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

![Bar chart showing the distribution of organisms isolated from peritoneal cultures stratified by diagnosis. The x-axis represents different types of organisms and the y-axis represents the percentage. The chart includes categories for No Growth, E. coli, Enterococcus, Other Strep, Pseudomonas, Klebsiella, and Bacteroides. The chart distinguishes between Normal, Acute, and Perforated conditions.]
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\textsuperscript{5}.
Comparison of the complication rate in the early appendectomy (EA), early-delayed appendectomy (EDA) and delayed appendectomy (DA) groups\textsuperscript{5}.

![Comparison of complication rates](chart.png)
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\textsuperscript{12}.

• Patients that undergo an interval appendicectomy:
  - 16% will not benefit from interval appendectomy (normal or obliterated appendix)
  - 84% likely benefit from interval appendicectomy (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\textsuperscript{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
<table>
<thead>
<tr>
<th>Study</th>
<th>OR time (min)</th>
<th>Postoperative pain (days)</th>
<th>Postoperative stay (days)</th>
<th>Days to solids</th>
<th>No. of wound infections</th>
<th>No. of complications</th>
<th>Intrabdominal abscess (n)</th>
<th>Return to normal activities (days)</th>
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<td>—</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>—</td>
</tr>
</tbody>
</table>

*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. 

![Graph showing the results of the meta-analysis with odds ratios and 95% confidence intervals for studies favoring LA or OA, with P values for the overall analysis.]
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

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

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\textsuperscript{11}.
Details of surgical complications and drains (n=320)
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\(^\text{13}\).
Summary of Post-operative complications

Early complications (first week postoperatively)

- **Wound infection**: Most common early complication following appendectomy for perforated appendicitis.
- **Intra-abdominal abscesses**: esp. in gangrenous or perforated appendicitis
  - responsible for the majority of reported deaths after LA
- **Postoperative ileus**
- **Port site haematoma**: for LA can be avoided by removing ports under vision
- **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

- **Miscellaneous complications**: pseudomembranous enterocolitis, pulmonary embolus, acute renal failure, myocardial infarction, DVT, and common iliac artery laceration secondary to laparoscopic trocar insertion.
References

References


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 intraperitoneal 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