Complications of acute appendicitis and of their treatment

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Pathology and pathogenesis

- Appendix lumen obstruction leads to congestion within the appendix
- Inflammatory exudate and mucous increases luminal pressure
  - Obstruction of lymphatic drainage
  - Oedema
  - Ulceration
  - Bacterial growth
  - Pus
  - Ischaemia of the appendix.
- The loss of integrity
  - bacterial invasion of the submucosa and muscularis propria resulting in acute appendicitis.
- Rarely the initial stages resolves
- Appendix may distend with mucus- mucocele

Appendicitis complications

- Gangrenous Appendicitis: Thrombosis of the appendiceal artery and veins
- Perforation: -complication rates 58 %[5].

  -perforation rate increased at both ends of the age spectrum[4]
- Peri-appendiceal abscess:-most frequent complication.

  -peri-appendiceal fibrinous adhesions
- Peritonitis: -Bacterial peritonitis in absence of fibrinous adhesions.

  -Escherichia coli[4]
- Bowel Obstruction
- Septic seeding of mesenteric vessels:

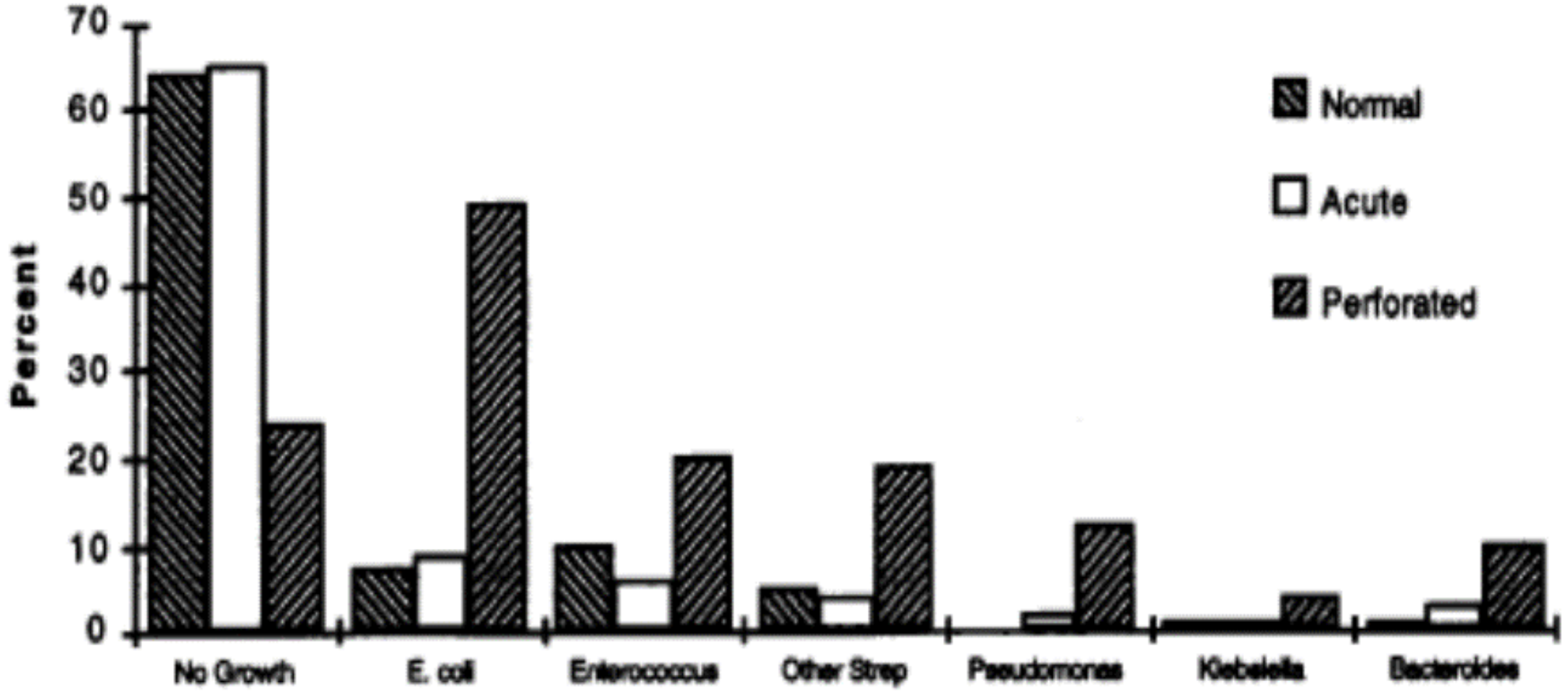
  -infection along the mesenteric–portal venous system
  -pylephlebitis, pylethrombosis, or hepatic abscess
- Appendicitis and Pregnancy:

  -1/5 with complicated appendicitis

  -perforation rate of 15-20% (esp. first and second trimesters)

  -5% risk of fetal loss (20% with perforation)

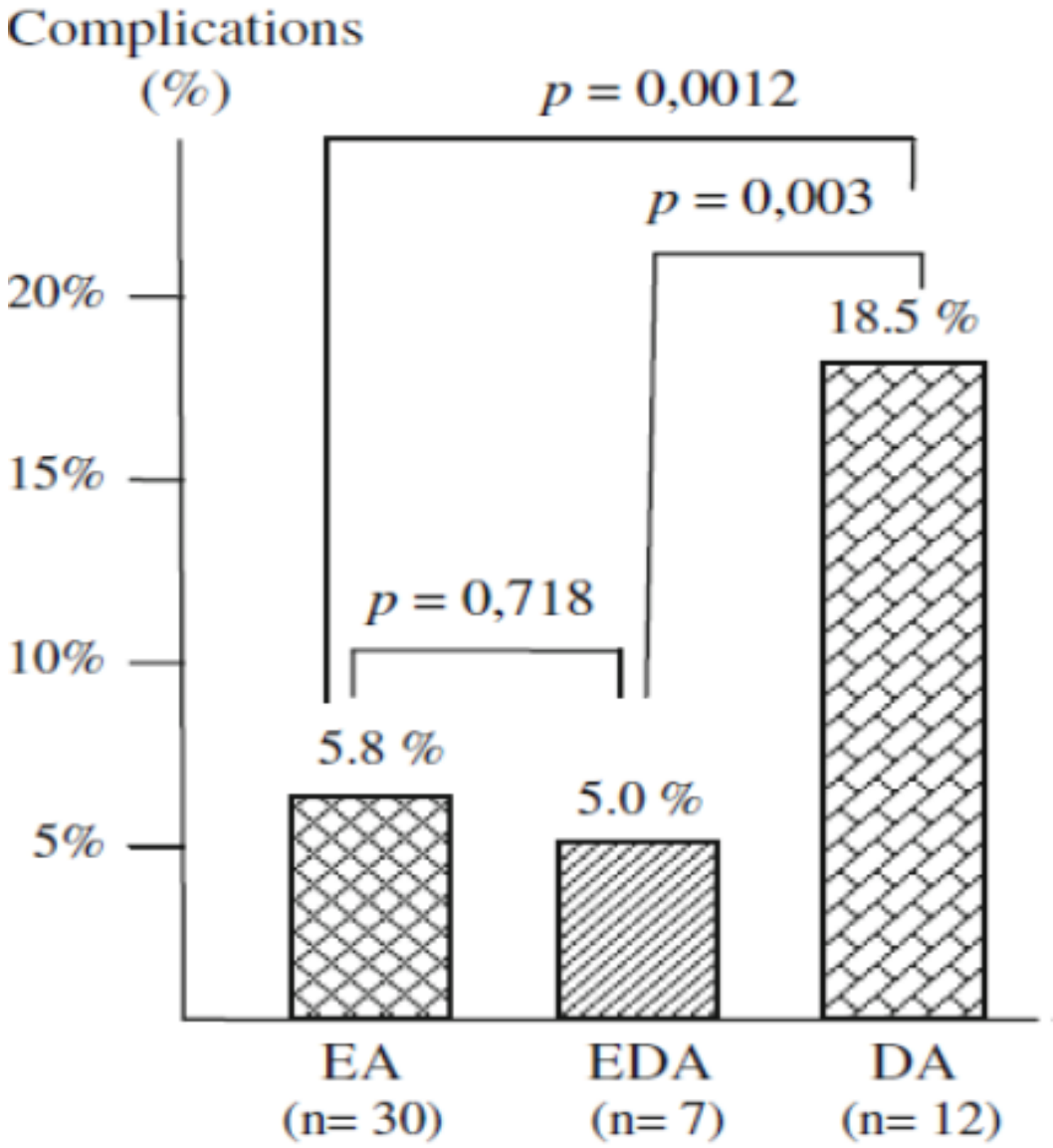
Distribution of organisms isolated from peritoneal cultures stratified by diagnosis[4]



Timing of Appendicectomy

- A prospective study of 723 patients
- 83% had OA and 17% had LA
- Early appendectomy: <12h
- Early-delayed appendectomies by 12–24 h after presentation: no impact on the perforation rate, operative time, complication rate or length of hospital stay.
- Delaying >24 h:- increased complications rate (18.5 %).
  - increased gangrenous appendices
  - worse grade of inflammation[5].

Comparison of the complication rate in the early appendectomy (EA), early-delayed appendectomy (EDA) and delayed appendectomy (DA) groups[5].



Management of Appendicitis

Uncomplicated appendicitis:

- Meta-analysis: lower post-intervention complications with surgery
  -appendicectomy (0.8%)
  -antibiotic therapy (10%)[6].

Complicated appendicitis:

- Meta-analysis: **conservative management with or without Interval appendicectomy**
- Conservative treatment:
  - Decreased complication and re-operation rate
  - Less wound infections, abdominal/pelvic abscesses, and ileus/bowel obstructions[7].

Interval Appendicectomy vs. No interval appendicectomy

- The risk of recurrent appendicitis is low compared to the risk of complications from interval appendectomy[12].
- Patients that undergo an interval appendicectomy:
  - -16% will not benefit from interval appendectomy (normal or obliterated appendix)
  - -84% likely benefit from interval appendectomy (persistent acute appendicitis, chronic appendicitis, evidence of inflammatory bowel disease, or neoplasm identified).
- Patients with **appendicoliths** are most likely to benefit from interval appendectomy as this becomes an environment for future infection[12].

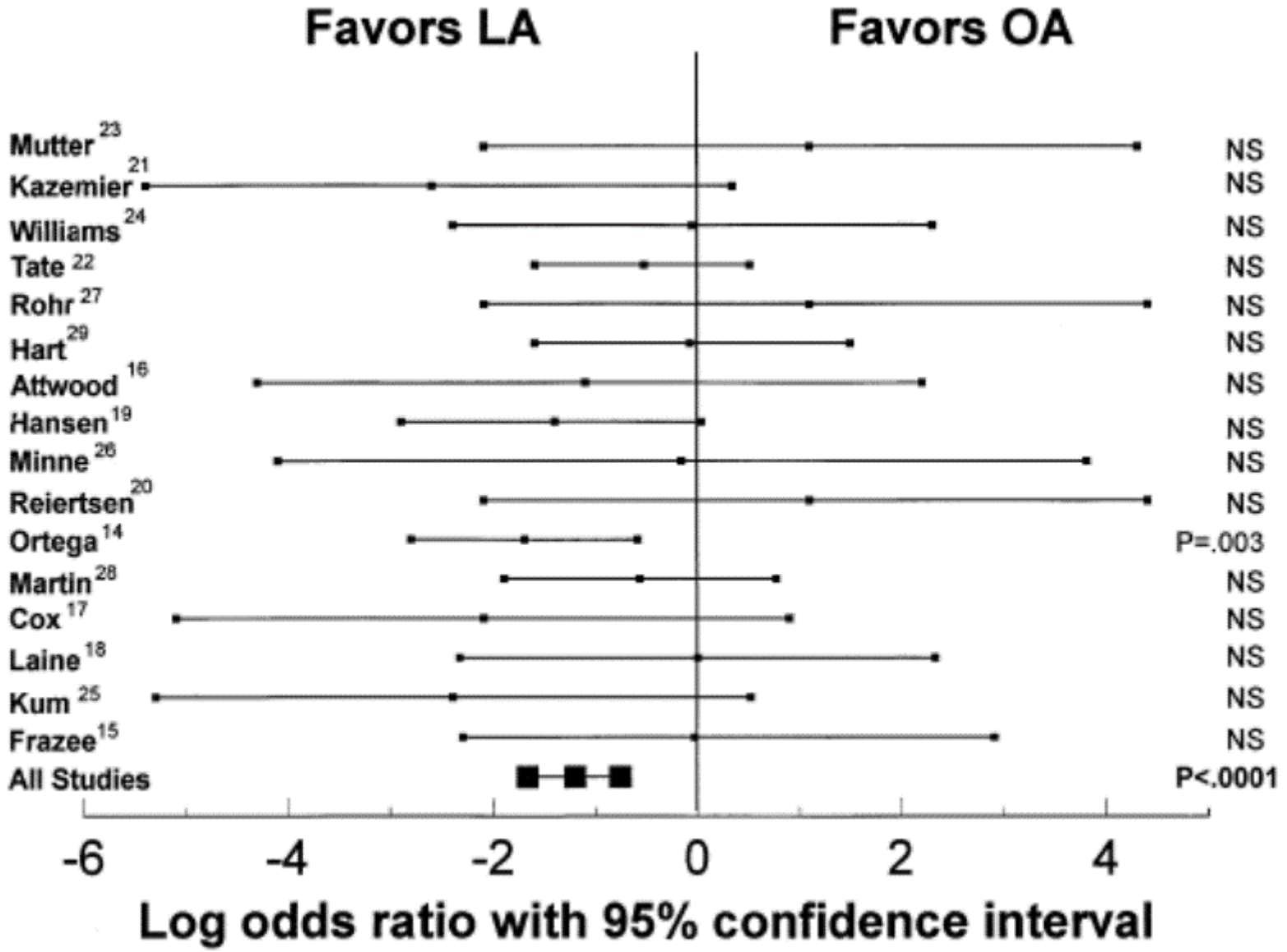
Laparoscopic vs. Open Appendicectomy

- A decreased incidence of wound infections has been considered to be a major advantage of laparoscopic appendectomy.
- Meta-analysis: wound infection rate in the Laparoscopic appendicectomy <50% the rate in the Open appendicectomy group.
- Intra-abdominal abscess incidence is higher in the Laparoscopic appendicectomy group (not statistical significant)[9].
- ?spillage within the abdominal cavity of infectious contents, promoted by the carbon dioxide pneumoperitoneum

Study	OR time (min)		Postoperative pain (days)		Postoperative stay (days)		Days to solids		No. of wound infections		No. of complications		Intra-abdominal abscess (n)		Return to normal activities (days)	
	LA	OA	LA	OA	LA	OA	LA	OA	LA	OA	LA	OA	LA	OA	LA	OA
Laine	56.0	32.0	—	—	2.7	2.3	—	—	1	1	1	0	0	0	13.1	18.2
Kazemier	61.0	42.0	35.3*	58.7*	3.7	4.4	2.1	2.2	0	6	8	5	0	1	—	—
Hansen	63.0†	40.0†	2.0‡	4.0‡	3.0†	3.0†	1.5	2.0	2§	8§	6	3	0	0	7.0	14.0
Cox	58.9	50.6	—	—	2.9	3.9	—	—	0‖	3‖	4	6	0	0	10.4	19.8
Tate	70.3¶	46.5¶	4.7*	5.3*	3.5	3.6	2.2	2.3	7‖	10‖	7	7	0	0	—	—
Martin	102.2	81.7	—	—	2.2	4.3	—	—	3	6	10	12	3	3	12.2	12.8
Frazee	87.0	65.0	1.2#	2.0#	2.0	2.8	1.7	2.5	1	1	2	3	1	0	14.0	25.0
Kum	43.4	40.1	1.0**	1.3**	3.2	4.2	1.8	1.8	0§	5§	—	—	0	0	17.0††	30.0††
Attwood	61.0†	51.0†	—	—	2.0†	3.0†	—	—	0	1	0	3	0	0	21.0‡‡	38.0‡‡
Minné	81.7† §§	66.8† §§	3.7*	4.0*	1.1†	1.2†	—	—	0	0	3	0	2	1	14.0‡‡	14.0‡‡
Ortega	67.1	58.0	4.1‖‖	4.2‖‖	—	—	—	—	4	11	79	33	6	0	9.0	14.0
Williams	93.0	87.0	1.0#	1.1#	2.4	2.8	0.98	1.6	1	1	3	2	—	—	—	—
Reiertsen	51.0	25.0	5.0*	5.4*	3.5	3.2	—	—	1	0	15	10	2	2	15.0	19.7
Mutter	45.0†	25.0†	4.7*	4.4*	5.3	4.9	1.03	0.875	1	0	2	1	0	0	—	—
Hart	73.8	45.0	4.05¶¶	5.58¶¶	3.23	3.03	—	—	3##	3##	—	—	3	0	9.0	16.2
Rohr	71.0	42.0	—	—	—	—	—	—	1	0	—	—	—	—	18.0‡‡	20.0‡‡

*Visual analog scale.
†Median.
‡Median dose of narcotics.
§Purulent drainage.
‖Discharge from wound and erythema.
¶Induction-reversal.
#Days of intramuscular narcotic use.
**Doses of intramuscular narcotics.
††Return to full home activities.
‡‡Time to return to work or school.
§§Time in room.
‖‖Days requiring pain medication.
¶¶Narcotic injections.
OR, operating room; LA, laparoscopic appendectomy; OA, open appendectomy.

Results of the Mantel-Haenszel meta-analysis for wound infections. LA, laparoscopic appendectomy;OA, open appendectomy[9].



Laparoscopic (LA) vs. Open Appendicectomy (OA) in Complicated Appendicitis

- Controversial
- LA: -higher technical demand
  -longer operative time,
  -higher reported incidence of intra-abdominal collections
- Retrospective study (1999-2004)
- The incidence of intra-abdominal collection rates for LA= 5.7% & OA= 4.3% ($p = 0.473$).
- Laparoscopic appendicectomy for complicated appendicitis is therefore feasible and safe and has less risk of wound infection ($p<0.001$)[10]

Laparoscopic (LA) Vs. Open Appendectomy (OA) for Complicated appendicectomy[10]

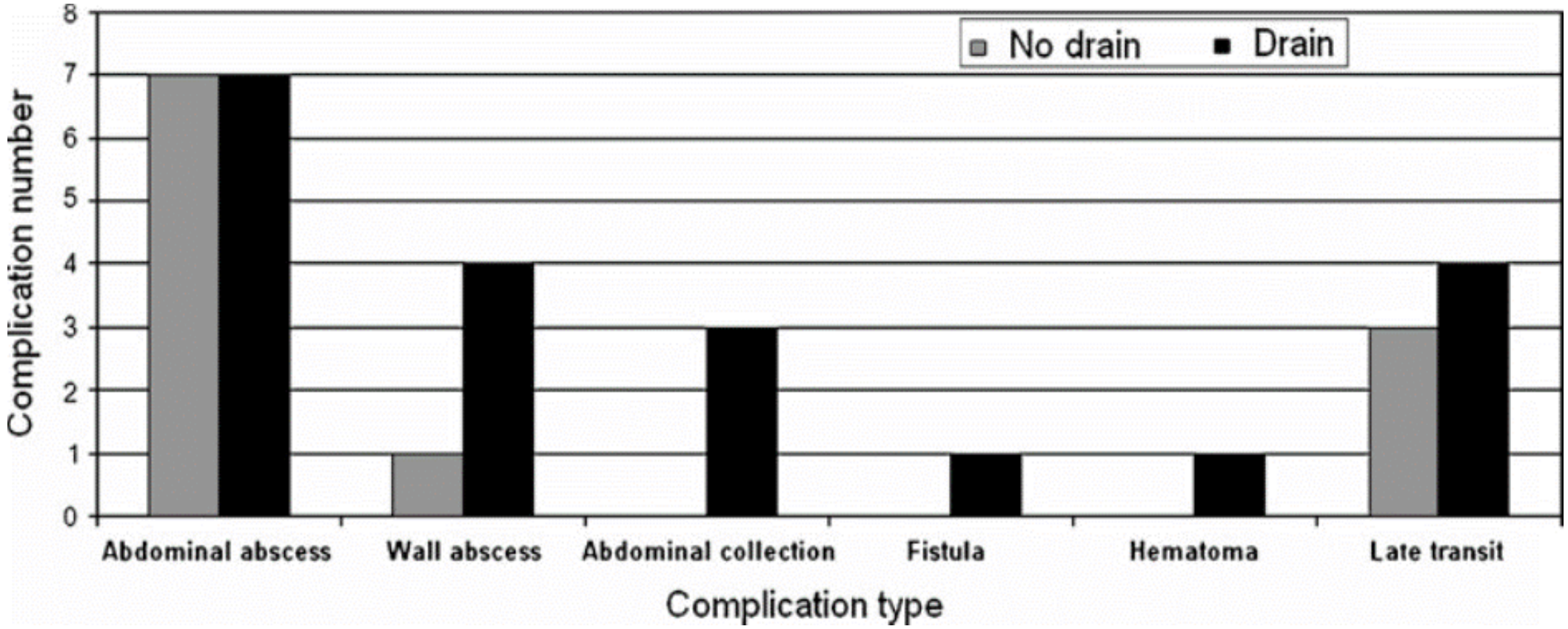
Characteristics	LA group (n = 175)	OA group (n = 69)	p Value
Gender (M/F)	75/100	35/34	0.27
Age (y), mean ± SD	46.3 ± 18.4	42.7 ± 19.1	0.17
Operative time (min), median (interquartile range)	55.0 (45–65)	70 (60–80)	<0.001*
Length of hospital stay (d), median (interquartile range)	5 (4–7)	6 (5–9)	<0.001*
Cases of wound infection, n (%)	1 (0.6)	7 (10)	<0.001*
Cases of intraabdominal collection, n (%)	10 (5.7)	3 (4.3)	0.47

F, female; LA, total laparoscopic appendectomy for complicated appendicitis, including 24 conversion cases; M, male; OA, open appendectomy for complicated appendicitis after diagnostic laparoscopy.
*Statistically significant.

Drain vs. No drain

- LA for complicated acute appendicitis with no-drain has a lower overall complication rate,
- No-drain=7.7% vs. Drain=18.5% (p=0.01),
- Complications are mainly low-grade.
- Abdominal wall abscesses are significantly more frequent in the drain group.
- Therefore the advantage of the laparoscopic, i.e. the reduced wound infection rate, is eliminated by routinely inserted drains[11].

Details of surgical complications and drains (n=320)[11]



NOTES (natural orifice transluminal surgery)

- A prospective study was done on 13 transvaginal-hybrid NOTES appendectomies.
- 1 developed an intra-abdominal abscess (with a vaginal fungal infection)
- 1 developed an infected hematoma
- Both occurred after a perforated appendicitis.
- No sexual dysfunction for up to 2 years or child-delivery complications
- Intraoperative and early postoperative data seem comparable to that of Laparoscopic appendicectomy.
- NOTES also prevents abdominal wall trauma like trocar hernias.
- NOTES appendectomy is an alternative to Laparoscopic appendicectomy[13].

Summary of Post-operative complications

Early complications (first week postoperatively)

- **Wound infection**: Most common early complication following appendicectomy for perforated appendicitis.
- **Intra-abdominal abscesses:-** esp. in gangrenous or perforated appendicitis

  - responsible for the majority of reported deaths after LA[4]
- **Postoperative ileus**
- **Port site haematoma:** for LA can be avoided by removing ports under vision[1]
- **Postoperative bleeding:-** trocar injury to the epigastric vessels (LA)

  -from inadequate hemostasis during the operative procedure

  -from unrecognized injury to a major vessel during laparoscopic appendectomy.

  Management: transarterial embolization or exploration
- **Postoperative leak**

Late complications (>1 week post appendicectomy)

- **adhesional obstruction**,
- **faecal fistula**
- **incisional hernias**
- **Urinary tract disorders** (retention and infection)-25% of all complications and is slightly more common in perforated appendicitis.
- **Postoperative pneumonias** More than half of are associated with the presence of perforation[4].
- **Miscellaneous complications:** pseudomembranous enterocolitis, pulmonary embolus, acute renal failure, myocardial infarction, DVT, and common iliac artery laceration secondary to laparoscopic trocar insertion[4].

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Introduction

- first described in the 16th century as perityphlitis (inflammation of the connective tissue around the caecum).
- 1886: Reginald H. Fitz- pathogenesis starting with acute inflammation of the appendix to peritonitis and iliac-fossa abscess.
- Fitz also recommended surgical for most cases.
- 1889: McBurney described the clinical findings.
- Appendicectomy is still the mainstay of treatment.

Post-operative antibiotics?

- Surgical Infection Society (SIS) Guidelines: post-operative antibiotic regimen adjusted according to the appearance of the appendix at operation.
- For perforated and gangrenous/inflamed appendicitis with **intraperitoneal contamination**, as many as five days of antibiotics is recommended.
- For gangrenous/inflamed appendicitis with **no evidence of intra-peritoneal contamination**, no more than one day of antibiotics is recommended.
- For **simple inflamed** appendicitis and normal appendices, no antibiotics should be administered after surgery.

Irrigation Vs. Suction

- Prospective, randomized trial
- With perforated appendicitis
- No difference in abscess rate, 19.1% with suction only and 18.3% with irrigation
- In the patients who developed an abscess, there was no difference in duration of hospitalization, days of intravenous antibiotics, duration of home health care, or abscess-related charges.
- Conclusions: There is no advantage to irrigation of the peritoneal cavity over suction alone