Treatment of appendiceal mass – a qualitative systematic review

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ABSTRACT

INTRODUCTION: The treatment strategy for appendiceal mass is controversial, ranging from operation or image-guided drainage to conservative treatment with or without antibiotics. The aim of this study was to assess the various treatment modalities with respect to complications and treatment failure.

METHODS: The analysis was based on the principles of a qualitative systematic review. The literature was searched in PubMed for the period from 1966 to March 2014. The articles were reviewed with respect to complications, treatment failure and hospital stay. Papers on post-operative intra-abdominal abscesses and abscesses of any cause other than appendicitis were excluded as were also studies only describing recurrent appendicitis and/or interval appendectomy. Sub-analyses were performed in children, adults, and in mixed populations.

RESULTS: A total of 48 studies were found eligible; they included in total 3,772 patients. Operation for appendiceal mass was beset with a moderate to high risk of complications of up to 57% and a risk of intestinal resection of up to 25%. Major complications were observed in up to 18% of cases. Conservative treatment with or without antibiotics was associated with a treatment failure rate of 8-15%. Drainage was beset with a risk of complications of 2-15% and a risk of treatment failure of 2-13%.

CONCLUSION: Operation with appendectomy for appendiceal mass carries a high risk of complications compared with conservative treatment or drainage. Drainage may lower the risk of treatment failure but entails a risk of complications. Based on the best evidence, we propose a step-down treatment strategy.

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Suspicion of acute appendicitis is one of the most common reasons for hospital admittance and emergency operations [1, 2]. In patients suffering from acute appendicitis, up to 7% will present with an appendiceal mass [3-5]. The pathological spectrum may range from discrete phlegmone to abscess formation [1, 2].

The optimal treatment of patients with an appendiceal mass is controversial and treatment strategies are based on sparse evidence [6, 7]. The different treatment strategies include conservative treatment with or without antibiotics, percutaneous, trans-rectal or trans-vaginal drainage and surgical treatment [1]. Conservative treatment may prolong hospital stay and convalescence, and surgical treatment carries a risk of intestinal resection and major complications. Drainage may carry a risk of both treatment failure and complications [2, 8].

This systematic review was undertaken to perform a critical analysis of outcome after conservative treatment with or without antibiotics, percutaneous drainage, and surgical treatment of appendiceal mass in children and adults. The primary outcome was treatment failure and complications, and the secondary outcome was duration of hospital stay. This review does not address treatment for recurrent appendicitis and interval appendectomy ("cold" appendicitis).

METHODS

The present analysis was based on the principles for qualitative systematic reviews as described by PRISMA [9, 10]. The search strategy and PICOS (Population, Interventions, Comparators, Outcomes, Study designs of interest) were made as described below. The heterogeneity of studies and the fact that the majority of the studies were uncontrolled retrospective series precluded a statistical meta-analysis.

Search strategy

The literature was searched through PubMed from 1966 to March 2014 using the following MeSH terms (and free text terms on a combination of these): "Appendicitis" [MeSH] AND ("abscess" [MeSH] OR "mass" [All Fields] OR "appendiceal" [All Fields] OR "conservative" [All Fields] OR "phlegmone" [All Fields] OR "interval" [All Fields]) AND ("humans" [MeSH Terms] AND English [lang]). A "free text term" search on combinations of the above terms was also performed in the Embase and Cochrane Library and included cross-reference to the referenced articles.

Study exclusion criteria

Only English language articles were included. Only original articles were included, thus reviews and meta-analysis were excluded. Papers on post-operative intra-abdominal abscesses/mass and abscesses of any cause other than appendicitis were excluded, as was papers in-

SYSTEMATIC REVIEW

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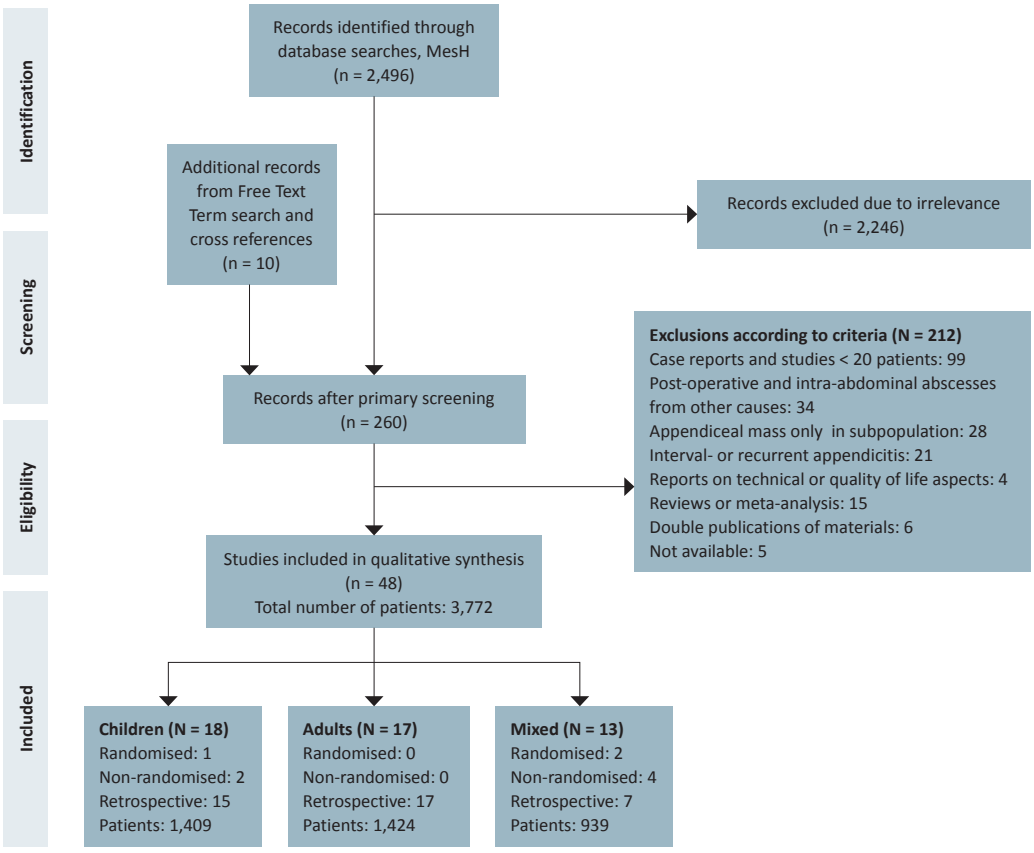
FIGURE 1

PRISMA flow diagram of study selection.



cluding poorly defined subpopulations of patients with appendiceal mass. Furthermore, studies only describing recurrent appendicitis and/or interval appendectomy were excluded from the analysis. Finally, we excluded non-randomised studies including less than 20 patients (**Figure 1**).

Definitions and outcomes

We defined an appendiceal mass as an inflammatory mass consisting of an inflamed appendix and adjacent viscera, ranging from phlegmone to well-defined abscess [1-3, 11]. Diagnosis of appendiceal mass was based on clinical examination, computed tomography (CT), transabdominal ultrasound (US) or peroperative findings. Treatment failure with conservative treatment or percutaneous drainage was defined as unsuccessful in case of operation during the same hospital admission or shortly after discharge (less than one week). Surgical treatment was defined as attempted operative appendectomy either with laparotomy or laparoscopy. Treatment outcome for phlegmone and abscess was noted separately whenever possible. Complications after drainage and surgical treatment were divided into major and minor complications [12]. Major complications were defined as severe and potentially fatal complications comprising death and those requiring reoperation, except for wound opening due to infection [12]. All other complications were defined as minor complications. Both surgical and medical complications were included. As almost all included studies, rarely mentioned complications due to surgery after treatment failure, it was not possible to summarise these systematically. In several papers, it was not possible to distinguish between the total number of complications and complications per patient, and the analysis therefore included total numbers of complications. Clinical presentation and mean hospital stay were noted whenever these had been reported. Children ≤ 15 years and adult patients were analysed separately when possible. Studies reporting a mixture of paediatric and adult patients were classified as mixed.

Trial registration: not relevant.

RESULTS

If possible and for reasons of clarity (see methods above), we report results separately for children and adults. From a pool of 2,496 potentially relevant studies, we included 48 studies (three prospective ran-

TABLE 1

Treatment failure and complications. Outcomes in 48 reports for appendiceal mass, with diagnostic modalities and type of treatment stated.

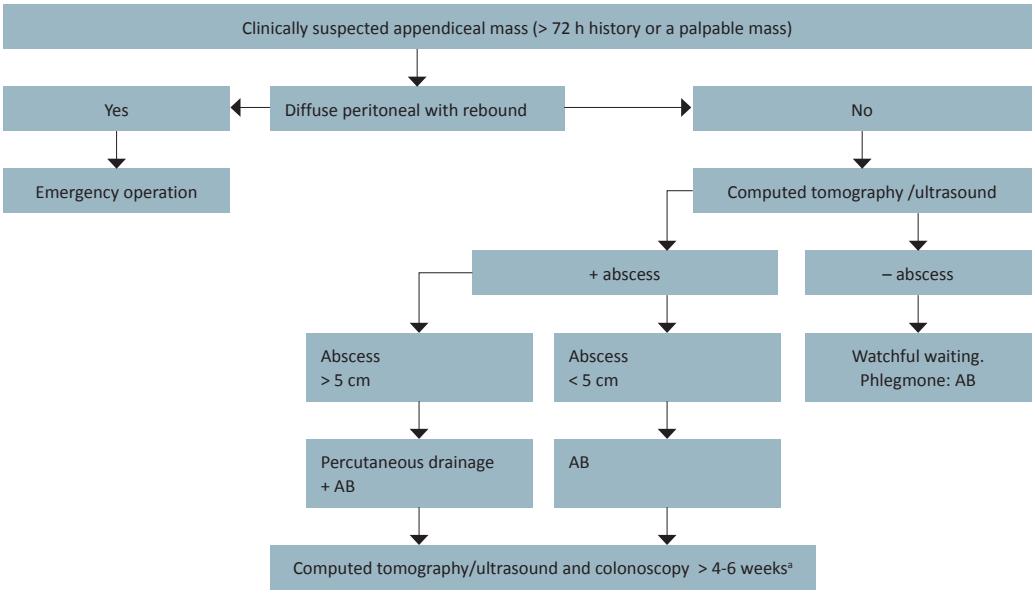
							Complications, %[b]		
Reference	Year	Study design	Treatment	Diagnosis	Patients, n	Treatment failure, %[a]	major	minor	Hospital stay, days
Chiuldren									
[16]	1980	R	C	Clin	37	19	–	–	13
[13]	1985	R	C	Clin	77	10	–	–	11
[15]	2000	R	C	Clin	59	8	–	–	9.5
[14]	2001	R	C	Clin/US/CT	411	16	–	–	6
[21]	2004	R	D	CT	73	26	–	–	–
[24]	2005	R	D	X-ray/US/CT	96	6	–	–	–
[23]	2006	R	D	CT/US	36	0	–	–	6
[22]	2007	R	D	CT/US	32	9			7
[27]	2008	R	D	CT	52		11	0	7
[25]	2008	R	D	CT/US	42	2			15
[26]	2013	R	D	CT/US	105	2	0	0	–
[33]	2010	RCT	D vs S	CT	40	20	0 vs 0	25 vs 20	7 vs 6.5
[35]	2002	P	C vs S	Clin/US	82	21	0	12	13 vs 5
[34]	2005	P	S	Clin/US/i.op	22		0	0	6
[37]	1969	R	C vs S	Clin/i.op	59	21	11	33	14 vs 15
[38]	1981	R	C vs S	Clin	54	10	19	56	26.5 vs 32
[39]	2005	R	C vs S	US/i.op	40	0	11	11	8 vs 7.5
[36]	2007	R	D vs S	Not defined	92	0	0 vs 0	0 vs 10	8 vs 7
Adults									
[18]	1987	R	D and C	Clin/US	40	8	6	0	–
[17]	1998	R	D and C	CT	66	13	0	3	8
[28]	2007	R	D and C	CT/US	94	5	1	0	9
[29]	2010	R	D	CT	41	10	2	0	–
[49]	1976	R	S	Clin	34		0	29	9
[50]	2010	R	S	Clin/US/i.op	114		0	11	6
[51]	2012	R	S	Clin/CT/UL	47		9	30	5
[42]	1978	R	C vs S	Clin	43	13	0	0	11 vs 7.5
[5]	1984	R	C vs S	Clin	48	22	0	57	11 vs 6.5
[48]	1988	R	C vs S	Clin	193	1	0 vs 5	2 vs 26	–
[47]	1995	R	C vs S	Clin/US	147	9	9	23	–
[46]	2007	R	C vs S	CT/US	121	0	0	33	9 vs 4
[41]	2000	R	D vs S	CT/i.op	155		6 vs 12	11 vs 39	9 vs 9
[44]	2002	R	D vs S	Clin/CT/US	93	2	0 vs 16	0 vs 46	6.5 vs 9
[40]	2003	R	D vs S	CT/US/i.op	104	4	6 vs 31	6 vs 70	9 vs 15
[43]	2009	R	D vs S	CT/i.op	56	0	0 vs 5	0 vs 20	9 vs 7
[45]	2010	R	D vs S	Clin/CT/US	30	0	0 vs 0	0 vs 40	15 vs 10
Mixed population of children and adults									
[30]	2007	RCT	C vs D	CT/US	50	32 vs 4			11 vs 15
[31]	1988	P	D	CT	70	13	0	53	7-12
[20]	1973	R	C	Clin	37	23			10.5
[19]	1982	R	C	Clin	202	12			13
[32]	2002	R	D	CT/US	24		0	17	6
[52]	2004	RCT	C vs S	X-ray/US	60	0	0	30	5 vs 21
[53]	1994	P	C vs S	Clin	58	0	0	17	19 vs 15
[56]	2003	P	D vs S	Clin/CT	32		0 vs 7	12 vs 27	8.5 vs 8
[55]	2008	P	C vs S	X-ray/US	176	15	0	22	–
[57]	1981	R	S	Clin	45		0	33	–
[59]	2001	R	S	X-ray/CT/US	92		6	21	10.5
[58]	2012	R	S	Clin/UL	46		0	33	3
[54]	1991	R	C vs S	Clin/US	47	0	5	47	10 vs 8

C = conservative treatment with or without antibiotics; Clin = clinical examination; CT = computed tomography; D = percutaneous drainage; i.op = intraoperative finding; P = prospective non-randomised; R = retrospective study; RCT = randomised clinical trial; S = surgery; US = ultrasound.

a) Failure of conservative treatment (%). b) Complications after drainage treatment or/versus after surgery (%).

FIGURE 2

Flow chart for treatment strategy for appendiceal mass.



AB = antibiotics.
a) Colonoscopy for adults > 40 years of age.

TABLE 2

Evidence-based recommendations for treatment of appendiceal mass.

Recommendations/comments	Level of evidence, classification strength) [a, b]
Phlegmone	
Treatment with broad-spectrum antibiotics is recommended	III (C)
Abscess	
Treatment with antibiotics for appendiceal mass in non-septic patients with abscess < 5 cm is recommended	II (B)
For smaller abscesses (< 5 cm), conservative treatment with antibiotics is probably as effective as drainage	II (B)
Larger abscesses (> 5 cm) may be treatment-resistant to antibiotics and percutaneous drainage is recommended	IV (D)
Drainage has a low to moderate risk of major and minor complications	III (C)
Surgical intervention has a high risk of complications including a moderate risk of unnecessary intestinal resection, and should be restricted to selected patients	III (C)

a) Evidence classification: I = evidence from meta-analysis or at least one well-designed randomised controlled trial; II = evidence from at least one well-designed controlled prospective non-randomised study; III = evidence from at least one uncontrolled retrospective study; IV = evidence from expert committee reports or opinions or clinical experience of respected authorities.
b) Strength of recommendation: A = directly based on category I evidence; B = directly based on category II evidence or extrapolated recommendation from category I evidence; C = directly based on category III evidence or extrapolated recommendation from category I or II evidence; D = directly based on category IV evidence or extrapolated recommendation from category I, II or III evidence.

domised studies (RCT), four prospective non-randomised studies, and 41 retrospective studies) with a total of 3,772 patients (Figure 1). Results from the literature are summarised in **Table 1**. On the basis of the analysis, we have proposed a treatment algorithm for the management of the appendiceal mass (**Figure 2**), and evidence-based recommendations are summarised (**Table 2**). Finally, a brief overview of the overall incidence failure rate and complications after treatment with antibiotics, percutaneous drainage, and surgery is provided in **Table 3**.

Conservative treatment with or without antibiotics

Children

We identified four uncontrolled retrospective studies (Table 1). Treatment failure was reported in 8/77, 65/411, 5/59 and 7/37 (8-19%) of cases [13-16] with a conservative regimen (with or without antibiotics). Unfortunately, the clinical presentation of the patients was only described sporadically.

Based on weak evidence, up to 19% of children presenting with appendiceal mass may experience treatment failure with conservative treatment.

Adults

Two uncontrolled retrospective studies were included (Table 1). One study (n = 67) found that 10/10 patients with phlegmone (no abscess on CT) responded on antibiotics alone [17]. Similar results were found in the other study (n = 40) where 9/9 of the patients with phlegmone responded to antibiotics [18].

Thus, weak evidence suggests that most adult patients with periappendicular phlegmone can be successfully treated using antibiotics alone.

Mixed

Two retrospective studies (Table 1) found that treatment failure with antibiotic treatment occurred in 23/193 and 9/40 (12-23%) [19, 20]. Treatment failure was defined as lack of clinical improvement, mechanical ileus, sepsis and persistent abscess. One patient died during hospitalisation, but the cause of death was not reported [19]. The clinical presentation of the patients was not described.

Conclusively, weak evidence from mixed patients with appendiceal mass suggests that treatment failure after using conservative treatment with antibiotics may reach 23%.

Percutaneous drainage

Children

Seven retrospective studies were included (Table 1). These studies reported data from patients treated with antibiotics and percutaneous drainage. Overall, treatment failure was seen in 19/73, 3/32, 0/36, 6/96, 1/42, 2/105 (0-26%) [21-26] of cases. In one small study, a high risk of treatment failure was observed in 10/23 (43%) in the subgroup of patients who underwent percutaneous drainage [21]. In another study, the risk of major complications related to drainage was 4/37 (11%) and in another study 0/42 [25, 27]. Drain-related complications were not reported in the remaining studies. In two studies, the clinical presentation was pain and fever and no clinical signs of generalised peritonitis [21, 22], whereas no information was provided in the remaining four studies.

In summary, percutaneous drainage may carry a risk of major complications of up to 11% and risk of treatment failure in up to 43% of cases.

Adults

Four retrospective studies were included (Table 1). One of the retrospective studies reported results for drainage after lack of clinical improvement with antibiotic treatment for at least 72 hours [17]. Clinical presentation was fever and leucocytosis. On this regimen, 30/66 patients (45%) had a drainage procedure performed and 4/30 (13%) underwent surgery after drainage due to lack of clinical improvement. No complications were reported in the patients who received antibiotics alone. One infection at a drain site was observed. The other three retrospective studies found treatment failure in 3/40, 5/94 and 4/41 (5-15%) for antibiotics and CT- or US-guided drainage, but not all included patients received a drainage procedure [18, 28, 29]. Complications to drainage in these studies were abscess perforation to the peritoneal cavity (1/17 patients) and small-bowel obstruction (1/41 and 1/94 patients) [18, 28, 29]. The clinical presentation of the patients was not described.

Thus, treatment failure with drainage may reach 15%. Major complications may appear in up to 6% of cases.

TABLE 3

Condensed summary of treatment results for all 48 included studies regarding treatment failure rate and complications in patients treated with antibiotics, percutaneous drainage, and surgery. The values are %.

	Antibiotics			Percutaneous drainage			Surgery		
	children	adults	mixed	children	adults	mixed	children	adults	mixed
Treatment failure	8-21	0-22	0-32	0-26	5-13	4-13	–	–	–
Complications, total	–	–	–	0-25	0-17	0-53	0-56	0-70	17-52
Complications, major	–	–	–	0-11	0-6	0	0-19	0-31	0-7

Mixed

We identified one RCT, one prospective non-randomised and one retrospective study (Table 1). The prospective randomised study (n = 50) compared intravenous antibiotics with a combination US-guided percutaneous drainage and antibiotics [30]. Treatment failure was significantly higher with 8/25 (32%) in the antibiotic group compared with 1/25 (4%) in the drainage group. Hospital stay was significantly longer for the drainage group than for the antibiotic group. Inclusion criteria were appendiceal abscess larger than 3 cm in diameter, and the clinical presentation was fever and leucocytosis. The prospective non-randomised study (n = 70) showed treatment failure in 4/32 (12.5%) on antibiotics alone [31]. Thirteen of 28 patients (46%) treated with drainage developed fistulas, and one patient underwent emergency operation due to diffuse peritonitis. The clinical presentation was fever, leucocytosis and pain in the right lower quadrant. In the retrospective study, no treatment failure was reported but two patients had an ileocecal resection performed due to entero-cutaneous fistulas (8%) [32]. The clinical presentation in this study included right lower quadrant pain, diffuse abdominal pain and/or fever and leucocytosis.

Thus, drainage may lower the risk of treatment failure compared with conservative treatment. However, drainage may be associated with a moderate risk of complications.

Surgical treatment

Children

One RCT, two prospective non-randomised studies and

FACTBOX

Acute appendicitis is the most common cause of acute abdomen, with a lifetime risk of 7-8%.

In patients with acute appendicitis, 7% will present with an appendiceal mass, although in children less than five years old, this figure may be as high as 60%.

An appendiceal mass consists of an inflamed appendix enclosed by adjacent viscera and the greater omentum. It can range from phlegmone to a pus-containing abscess.

Treatment may range from a conservative approach with or without antibiotics to image-guided drainage or immediate surgery.

four retrospective studies were included (Table 1). In the prospective randomised study (n = 40) comparing surgical treatment and percutaneous drainage, 4/20 patients (20%) had treatment failure after drainage and subsequently underwent surgical intervention [33]. There was no significant difference in number of complications between drainage and surgery. Clinical presentation included fever and leucocytosis. In one of the prospective non-randomised studies (n = 22), no complications were reported after laparoscopic surgery [34]. In another non-randomised prospective study (n = 82) and in the four retrospective studies comparing conservative treatment or drainage with surgery, there were treatment failure in 10/48, 0/32, 6/29, 3/31 and 0/21 (0-21%) [35-39]. Minor complications were reported in 4/34, 6/60, 12/36, 9/16 and 2/19 (10-56%) [35–39] and major complications in 4/36, 3/16 and 2/19 (10.5-19%) [37-39]. The clinical presentation in these studies was pain, fever vomiting and for some patients rebound and guarding.

In conclusion, surgical treatment in children probably carries a high risk of minor complications in up to 56% of cases and a risk of major complications in up to 19% of cases.

Adults

A total of 13 retrospective studies were included (Table 1). Ten of these studies compared a conservative regimen or drainage with surgery. Thus minor and major complications were found in 12/21, 30/36, 34/67, 0/13, 10/40, 27/43, 6/15, 34/104, 22/78 and 30/95 (0-57%) [4, 40-48]. Three uncontrolled retrospective studies assessed complications after surgical intervention without comparison with other treatment modalities and found overall complications in 10/34, 12/114 and 18/47 (10.5-38%) [49–51]. Complications were mostly minor, but in five studies the frequency of major complications was 4/68, 13/67, 2/40, 7/43, 7/78, 5/95 and 4/47 (5-19%) [40, 41, 43, 44, 47, 48, 51]. Ileocecal resections were performed in 1/21, 2/13, 10/40, 5/43, 6/95 and 5/47 (5-25%) [4, 42-44, 48, 51]. Complication rates in patients receiving additional antibiotic treatment and/or drainage were found in 7/68, 15/88, 0/16, 0/43 0/15 (0-17%) with major complications in 1/68, 5/88 [40, 41, 43-45]. The rate of treatment failure was 3/68, 0/16, 1/43 and 0/15 (0-5%) for the regimes with antibiotics and drainage [40, 43-45], whereas treatment failure was 6/27, 3/30, 0/17, 6/69 and 3/101 (0-22%) in the groups treated with antibiotics alone [4, 42, 46-48]. In two of the studies, patients with signs of generalised peritonitis and severe sepsis were excluded [41, 45]. The clinical presentation in four of the studies was right lower quadrant pain, fever, raised c-reactive protein and leucocytosis [40, 44, 46, 47], whereas there was no information on clinical presentation in the other studies [4, 42, 43].

In conclusion, surgical treatment in adults carries a risk of complications in up to 57% and major complications in up to 19% of cases. In adult patients, the risk of intestinal resection may be 5-25%.

Mixed

We found one RCT, three prospective non-randomised studies and four retrospective studies (Table 1). In the prospective randomised study (n = 60) 6/20 minor complications were reported after surgical intervention compared with 0/40 after conservative treatment [52]. The clinical presentation was right lower quadrant pain, whereas the exclusion criteria were free air or pus collection in the pelvis on x-ray/US. The three non-randomised prospective studies and three of the retrospective studies found the complication rates due to surgery in 5/30, 10/19, 19/88, 5/15, 15/42 and 15/46 (17-52%) of cases, most of these were minor [53-58], whereas treatment failure was 4/29, 0/28 and 13/88 (0-15%) in the conservative regime/drainage groups [53-55]. The clinical presentation was only reported in two studies (right lower quadrant pain, fever and leucocytosis) [57, 58]. The last retrospective study (n = 92) reported outcomes from ileocecal resections as the primary treatment modality of appendiceal mass [59]. A total of 59% had a primary anastomosis. Complications were seen in 25/92 (27%) of which 5/92 (5%) were major complications.

In summary, the risk of minor complications in mixed patients after surgical treatment may be up to 52%, and the risk of major complications may reach 5%.

DISCUSSION

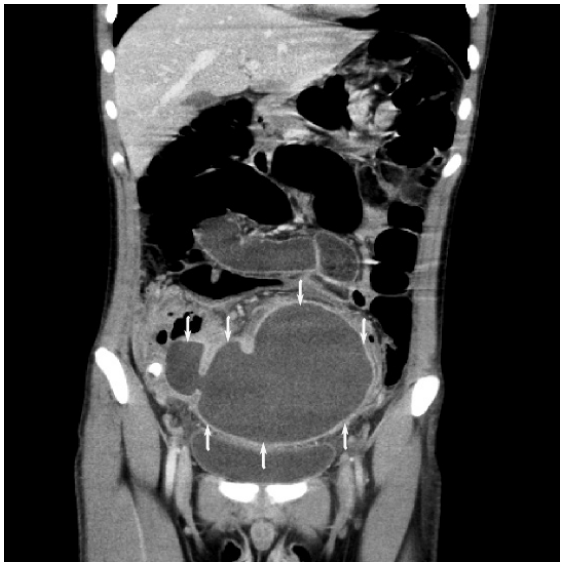
The findings of this systematic review showed that a conservative approach to treatment of an appendiceal mass is safe in most patients. This approach has a success rate of around 80-90% and is associated with a low risk of major complications in children as well as in adults. A few small studies found that antibiotics could be restricted to patients with fever; however, most studies were conducted with broad-spectrum antibiotics

as the minimum intervention. Percutaneous drainage may lower the risk of treatment failure and subsequent surgery, but the risk of complications in relation to drain placement is around 2-15%. Furthermore, the hospital stay may be prolonged because of the risk of enterocutaneous fistulas, which may reach 45%. The risk of complications in relation to emergency surgery is high and especially adults are at risk with a complication rate of up to 57%, including a high risk of intestinal resection of approximately 10%.

The results of the present analysis are comparable to those found in two meta-analyses in which the treatment failure rate with non-operative treatment (watchful waiting, antibiotics or drainage) was 7.2% [3] and a significantly increased risk with surgery compared with non-operative regimes [3, 11]. Generally, the risk of major complications and morbidity after gastrointestinal resection, such as right hemicolectomy or iliocecal resections, is probably 5% [59]. Although not fully comparable, the risk of anastomotic leakage after iliocecal resection in patients with Crohn's disease was up to 14% when abscess was present [60]. Due to the high risk of serious complications after surgical intervention for appendicular abscess, in our opinion, this approach should be restricted to patients with treatment failure after conservative treatment or drainage.

Based on these results, we propose a step-down treatment algorithm for the management of the appendiceal mass (Figure 2) focusing on a primarily conservative approach. It is recommended that patients with a history exceeding 72 hours and/or a palpable mass in the right lower quadrant undergo CT with intravenous and per oral contrast (in adults) or US (in children), depending on the local radiological expertise. Data do not support an evidence-based discrimination between small and large abscesses. However, based on extrapolation of data from a non-randomised prospective and a retrospective study of diverticular abscesses and intra-abdominal abscesses of various causes, abscesses larger than 5 cm were significantly more prone to treatment failure after antibiotics leading to percutaneous drainage [61, 62]. Therefore, we suggest a differentiated treatment of abscesses according to size. Thus, initial drainage is not recommend in non-septic patients and smaller abscesses < 5 cm. The literature offers no evidence for regimes regarding withdrawal of drain or flushing regimes.

The literature does not support clear recommendations in patients with well-defined abscess, recommendations on the specific antibiotics regimens or when to start and end antibiotic treatment. Our recommendation, based on class IV evidence, would be that patients with well-defined abscess can start broad-spectrum antibiotics and continue treatment until normalisation of temperature and inflammatory parameters. Patients with phlegmoneous mass without abscess can be managed with antibiotic treatment alone. Patients should regularly be evaluated clinically, and if needed radiologically, to detect any deterioration and initiate management accordingly. Because of the risk of missing a cancer or other pathology, we recommend out of hospital colonoscopy for patients above 40 years of age, after successful non-operative treatment [1, 3].



Large periappendicular abscess formation (white arrows) shown on computed tomography of the abdomen with intravenous contrast.

The results of the present analysis should be interpreted with caution. Recommendations and findings were for the most part was based on small retrospective studies with considerable heterogeneity. Moreover, patients in this analysis were only vaguely characterised, and the criterions leading to drainage or surgery were not clearly defined. For these reasons, we assessed that a meta-analysis was precluded. For practical reasons, complications due to surgery in patients with treatment failure after non-operative treatment were not reported. Furthermore the diagnostic entity "the appendiceal mass" ranged from phlegmone to well-defined abscess. Thus, patients in the studies may not be comparable. The consequence of the inconsistency and variations of outcomes between studies should be interpreted with care. We did not make a distinction with regard to older versus newer studies. It may be that introduction of CT and US in more recent studies may have altered the characteristics of patients undergoing individual treatment regimens. Similarly, old and new studies may not be comparable, because of new interventions or operation techniques such as guided drainage or laparoscopic surgery. In the future, RCTs are warranted especially for comparison between conservative treatment and percutaneous drainage to establish clear indications for drainage compared with other regimens.

CONCLUSION

The available evidence supports a conservative approach. Drainage should be restricted to patients with abscesses > 5 cm. Surgical intervention by open or laparoscopic operation should be reserved for patients not manageable by less invasive treatment options.

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