Amsterdam UMC
University Medical Centers

Amsterdam Infection & Immunity Institute

Complex appendicitis in the pediatric population

Identification of the optimal treatment strategy according to the severity

P. van Amstel, MD[1], R. Bakx, MD PhD[1], L.W.E. van Heurn, MD PhD[1],
J.H. van der Lee, MD PhD[2], R.R. Gorter, MD PhD[1]

1. Department of Pediatric Surgery, Emma Children's Hospital, Amsterdam UMC, University of Amsterdam & Vrije Universiteit Amsterdam, Amsterdam, The Netherlands.
2. Division Woman and Child, Amsterdam UMC, University of Amsterdam & Vrije Universiteit Amsterdam, Amsterdam, The Netherlands.

This research was supported by a travel grant of the Amsterdam Infection & Immunity Institute

Appendicitis

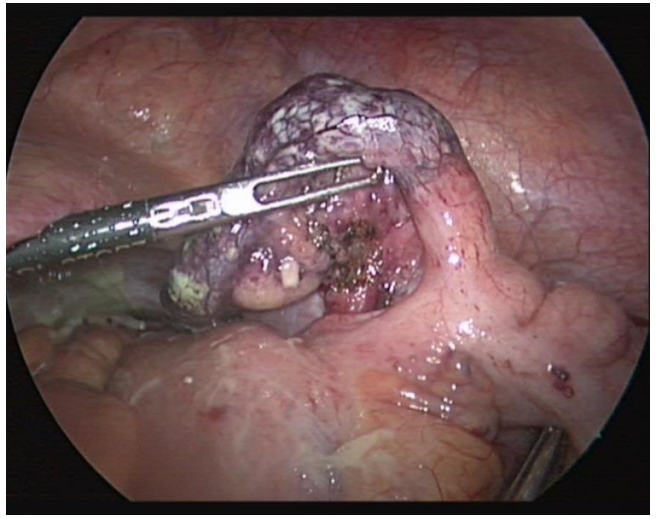
Incidence:
1/1000 per year

Treatment:
Appendectomy (2010):15692
Age 0-20jr: 5665[1]

Types:
Simple (70%)
Complex (30%)%[2]

CBS statline, Bolmers et al 2018

Simple vs. Complex



Treatment of complex appendicitis

Time to surgery and risk of perforation

- In hospital delay ≠ higher risk of perforation[1]
- Cohort 2756 children
- Multivariate logistic regression analysis
- No association between time to surgery and increased risk of perforation

1. Almstrom et al

	Macroscopic appearances	Microscopic appearances	Clinical relevance
Normal appendix (figure 1A)			
Normal underlying pathology	No visible changes	Absence of any abnormality	Consider other causes
Acute intraluminal inflammation	No visible changes	Luminal neutrophils only with no mucosal abnormality	Might be the cause of symptoms, but consider other causes
Acute mucosal/submucosal inflammation	No visible changes	Mucosal or submucosal neutrophils and/or ulceration	Might be the cause of symptoms, but consider other causes
Simple, non-perforated appendicitis (figure 1B)			
Suppurative/phlegmonous	Congestion, colour changes, increased diameter, exudate, pus	Transmural inflammation, ulceration, or thrombosis, with or without extramural pus	Likely cause of symptoms
Complex appendicitis (figure 1C)			
Gangrenous	Friable appendix with purple, green, or black colour changes	Transmural inflammation with necrosis	Impending perforation
Perforated	Visible perforation	Perforation; not always visible in microscope	Increased risk of postoperative complications
Abscess (pelvic/abdominal)	Mass found during examination or abscess seen on preoperative imaging; or abscess found at surgery	Transmural inflammation with pus with or without perforation	Increased risk of postoperative complications

Modified from the classification system by Carr.[6] Figure 1 provides photographic examples of macroscopic pathology.

Table 1: **Stratified disease approach to acute appendicitis**

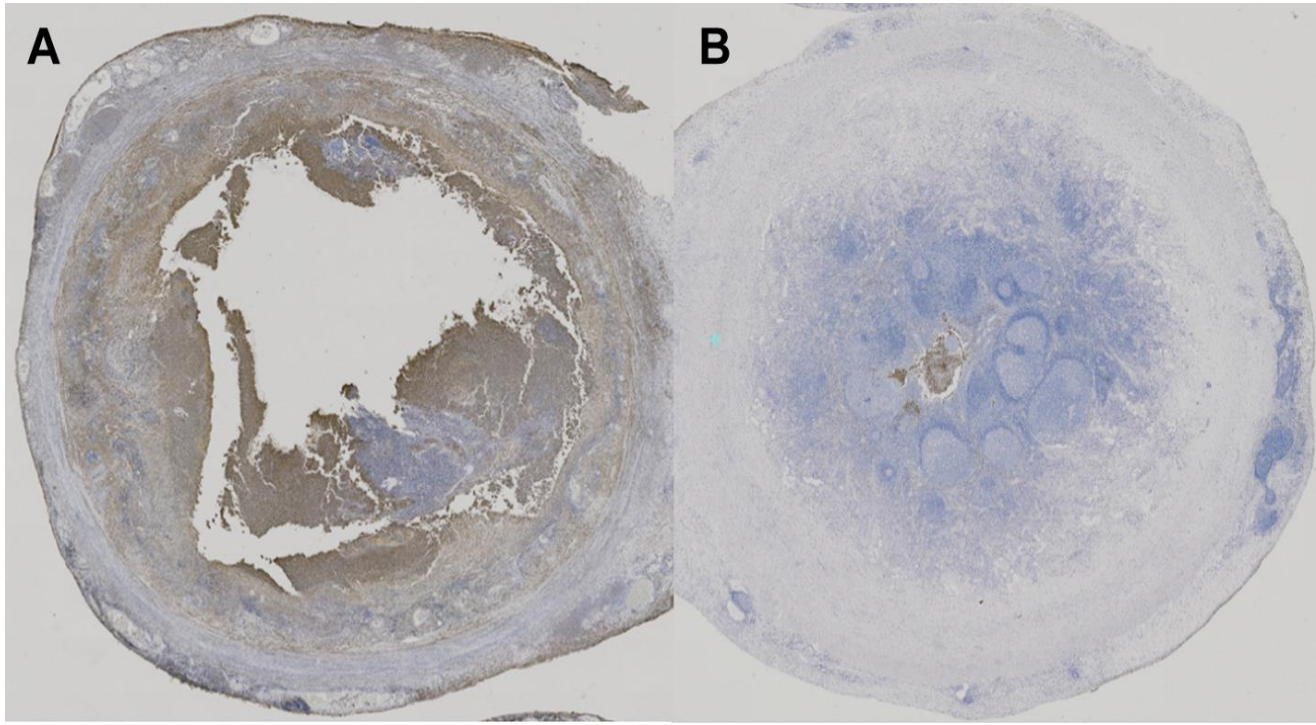
Bhangu et al 2017, Carr et al 2000

Pathology

Immunologic response in appendix (N=47)

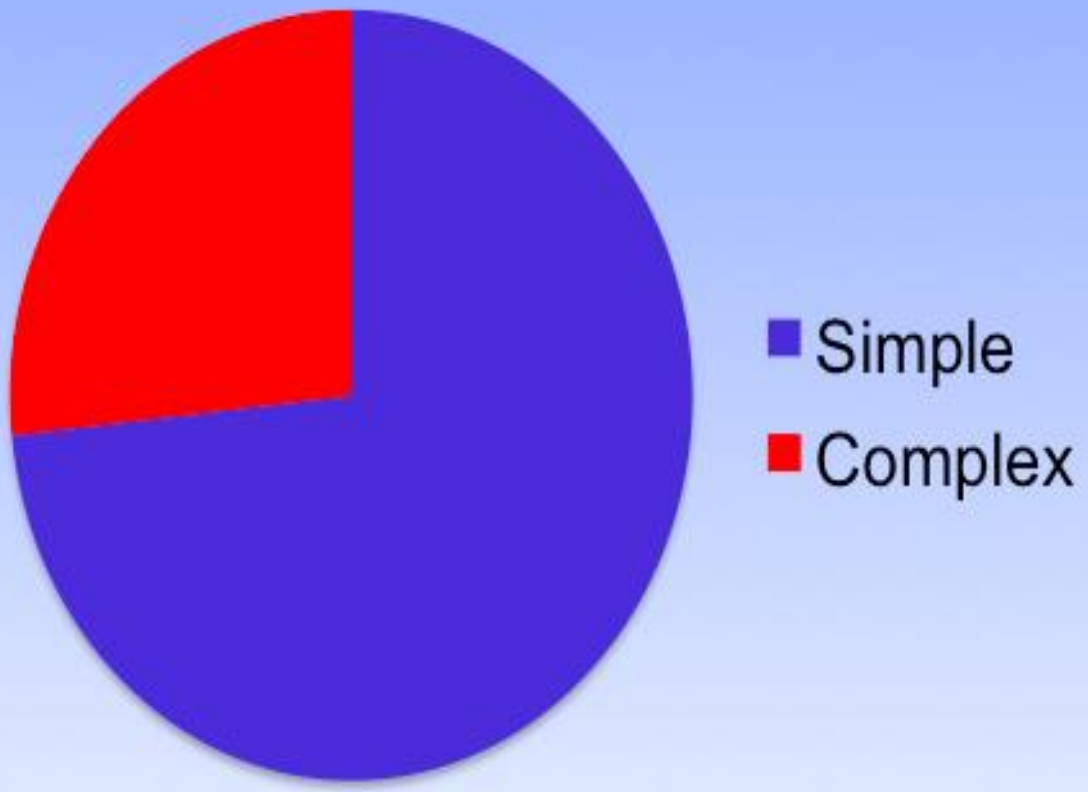
Complex appendicitis

- Increase in MPO+ Cells
- Decrease in CD8+/CD20/21 Cells

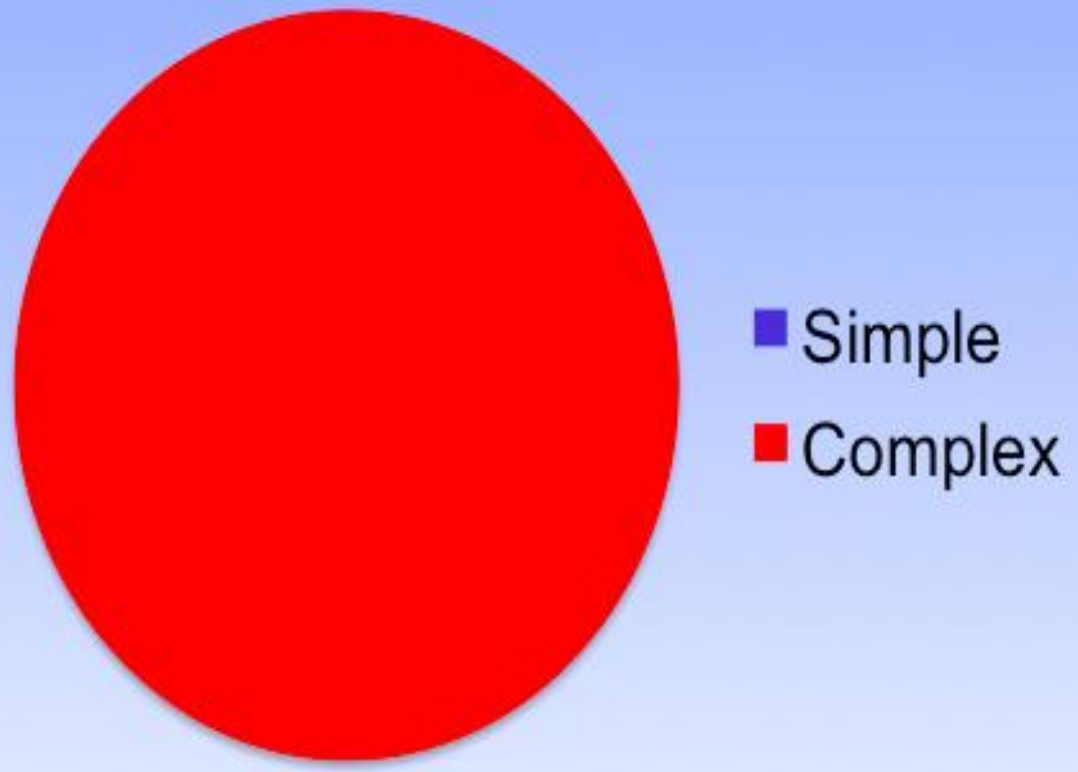


Gorter et al

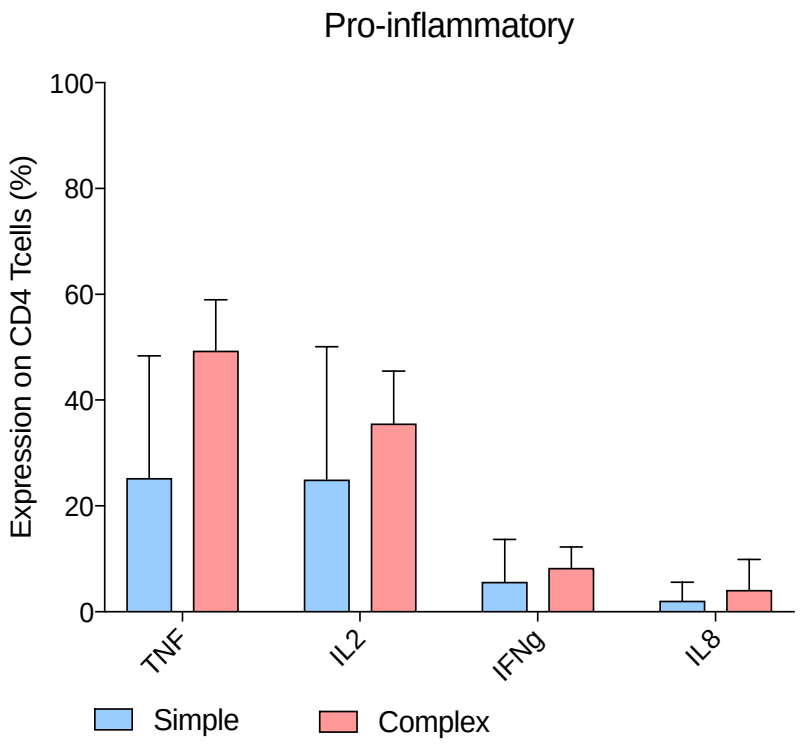
Cluster 1

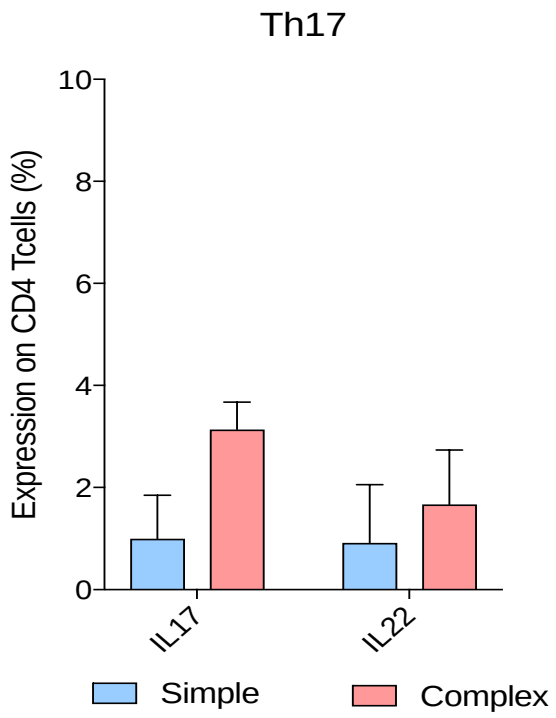


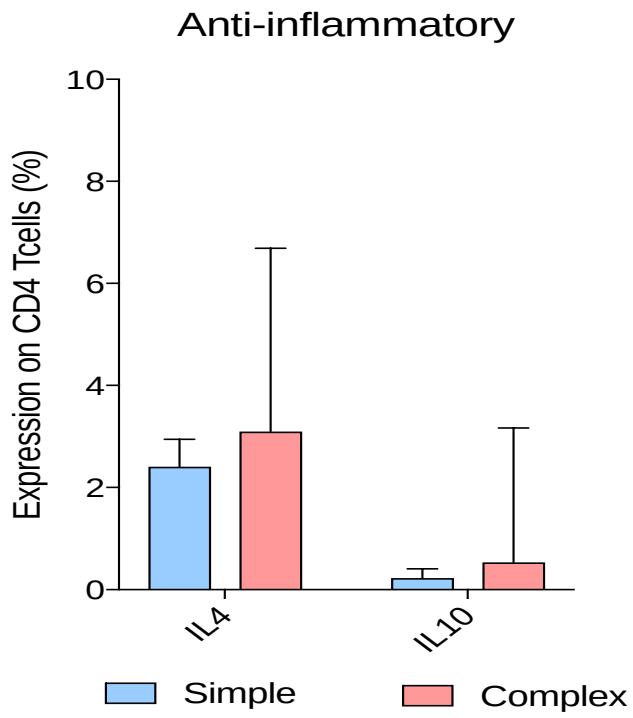
Cluster 2



Immunologie (N=20)







The et al (unpublished data)

Treatment of complex appendicitis

Subtypes:

Complex appendicitis without abscess or mass

Complex appendicitis with abscess or mass

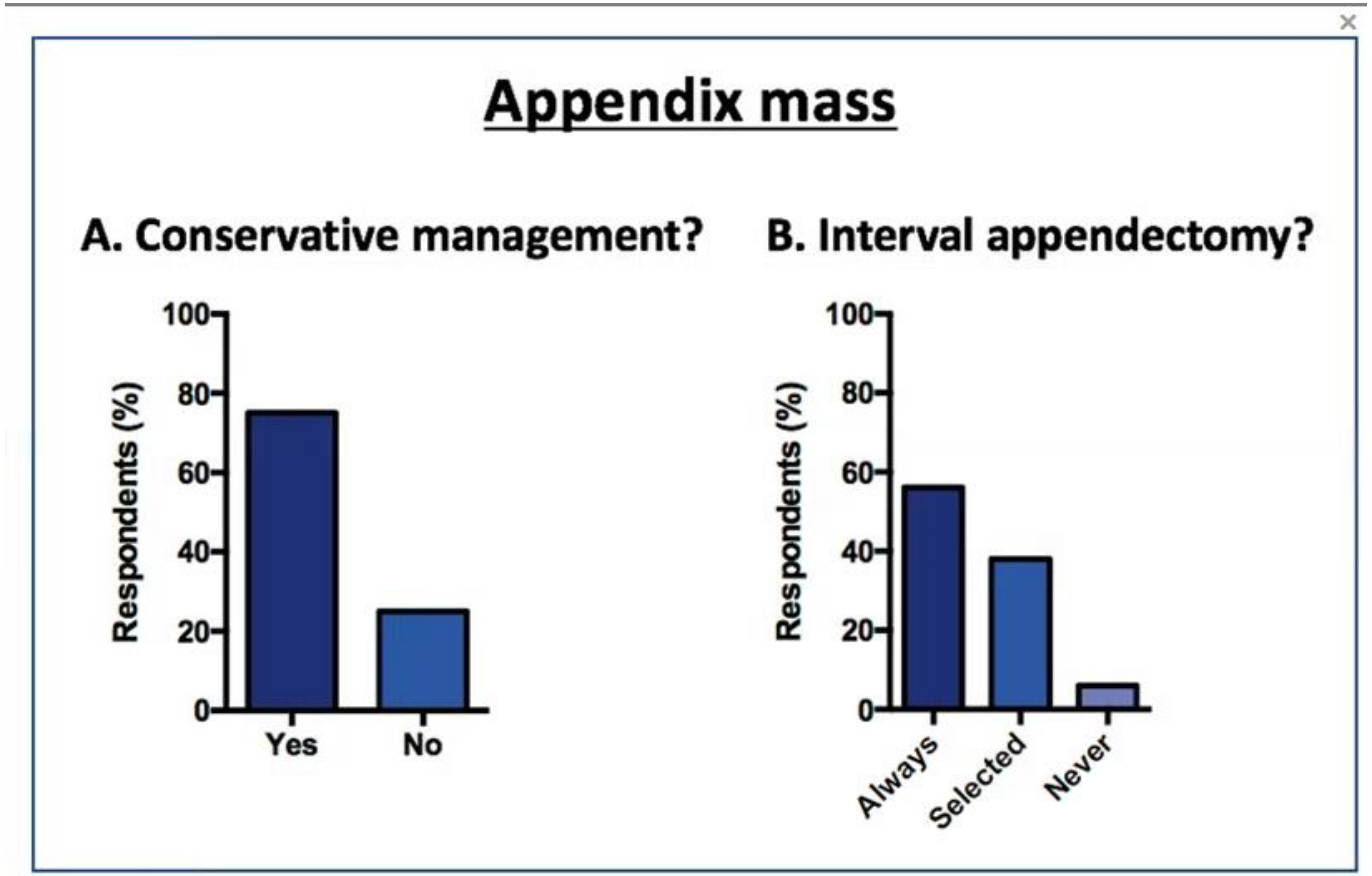
CBS statline, Bolmers e*Complexe appendicitis zonder abces of infiltraat vorming*
t al 2018

National guideline

- Recently updated (2019)

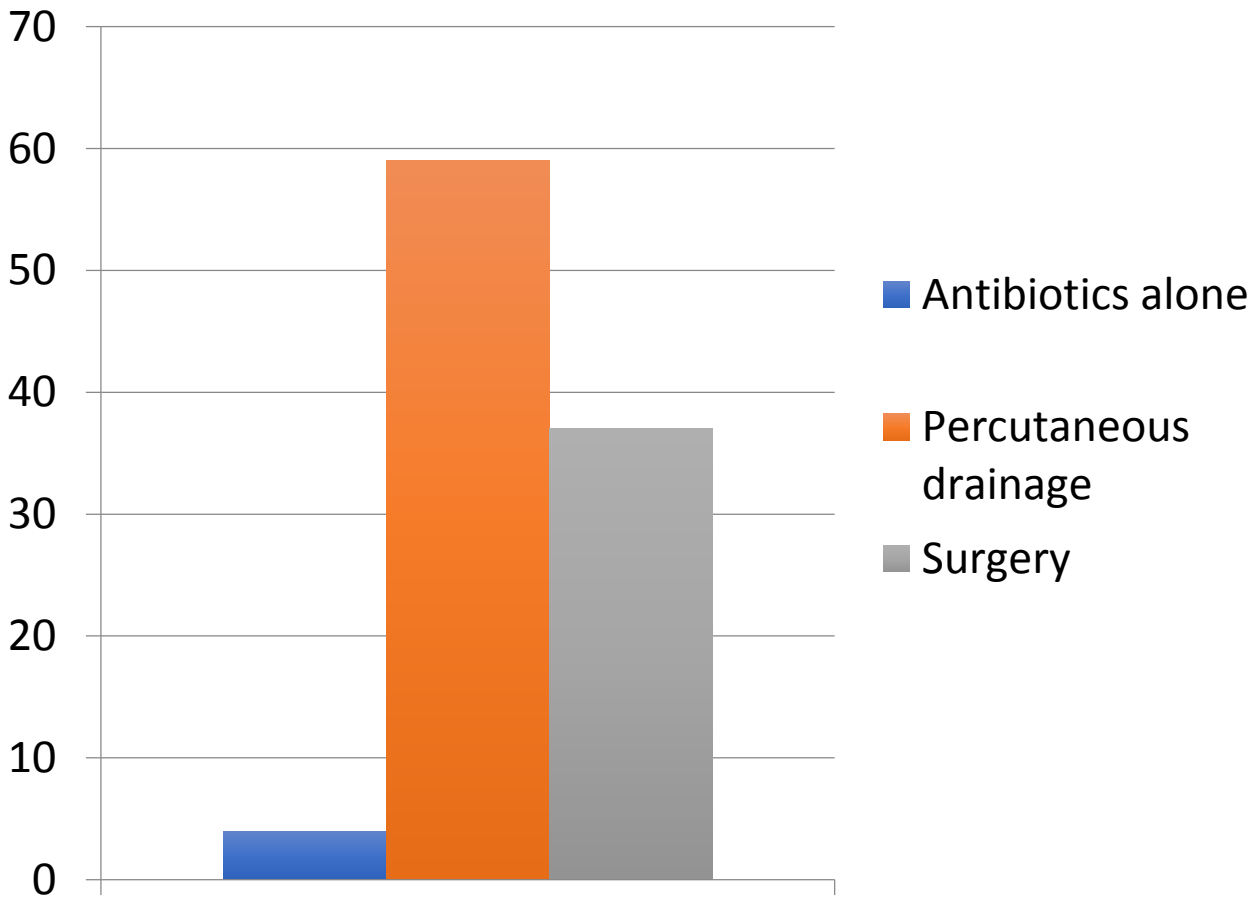
- Recommendation for early appendectomy
  - No readmission (interval appendectomy)
  - Shorter length of stay

Complexe appendicitis with mass



Zani et al 2019

Complexe appendicitis with abscess



Zani et al 2019

Meta-analysis

To compare the overall complication rate between non-operative treatment and early appendectomy for children with an appendiceal mass/abscess

Methods

Systematic review (PRISMA)

Children <18 years old with appendiceal mass/abscess

Non operative treatment (NOT)

Early appendectomy (EA)

RCT

Cohort studies

Overall complication rate

Secondary:

length of stay, readmission rate

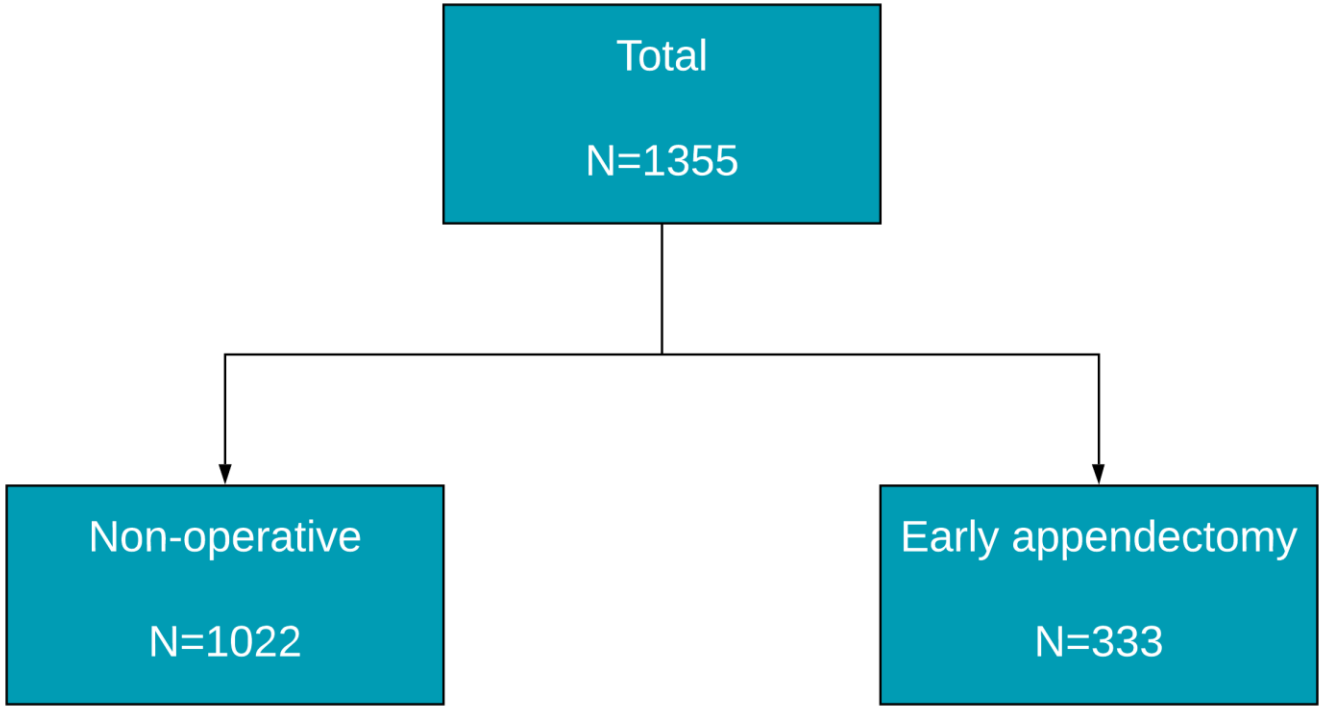
Included studies

RCT (N=1)
Prospective cohort (N=2)
Retrospective cohort (N=11)

N=1355

Risk of Bias

- Moderate (5 studies)
- Severe (9 studies)

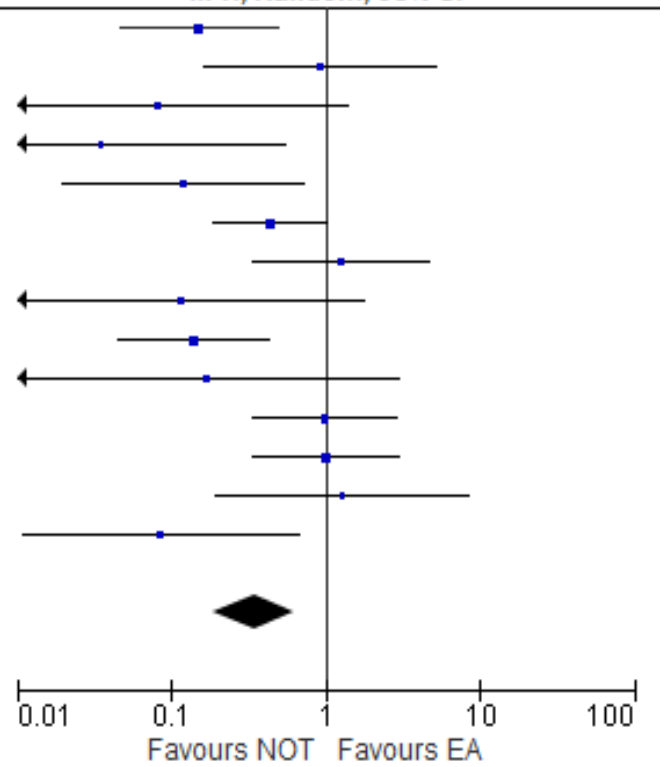


Overall complication rate

Study or Subgroup	NOT Events	NOT Total	EA Events	EA Total	Weight	Risk Ratio M-H, Random, 95% CI
Calvert 2014	3	64	13	42	9.6%	0.15 [0.05, 0.50]
Emil 2007	2	32	3	44	6.8%	0.92 [0.16, 5.17]
Erdogan 2005	0	21	5	19	3.5%	0.08 [0.00, 1.40]
Furuya 2015	0	16	13	15	3.6%	0.03 [0.00, 0.54]
Gahukamble 1993	2	59	2	7	6.5%	0.12 [0.02, 0.72]
Gastrin 1969	6	29	9	19	11.8%	0.44 [0.19, 1.03]
Gillick 2001	65	411	2	16	8.9%	1.27 [0.34, 4.71]
Handa 1997	0	6	5	8	3.7%	0.12 [0.01, 1.78]
Puri 1981	3	31	11	16	10.0%	0.14 [0.05, 0.43]
Roach 2007	0	32	5	60	3.4%	0.17 [0.01, 2.95]
Samuel 2002	9	57	4	25	10.3%	0.99 [0.34, 2.91]
St Peter 2010	5	20	5	20	10.4%	1.00 [0.34, 2.93]
Surana 1995	27	189	1	9	6.1%	1.29 [0.20, 8.43]
Tanaka 2016	1	55	7	33	5.5%	0.09 [0.01, 0.67]
Total (95% CI)		**1022**		**333**	**100.0%**	**0.34 [0.19, 0.63]**
Total events	123		85			

Heterogeneity: Tau² = 0.60; Chi² = 27.01, df = 13 (P = 0.01); I² = 52%

Test for overall effect: Z = 3.50 (P = 0.0005)



Secondary outcomes

NOT:

Increased total length of stay (n=9)

2.92 [-0.15 - 5.99] days

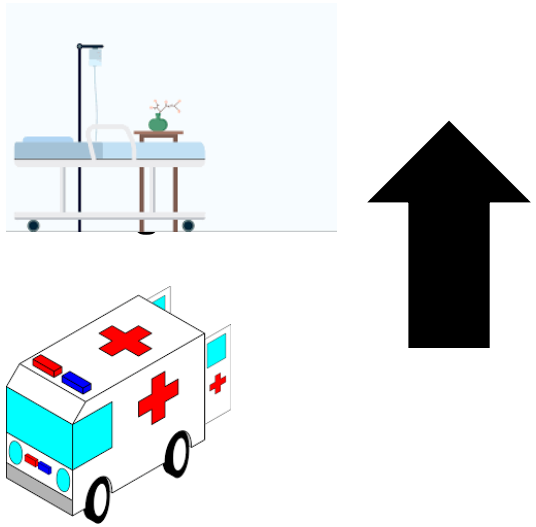
Increased readmission rate (n=8)

RR 1.75 [0.79 - 3.89]

Conclusion

1. **High quality data is lacking**

2. Non-operative treatment strategy for children with an appendiceal mass/abscess



CAPP study

- Nationwide prospective cohort study

- To compare
  - NOT vs EA for complicated appendicitis (CA) with abscess/mass

- Outcomes:
  - Overall complication rate within 3 months
    - QoL, costs, length of stay

Overall conclusion

Two types of appendicitis

Treatment complex appendicitis (abscess/mass)

Evidence: Scarce

Low quality