Am Surg 71: 135, 2005



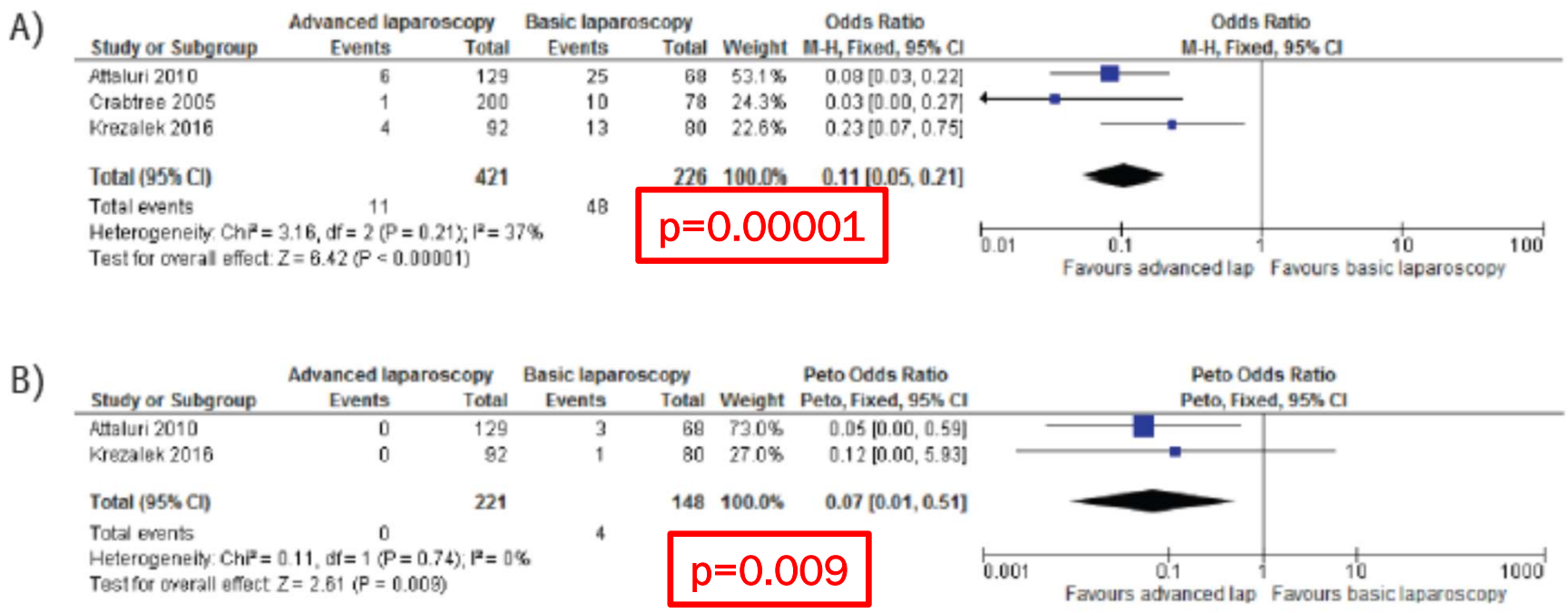
Superior Outcomes with Advanced Laparoscopy

Shrestha et al. Perit Dial Int 38:163, 2018

- Compared to either open surgical insertion or basic laparoscopy, advanced laparoscopy is associated with superior outcomes for:
  - Catheter obstruction
  - Catheter migration
  - Leaks (vs. open; not vs. basic laparoscopy)
  - 1- and 2-year catheter survival rates
- No differences noted in rates of infectious complications; ESI or peritonitis

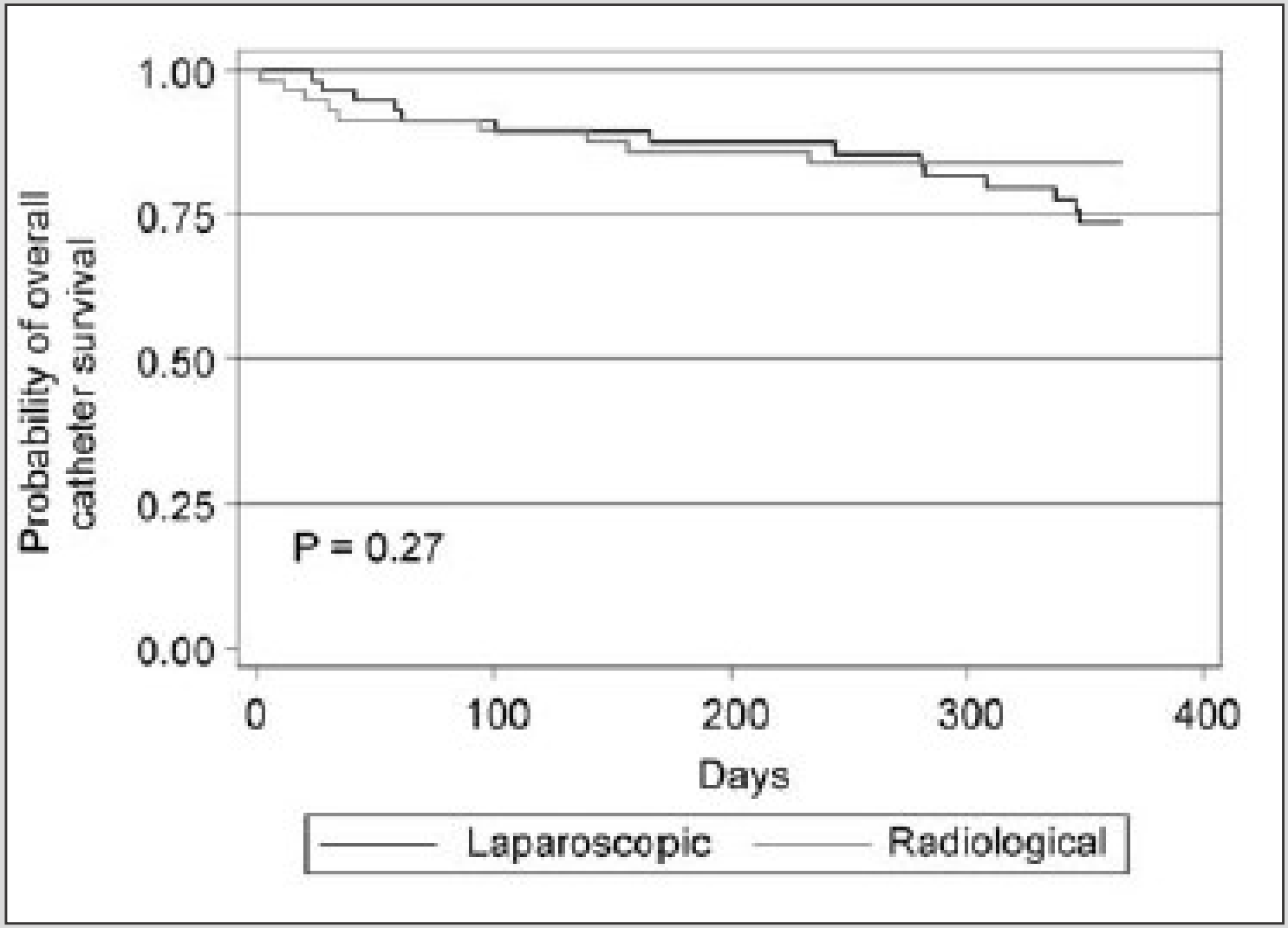
Superior Outcomes with Advanced Laparoscopy

Shrestha et al. Perit Dial Int 38:163, 2018



Laparoscopic vs. Fluoroscopic PD Catheter Placement: Prospective

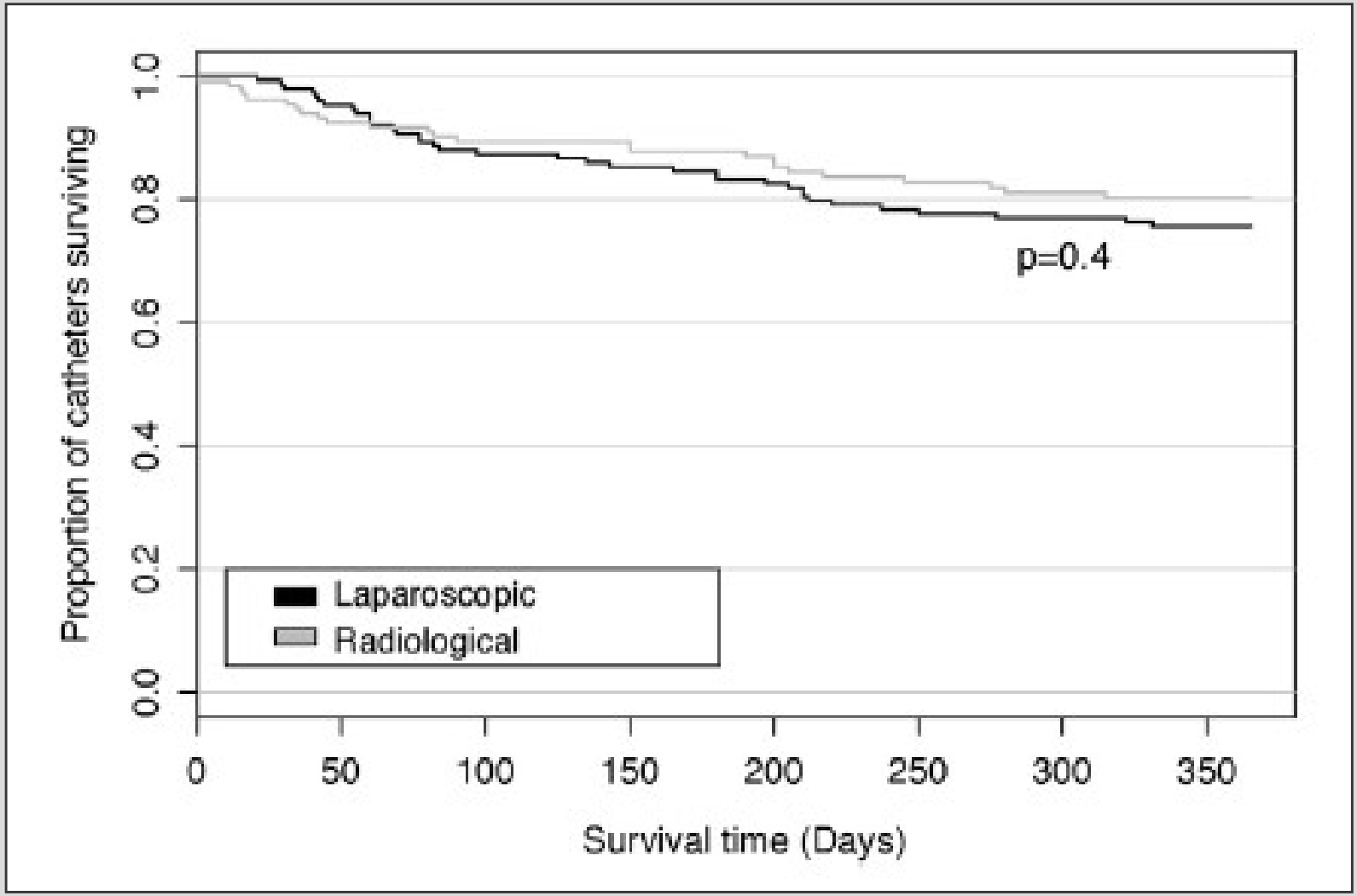
Voss D et al. Nephrol Dial Transpl 27:4196, 2012



Did not describe using advanced laparoscopic techniques

Laparoscopic vs. Fluoroscopic PD Catheter Placement: Retrospective

Maher E et al. J Vasc Interv Radiol 25:895, 2014



Did not describe using advanced laparoscopic techniques

Creating Optimal Peritoneal Dialysis Access
Crabtree JH et al. Perit Dial Int 39:414, 2019

- Choice of PD catheter implantation approach should be based upon patient factors, facility resources, and operator expertise (not graded)

- We recommend that laparoscopic PD catheter implantation employ advanced adjunctive procedures that minimize the risk of mechanical complications (1B)

Postoperative Catheter Care
Crabtree and Chow Semin Nephrol 37:17, 2017

- Immobilization-medical adhesive tincture and sterile adhesive strips
- Non-occlusive barrier dressing- changed in 1 week
- Secure transfer set to abdominal wall- separate dressing from catheter, to allow access
- Flushing after OR: start within 72 hours, optimal frequency not known
- Other issues- avoid heavy lifting, no bath/shower until instructed

Catheter Break In

- Traditionally, wait 2 weeks unless needed for urgent start

- Leaks can be an issue if used earlier

Immediate Post Placement Complications

- Bowel perforation
- Bladder perforation
- Rectus sheath hematoma (injury to epigastric artery or its branches)
- Peritoneal bleeding / hemoperitoneum
- Catheter kinking
- Complications of anesthesia
- Pain

Peri-catheter Leaks

Ghaffari. Am J Kidney Dis. 2012 Mar;59(3):400-8
Ranganathan, et al. Perit Dial Int. 2017 Jul-Aug;37(4):420.

- Rare in patients who have 2-3 weeks of healing prior to catheter use
- Chance of leak may be reduced with bedside Seldinger technique or open / laparoscopic technique with deep cuff purse-string suture
- More common in urgent start peritoneal dialysis
- With urgent start patient's risk of leak can be decreased by using lower volumes, supine PD

Initial Fill Volumes for Urgent Start PD

Ghaffari A et al. Perit Dial Int 33:611, 2013

BSA (m^2)	Fill Volume (mL)
< 1.65	750
1.65-1.80	1000
>1.80	1250

Catheter-Related Complications

Catheter-Related Problems

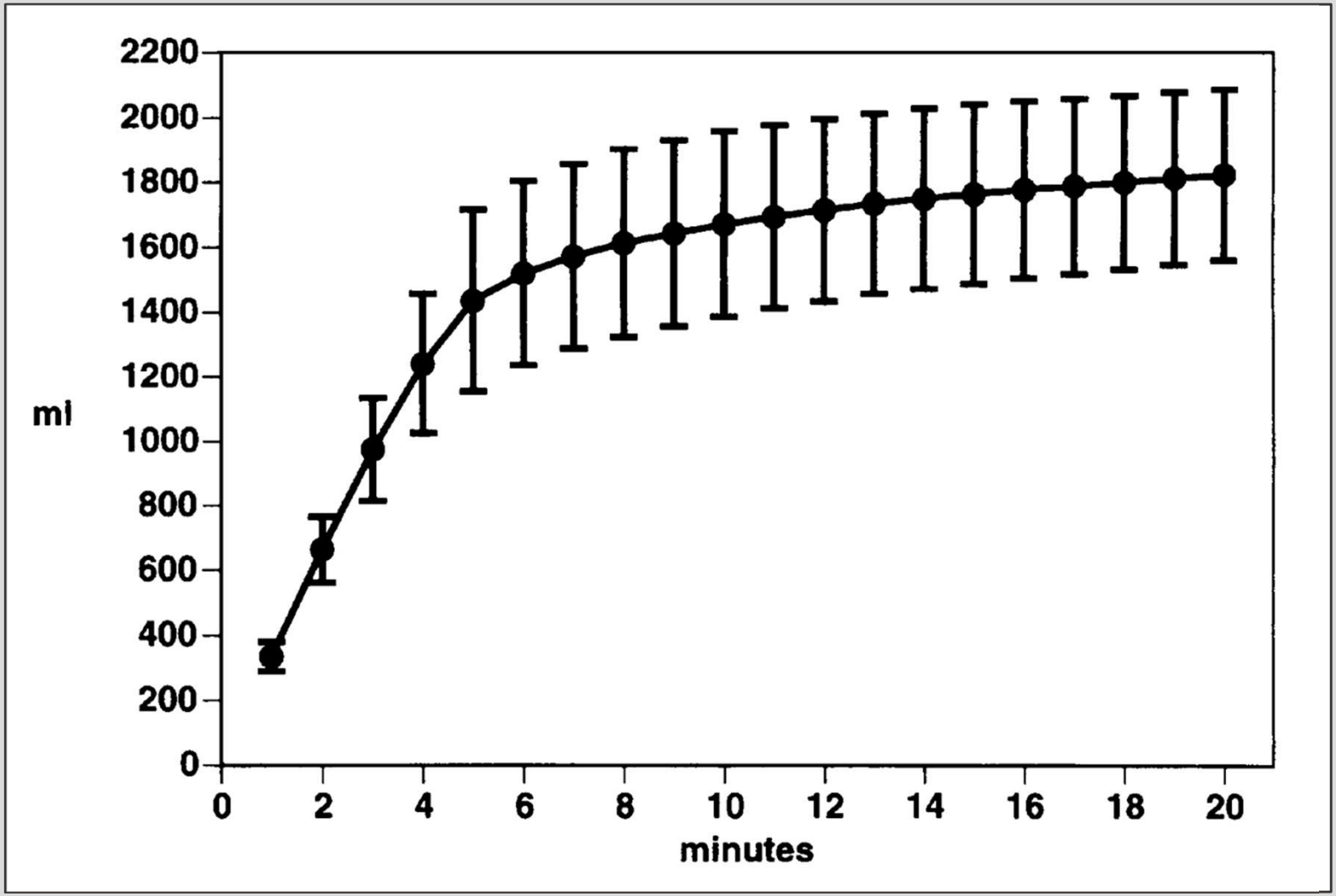
Usually occur soon after implantation/ beginning of use:

- 1-way obstruction
  - good inflow, poor outflow
- 2-way obstruction
  - problem with inflow and outflow
- Pain during inflow or outflow

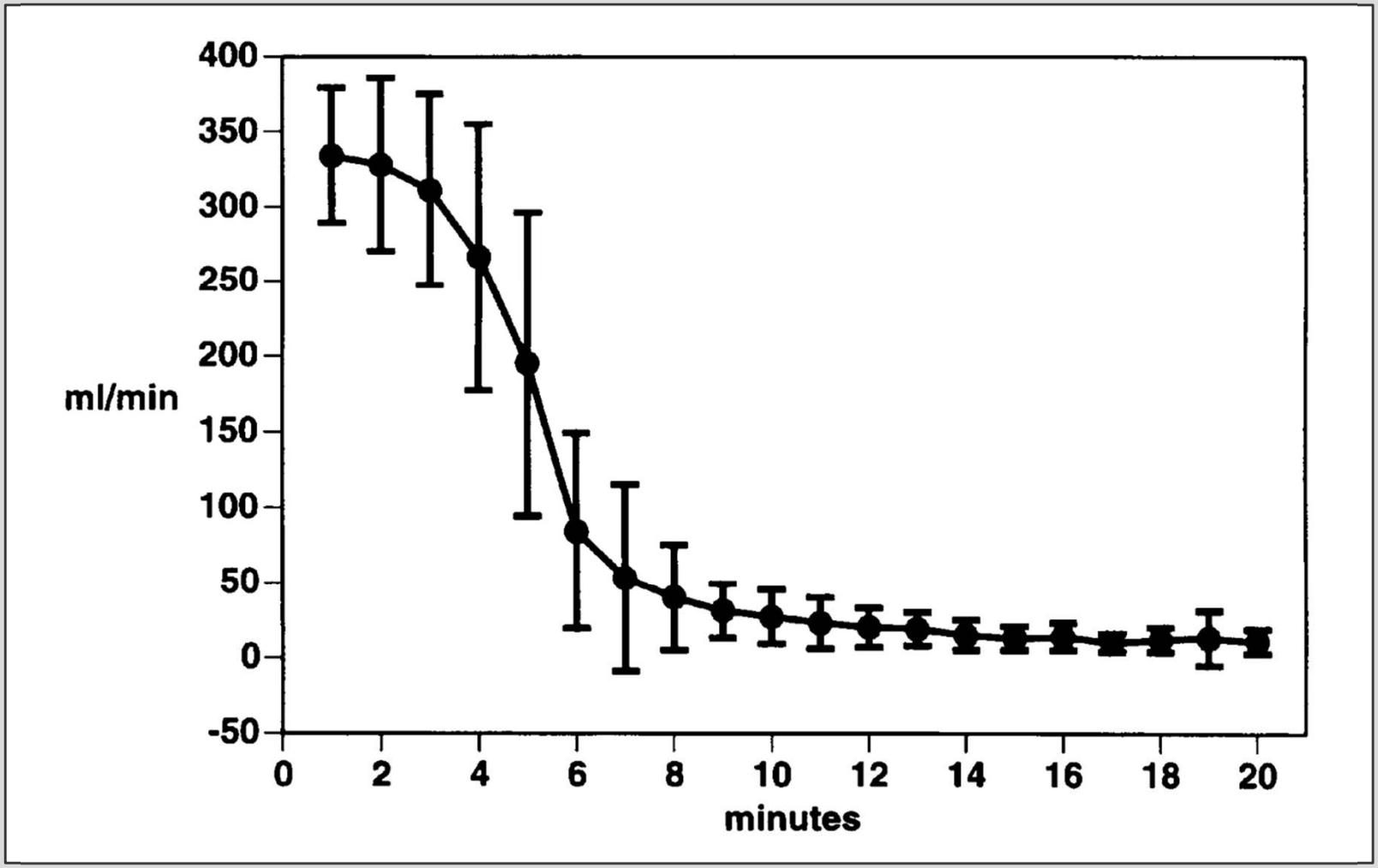
Catheter Flow Rate

- How long should it take to fill or drain a liter of dialysate?
  - 3-5 minutes
  - 10-20 minutes
  - 20-30 minutes

Time Course of a 2L Dialysate Fill (Volume)



Time Course of Dialysate Drain (Rate)



A Patient in whom Dialysate Infuses Easily but Drains Poorly

A Patient in whom Dialysate Infuses Easily but Drains Poorly

Her abdominal flat plate shows:

- A large quantity of stool in the large bowel
- Catheter tip in the right upper quadrant

A Patient in whom Dialysate Infuses Easily but Drains Poorly

- She is given lactulose and a tap water enema, and you are told that there are "good results"

Are you satisfied?

a. Yes
b. No

A Patient in whom Dialysate Infuses Easily but Drains Poorly

- She is sent home for the weekend with lactulose and senna.
- Over the weekend she has 8 more bowel movements.
- Still no improvement in outflow.
- Repeat abdominal flat- plate documents near absence of stool.

A Patient in whom Dialysate Infuses Easily but Drains Poorly

What would you do now?

1. Change her to hemodialysis
2. Surgically remove and re-implant the catheter
3. Manipulate the catheter radiologically
4. Inject dye into the catheter lumen
5. Refer for laparoscopy

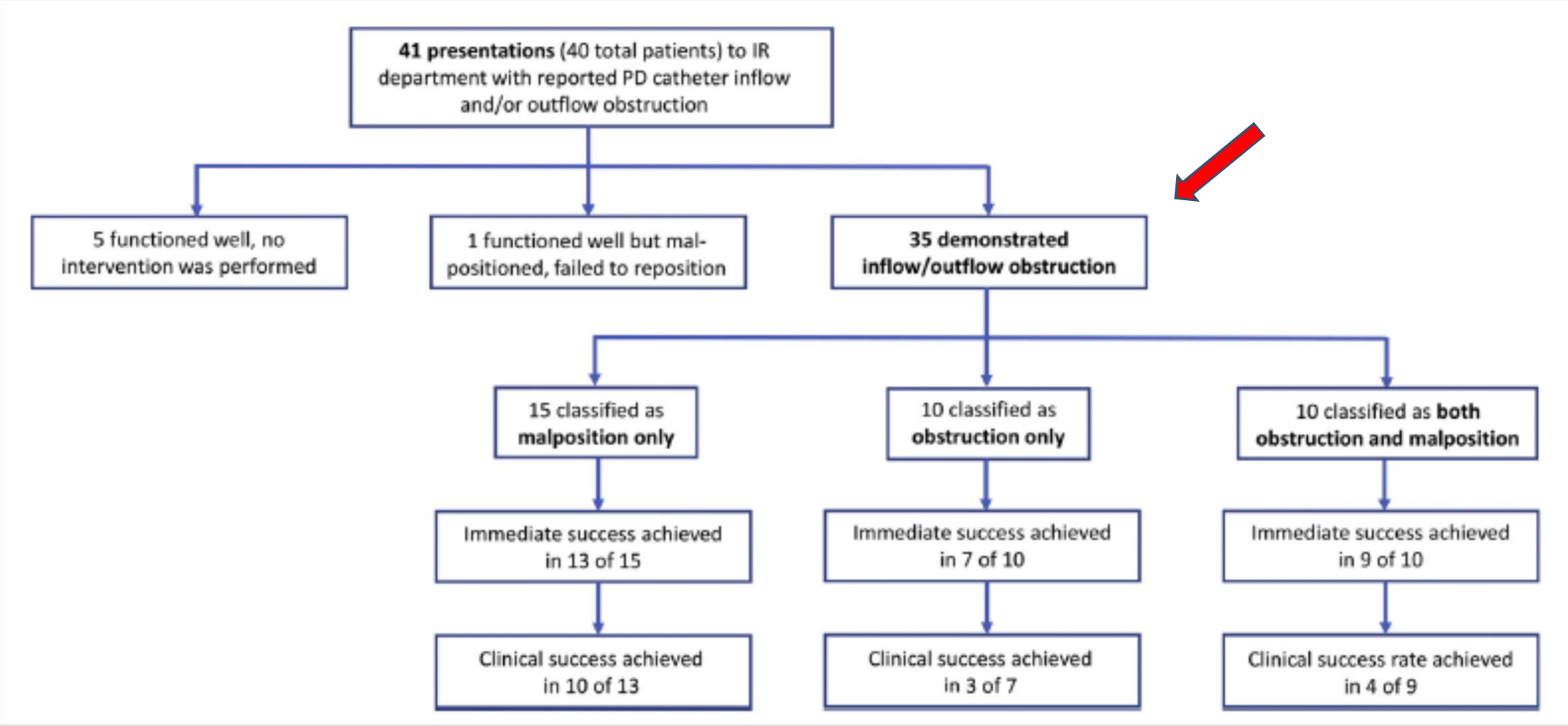
Fluoroscopic Manipulation of Tenckhoff Catheters: Outcome Analysis

Diaz- Buxo JA et al. Clin Nephrol 47:384, 1997

- Ten-year experience
- 69 catheters (59 straight, 10 curled)
- Median 18 days after insertion (1 day- 5 years)
- Used a flexible guidewire under fluoroscopy
- Success- defined as adequate catheter function 3 months later- in 60.9% (same for straight and curled catheters)
- In other studies, average success at 1month ranges from 50-71% (Nessim SJ et al. Perit Dial Int 31:208, 2011)

Salvage of Malfunctioning Peritoneal Dialysis Catheters by Interventional Radiology

Li et al. J Vasc Interv Radiol 32:902, 2021

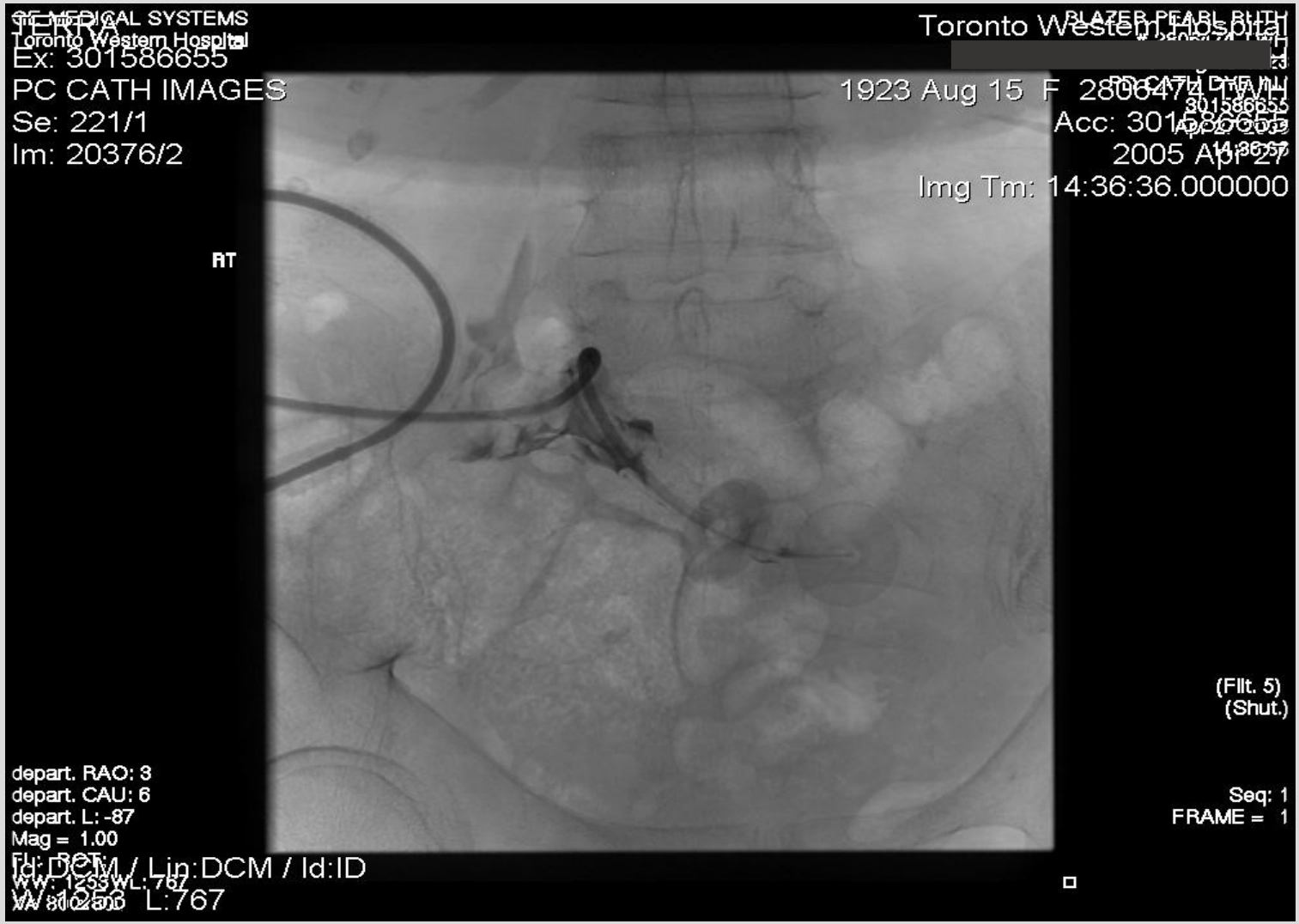


30- day patency rate of 59%; overall success at 30 days = 33.5% (17/35 x 0.59). No long- term follow up available.

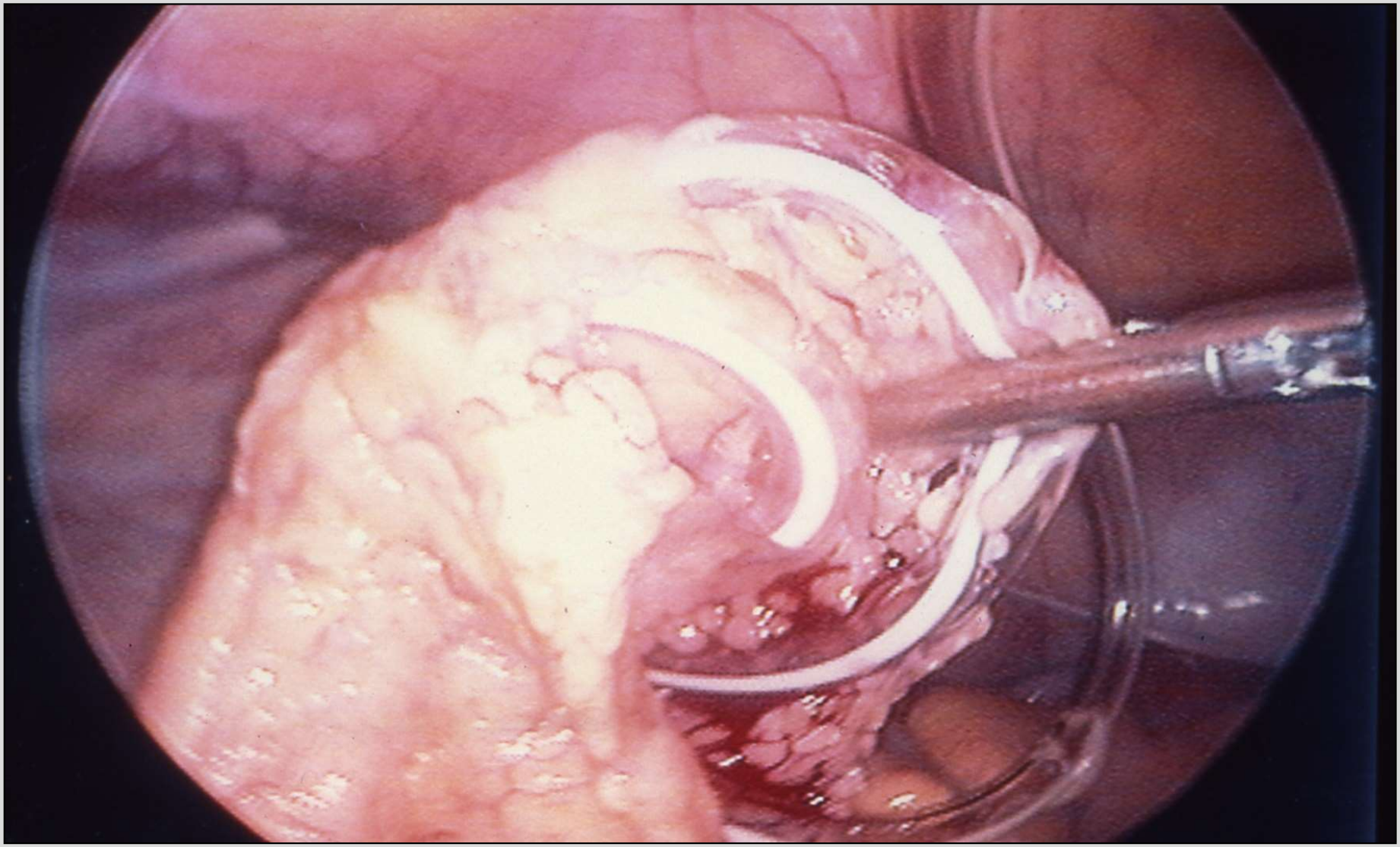
Cathetergrams

- Inject enough dye to fill catheter and spill into peritoneal cavity
- What you can diagnose:
  - Kink in catheter
  - Obstruction within lumen
  - Omental wrap
  - Peritoneal compartment problem

Catheter Dye Study Suggesting Omental Wrap



Omental Wrap



Courtesy of Dr. John Crabtree

Catheter-Related Problems

- 1-way obstruction
  - Constipation ***
  - Catheter migration into upper quadrants or into a loculated pocket
  - Omental wrap
- Treatment:
  - Careful attention to bowel cleanout ***
  - Laparoscopic manipulation of catheter
  - Surgical removal of omentum or laparascopic omentopexy

Catheter-Related Problems

- 2-way obstruction
  - Kink or bend in catheter
  - Intraluminal obstruction (blood clot, fibrin). Extrinsic obstruction rarely causes 2- way obstruction.
- Treatment:
  - Vigorous flush with heparinized saline.
  - Straighten catheter or establish patency (e.g. remove intraluminal fibrin) laparoscopically.

Intraluminal Fibrin Causing Catheter Obstruction (1011573 – 6/5/15)

Pain on Infusion and/or Drain

- A 48-year-old man initiates CAPD for ESRD due to hypertensive nephrosclerosis.
- While still in training the patient describes 2 distinct pains - one on infusion and one on drainage.
- The infusion pain is worse with hypertonic solutions and is helped by slowing the infusion rate.
- The drain pain occurs towards the end of the drain and is relieved by clamping the drain line.

Pain on Infusion and/or Drain

- What is the pathogenesis of each of these two pains ?

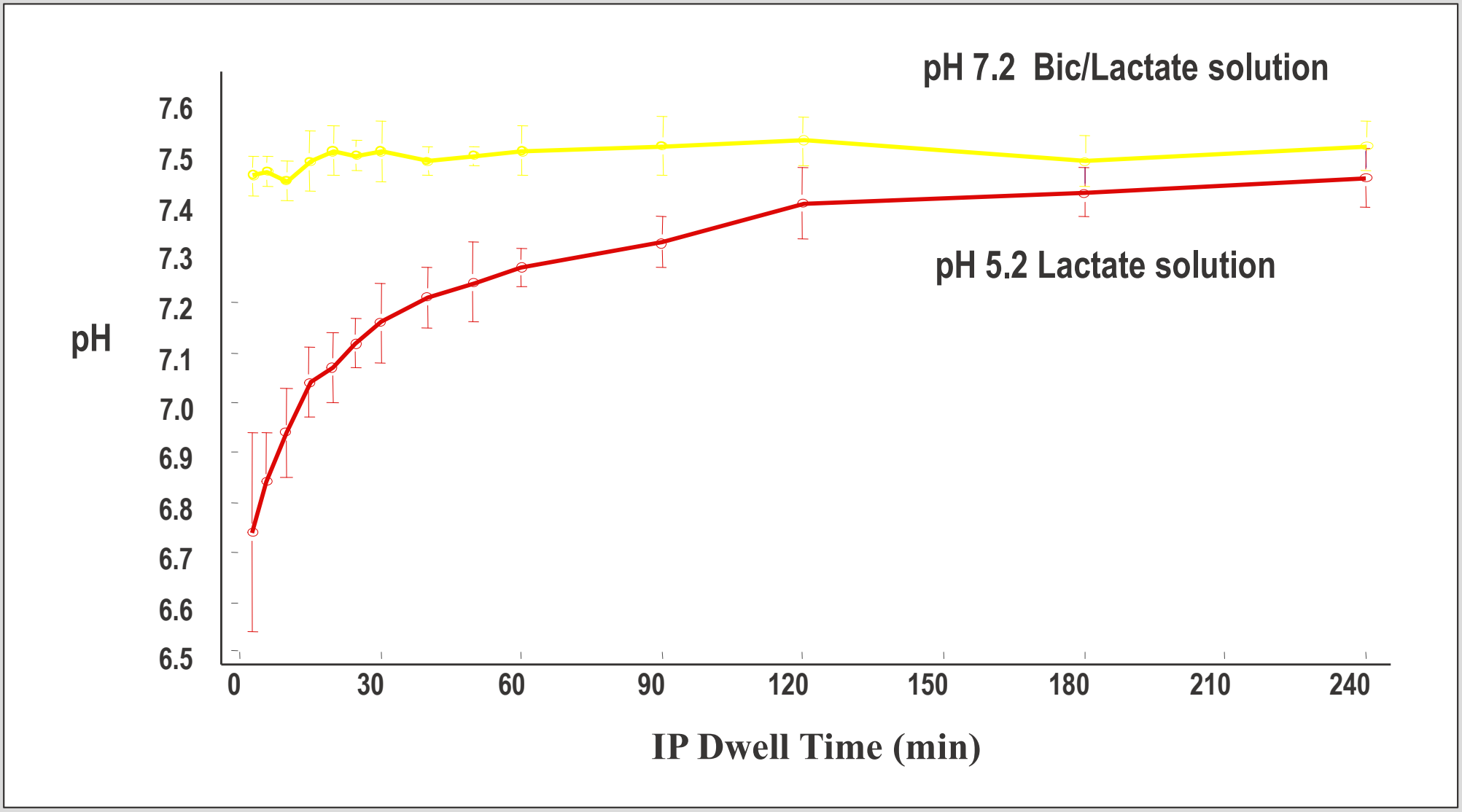
- What can be done to deal with them ?

Pain Related to Dialysate Flow

- Inflow pain
  - "Jet" effect- *use a curled catheter or slow the rate of inflow*
  - Irritation of an adjacent organ- *Often diminishes with time on PD but may require repositioning of catheter.*
  - Undue sensitivity to dialysate- *pH of dialysate is only 5.2. May add HCO3 (4-5 meq/ L) or may also consider adding lidocaine (5 mL of 1% per 2L exchange). Ideally should use dialysate with physiologic pH. Often diminishes with time on PD.*

Biocompatibility: pH and Buffer System

Heimburger et al. 1999



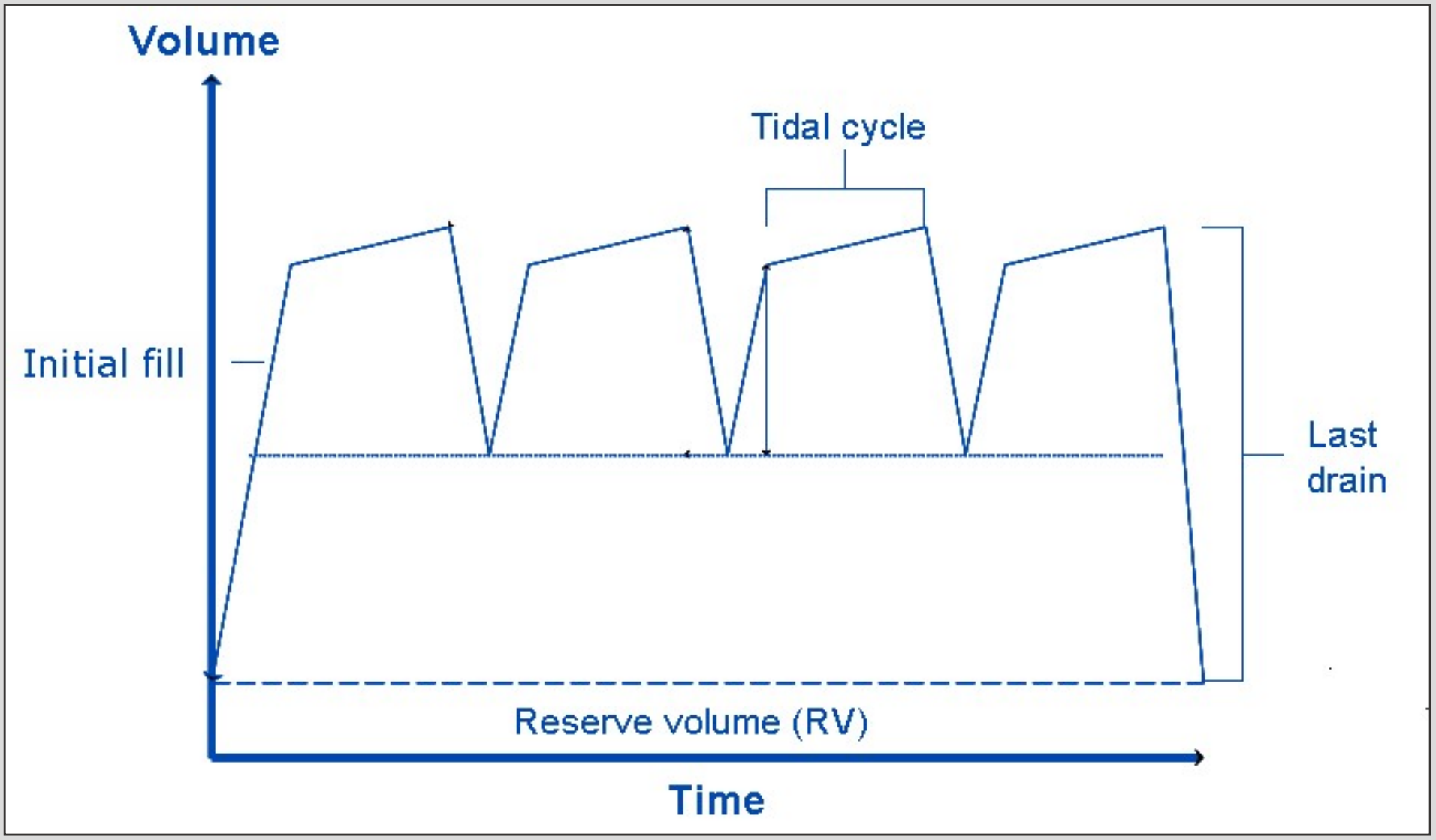
- What about the drain pain? Remember, it occurs towards the end of the drain and is relieved by clamping the drain line.

Pain on Outflow

- Unrelated to pH; rather, most likely due to suction (Bernoulli effect) on intra-abdominal viscera.
- Commonly localizes to the rectal or suprapubic areas.
- Usually worse in APD than CAPD and often positional. Usually worse toward end of drain. May reflect poor catheter position.
- May resolve with time. If it fails to resolve, pain may be lessened by incomplete drainage (e.g. tidal dialysis). Catheter repositioning or removal may be necessary.

Tidal Peritoneal Dialysis

http://www.advancedrenaleducation.com/Portals/0/Gif/Tidal-technique%20lg.gif



THANK YOU

isaac.teitelbaum@cuanschutz.edu