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ORIGINAL ARTICLE

Comparison of conservative versus surgical therapy for acute appendicitis with abscess in five German hospitals

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Abstract

Introduction The aim of this study was to evaluate the effectiveness of initially conservative therapy compared to immediate appendectomy for acute appendicitis with abscess in terms of medical and economic outcomes.

Methods Of all the patients treated for appendicitis from January 2009 to December 2017 in five German hospitals, 240 were included in the study. Fifty-three patients received conservative (CON) and 195 patients received surgical (SUR) therapy as initial treatment.

Results Length of stay was similar (12.5 days in CON vs. 13.3 days in SUR, $p = 0.530$). Readmission rate was higher in the conservative group (54.7% vs. 6.2%, $p < 0.001$). The majority (53.7%) of the 41 operations in CON group were appendectomies (22 procedures), 1 (4.5%) of them was in the first hospital stay because of persisting symptoms, 21 (95.5%) after a recovery interval. Seven (33.3%) of the recovery appendectomies were performed due to persisting or recurrent symptoms and 14 (66.7%) due to the request of patient. Twenty-one patients (39.6%) in the CON group did not need surgery. The rates of complication-related operations per patient (0.04 versus 0.58, $p < 0.001$), conversions of surgical technique (1.9% vs. 34.9%, $p = 0.0287$), and extended resections (1.9% vs. 31.3%, $p < 0.001$) were higher in SUR group. Furthermore, morbidity, hospital costs, and loss in quality of life were significantly higher in the surgical group (17.0% vs. 66.2%, $p < 0.001$; € 5044 vs. € 8457, $p < 0.001$, and 4.3 days vs. 7.5 days, $p < 0.001$, CON vs. SUR).

Conclusion Initially, conservative treatment for acute appendicitis with abscess is preferable to immediate surgical treatment in reduction of morbidity, hospital costs, and loss in quality of life.

Keyword Acute appendicitis · Length of stay · Appendectomy · Conservative therapy · Appendicitis with abscess · Surgical therapy · QALY

Introduction

Acute appendicitis (ICD-10K35) is one of the most common causes of emergency treatment in hospitals. According to the Federal Health Reporting (GBE), in 2016, 110,688 hospital cases with the ICD-10 diagnosis K35-K38 (diseases of the appendix) were reported in Germany [1]. Despite its frequency, acute appendicitis can present a diagnostic and therapeutic challenge. In most patients with acute appendicitis, an emergency surgical therapy, an appendectomy (AE), is performed at an early stage, before complications arise. However, in some patients (approx. 2–10%) perforation of the inflammatory appendix results in formation of a periappendiceal abscess [2–5]. These patients are usually admitted to the hospital with a delay of several days after onset of abdominal symptoms.

The treatment of appendicitis with abscess has been controversial [3, 6–12]. Both conservative and/or interventional therapy, e.g., antibiotic alone or in combination with interventional drainage, as well as immediate surgical appendectomy are available treatment options. Opinions also vary in terms of the need for elective appendectomy following successful initial conservative management.

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The aim of this retrospective study was to evaluate the effectiveness of initial conservative therapy in comparison to immediate appendectomy in terms of medical and economic outcomes in patients with acute appendicitis with abscess.

Methods

All patients were admitted to the following German hospitals, all members of the Northern German Colorectal Cancer Network, between January 2008 and December 2017 with a diagnosis of appendicitis and were analyzed retrospectively: University Hospital Schleswig-Holstein, Campus Luebeck; Helios Klinikum Schleswig; Hospital Reinbek, Segeberger Kliniken, and Westkuestenklinikum Heide. The study population included all patients who were treated initially conservatively (e.g., antibiotic and/or drainage) or by immediate surgical appendectomy (laparoscopic or open) for acute appendicitis. All patients had an appendicular/periappendiceal abscess diagnosed before surgery via sonography, computed tomography (CT), magnetic resonance imaging (MRI), or intraoperatively during diagnostic laparoscopy or appendectomy. Periappendiceal abscess was defined as enclosed fluid collection around the appendix with membranous border and/or air inclusion. Patients with malignancy were excluded. Depending on their initial therapy, patients were divided into two groups: initially conservative (CON) or immediately surgically (SUR) treated.

Outcome measures included length of stay in hospital (including length of stay after readmission), length of stay at intensive care unit (ICU), hospital readmission rate, number of complication-related operations (operative procedures under general anesthesia due to complication), number of extended resections, conversion rate, morbidity, and mortality. In addition, loss in quality of life and hospital costs were evaluated. Data was collected from the following sources: medical reports, discharge letters, radiologic reports, laboratory findings, and operation reports. Data on hospital costs were retrieved from the DRG workplace.

Complications were presented as overall, minor, and major complications. The classification of minor and major complications was based on the intervention necessary to treat the complication and the consequences of the complication. A minor complication was defined as any deviation from the usual course without the need for surgical, radiological, or endoscopic intervention under general anesthesia (Clavien-Dindo I-IIIa) [13]. All complications with need for surgical, radiological, or endoscopic intervention under general anesthesia, life-threatening complications that necessitate intensive care treatment because of single or multiple organ failure (e.g., dialysis due to kidney failure) or death of the patient, were classified as major (Clavien-Dindo IIIb-V).

The loss in quality of life was calculated under consideration of all contributing factors (hospital stay, ICU stay, interventions, morbidity, mortality, complications) and was presented as loss of quality-adjusted life days (QALD). The loss of QALD was calculated as the product of the disutility value of a certain morbidity and the time (days) a patient spent in the respective morbidity state. The necessary values for disutilities of morbidity states that occurred as a consequence of therapy were derived from literature and the "Tufts Cost Effectiveness Registry (CEA™) of Center for the Evaluation of Value and Risk in Health (CEVR)" [14]. Utilities published on this site were confirmed through assessment of the original publication.

Hospital costs were retrieved from hospitals accounting data. If a patient was readmitted, hospital costs were added together.

The study design was reported to and registered by the ethics committee of the University of Schleswig-Holstein, Campus Luebeck.

Statistical analysis

Categorical variables were analyzed descriptively with frequencies and percentages and compared using a test for differences (risk difference, z test). Fisher's exact test was applied additionally but came to no other conclusion. Continuous variables were expressed as means and standard deviation and compared using the two-sample t test for independent samples (without the assumption of equal variances). For outcome measures based on count data (i.e., number of events per patient), a rate comparison was carried out using the Poisson test. All tests were performed as two-sided tests with a significance level of 0.05 (without correction for multiplicity) in MS-Excel.

Results

In total, 2687 patient records with the diagnosis appendicitis were examined. We identified 248 patients treated for appendicitis with abscess. Fifty-three patients (21.4%) were initially treated conservatively (CON) and 195 patients (78.6%) received immediate surgery (SUR). The decision for a conservative or operative therapy was dependent on the attitude and experience of the respective clinic or surgeon. All patients in the surgical group underwent surgery immediately after hospitalization for appendicitis.

Patients treated conservatively were on average 56.02 (SD = 19.65) years old and 50.9% were male. In the surgical group, patients were on average 53.55 (SD = 21.80) years old and 57.4% were male. The average white blood cell count (WBC) was 14,910 × 1000/μl (SD = 4.86) in the conservative

group and 13,530 × 1000/μl (SD = 5.88) in the surgical group. The average CRP (C-reactive protein) level was 20.73 (SD = 19.13) mg/dl in the conservative and 15.89 (SD = 11.49) mg/dl in the surgical group. The distribution of the American Society of Anesthesiologists (ASA)-score in categories 1 to 3 was 58.2%, 34.1%, and 7.7% in the CON group and 60.4%, 35.2%, and 4.4% in the SUR group respectively. The average body mass index (BMI) of the patients was 32.4 kg/m^2 in the CON and 30.8 kg/m^2 in the SUR group. The four main categories of comorbidity were comparable in both groups. These were arterial hypertension (11.2% vs. 10.6%), cardiovascular diseases (8.9% vs. 8.1%), chronic obstructive pulmonary disease (4.5% vs. 4.7%), and diabetes mellitus (2.6% vs. 2.4%). There were no significant differences in age ($p = 0.43$), sex ($p = 0.40$), number of leucocytes ($p = 0.35$), CRP-level ($p = 0.15$), ASA-score ($p = 0.38$), BMI ($p = 0.28$), and comorbidities between the two groups.

The average time of follow-up was 86.26 months (SD 196.98).

Outcome parameters are shown in Tables 1 and 2.

Hospital stay

The average length of hospital stay was not significantly different between two groups. The average length of stay at the ICU was significantly longer in the surgical group ($n = 0.5259$). In the conservative group, no patient had to be admitted to the ICU. There were 47 readmissions in 41 patients. The readmission rate was significantly higher in the conservative group.

Surgery interventions

In the surgical group, 308 surgeries (1.58 procedures per patient) were performed of which 113 (0.58 procedures per patient) were due to complications. In the conservative group, 41 surgical procedures (0.77 procedures per patient) were performed on 32 patients (60.4%), of which 22 (53.66%) were appendectomies, 1 was extended resection, and 18 were diagnostic laparoscopies with or without drainage. One appendectomy and one extended resection were performed during the primary hospital stay due to complications, 21 appendectomies were performed after an interval of 6 weeks to 14 months. Seven of these interval appendectomies were performed because of persistent or recurrent symptoms, 14 were planned due to the request of patients. A total of 13 interventional or surgical drainage were performed in the CON group. Twenty-one patients (39.6%) of the CON group received no surgical procedure. Patients treated conservatively had a significantly lower rate of operations, complication-related operations, extended resections, and conversion of surgical method from laparoscopy to open procedures (Table 1).

Table 1 Outcome measures

Outcome	CON ($n = 53$)	SUR ($n = 195$)	p value
Length of hospital stay (incl. readmission) (days) (mean ± SD)	12.50 ± 6.26	13.30 ± 12.37	0.5259 (n.s.)[a]
Length of ICU stay (days) (mean ± SD)	0	1.90 ± 6.16	< 0.001[a]
Patients with readmission	29 (54.7%)	12 (6.2%)	
Number of readmissions	32	15	< 0.001[c]
Readmission rate per patient (mean ± SD)	0.60 ± 0.60	0.08 ± 0.58	< 0.001[c]
Number of operations	41	308	
Operation rate per patient (mean ± SD)	0.77 ± 0.72	1.58 ± 1.24	< 0.001[c]
Number of extended resections	1 (1.89%)	61 (31.28%)	< 0.001[c]
Complication-related operations	2 (4.88%)	113 (36.69%)	
Complication-related operations			
Per patient (mean ± SD)	0.04 ± 0.19	0.58 ± 1.24	< 0.001[c]
Number of conversions	1 (1.9%)	68 (34.9%)	0.0287 [c]
Costs (€) (mean ± SD)	5044.78 ± 2777.62	8457.42 ± 11,603.30	< 0.001[a]
Loss of QALD per patient, all patients (mean ± SD)	4.32 ± 4.05	105.83 ± 682.51	< 0.05 (0.039)[a]
Loss of QALD, without deaths (mean ± SD)	4.32 ± 4.05	7.52 ± 9.10	< 0.001[a]

[a] t test

[b] z test

[c] Poisson test

CON, conservative group; *SUR*, surgical group; *ICU*, intensive care unit; *QALD*, quality-adjusted life days; *n.s.*, not significant; *SD*, standard deviation

Table 2 Complications

Outcome	CON ($n = 53$)	SUR ($n = 195$)	p value
Patients with complications			
Total ($n = 138$)	9 (17.0%)	129 (66.2%)	< 0.001[b]
Minor ($n = 91$)	7 (13.2%)	84 (43.1%)	< 0.001[b]
Major ($n = 47$)	2 (3.8%)	45 (23.1%)	< 0.01 (0.0015)[b]
Death	0 (0.0%)	6 (3.1%)	0.1961 (n.s.)[b]
Gastrointestinal	5 (9.4%)	58 (29.7%)	< 0.01 (0.0026)[b]
Pulmonary	1 (1.9%)	34 (17.4%)	< 0.01 (0.0039)[b]
Infection, deep	3 (5.7%)	18 (9.2%)	0.4077 (n.s.)[b]
Infection, superficial	1 (1.9%)	17 (8.7%)	0.0892 (n.s.)[b]
Bleeding	0 (0.0%)	27 (13.8%)	< 0.01 (0.0041)[b]
Sepsis	0 (0.0%)	9 (4.6%)	0.1111 (n.s.)[b]
Urinary tract	0 (0.0%)	19 (9.7%)	< 0.05 (0.0180)[b]
Cardiac	1 (1.9%)	10 (5.1%)	0.3095 (n.s.)[b]
Renal failure	0 (0.0%)	6 (3.1%)	0.1961 (n.s.)[b]
Thromboembolic	0 (0.0%)	4 (2.1%)	0.2932 (n.s.)[b]
Cerebral	0 (0.0%)	4 (2.1%)	0.2932 (n.s.)[b]
Number of complications			
Total ($n = 232$)	11 (4.7%)	221 (95.3%)	< 0.001[b]
Minor ($n = 160$)	9 (5.63%)	151 (94.37%)	< 0.001[b]
Major ($n = 72$)	2 (2.78%)	70 (97.22%)	< 0.01[b]
Complications per patient			
Total (0.935)	0.21	1.13	< 0.01[c]
Minor (0.645)	0.17	0.77	< 0.01[c]
Major (0.290)	0.04	0.36	< 0.01[c]

[a] t test

[b] z test

[c] Poisson test

CON, conservative group; *SUR*, surgical group; *ICU*, intensive care unit; *QALD*, quality-adjusted life days; *n.s*, not significant; *SD*, standard deviation

Complication, morbidity, and mortality

Overall, 232 complications occurred in 138 patients during treatment. Of these, 160 (69.0%) were minor and 72 (31.0%) were major complications. Of all complications, 221 (95.3%) occurred in the surgical and 11 (4.7%) in the conservative group. Complications data are listed in Table 2.

In the surgical group, 31.7% of all complications were major, whereas in the conservative group, 18.2% of all complications were major. The total number of surgically treated patients with minor and major complications was significantly higher ($p < 0.001$).

The most common complications in both groups were gastrointestinal complications (overall 63 patients, 25.4%). They were significantly higher in the surgical group. Pulmonary, bleeding, and urinary tract complications occurred also significantly higher in the surgical group. The rates of cardiac, thromboembolic and cerebral complications, infection, sepsis, and acute renal failure were not significantly different between the two groups.

Six patients (3.1%) treated surgically died due to complications during hospital stay whereas no patient died in the conservative group ($p = 0.196$).

Costs of therapy

Hospital costs were significantly higher in patients treated surgically (€ 5044 ± 2.777 in CON vs. € 8457 ± 11.603 in SUR, $p < 0.001$).

Loss of QALY

The values for the loss of QALY are presented in Table 1. These describe the total loss of QALY by the inpatient treatments also in the case of readmissions. Regardless of the inclusion or exclusion of the deceased patient, the QALD remains significantly lower in the conservative group.

Discussion

While appendicitis is still considered a surgical disease, its therapy has recently become increasingly controversial. Especially, the optimal therapy of acute appendicitis with appendicular abscess remains unclear.

In the Anglo-Saxon area, conservative treatment of appendicitis with abscess with sole antibiotic therapy or in combination with drainage has become the therapy of first choice. However, the evidence whether conservative treatment is actually superior to primary surgical appendectomy has still been questioned in recent years.

According to the consensus statement of the European Association for Endoscopic Surgery (EAES), the initial non-surgical treatment of appendicitis with abscess remains the preferred treatment (level of evidence II, strength of recommendation weak) [15].

Similarly, the World Society of Emergency Surgery (WSES) recommends non-surgical treatment as a first-line treatment for patients with perforated appendicitis with abscess [16]. Despite of these recommendations, in most of German hospitals, acute appendicitis with abscess is still primarily treated by emergency appendectomy.

Several studies showed that immediate surgical treatment in patients with abscess is associated with increased morbidity (odds ratio 3.3) or complications (wound infections, abdominal/pelvic abscesses, ileus/intestinal obstruction, and redo surgeries) compared to conservative therapy [3, 7, 17]. Two RCTs were included in the meta-analysis by Andersson et al. [3] comparing conservatively treated patients for interval, delayed or no appendectomy, but no RCT compared surgical versus conservative therapy for appendicitis with abscess. Our results are essentially consistent with these studies. Complications were significantly more frequent in the surgical group, both minor and major complications.

In addition, when considering individual complications such as bleeding, gastrointestinal, pulmonary, and urinary complications, significantly higher events occurred in the surgical group. In addition, the rate of conversion of operations was significantly higher in the surgical group. This is attributed to the fact that laparoscopic appendectomy was technically easier after several months of recovery of the patients in the conservative group and thus associated with fewer conversions. In our opinion, this explanation also applies to our finding that the number of extended operations (small and/or large bowel resection) was significantly higher in the surgical group than in the conservative group. In addition, mortality was higher in the surgical group with 3.1%.

However, other recent studies also came to contrary conclusions. These studies favor a primary surgical procedure in appendicitis with abscess, mainly because of the high failure rate of conservative therapy [6, 8]. A retrospective study published in 2014 by Deelder et al. and a randomized controlled trial by Mentula et al. favored the primary surgical approach because conservative treatment resulted in more interventions (surgery or drainage) and readmissions due to a relatively high failure rate at comparable hospital stay [6, 8].

Our study comes to similar results in terms of the readmissions and the length of hospital stay. Although conservatively treated patients had significantly higher rates of readmissions (0.604 vs. 0.077, $p < 0.001$), their overall length of hospital stay was even shorter than in the surgical group, though not significantly.

Furthermore, the incidence of complication-related surgery per patient was significantly higher in the surgical group (0.58 procedures per patient) than in the conservative group (0.04 procedures per patient). In other words, although conservatively treated patients showed more readmissions than the primary operated patients, partially due to persistent or recurrent complaints, they were affected by significantly lower rates of therapy-related complications and thus a significantly lower loss in the quality of life (QALY).

The surgical treatment was also associated with higher hospital costs compared to conservative treatment. The reasons for the greater loss in quality of life and the higher costs were complications, in particular major complications that necessitated a secondary intervention or intensive care unit admission. These events were 22 times more common in the surgical group.

Due to the partly contradictory results that have been reported in previous publications, it has been difficult to make a clear recommendation regarding the treatment of acute appendicitis with abscess. However, our results suggest clearly that the initial conservative therapy offers a better recovery with less complications, lower loss of QALY, and lower hospital costs.

A theoretical approach to the issue

From our point of view, it is helpful to compare the approach to similar clinical conditions with intra-abdominal abscess as, for example, sigmoid diverticulitis with abscess. The comparison provides a theoretical basis for the hypothesis that immediate appendectomy, equivalent to immediate resection of the sigmoid colon, may not be the treatment of first choice in acute appendicitis with abscess. Conservative treatment of sigmoid diverticulitis with abscess has been established as a first-line treatment in both evidence-based medicine and good clinical practice [18, 19]. It has been shown that the immediate surgical treatment of sigmoid diverticulitis with abscess is associated with a significantly higher risk of morbidity and mortality and is associated with high costs.

Conservative or interventional therapies in the form of drainage or antibiotics are also regarded as therapy of first choice in other intra-abdominal abscesses of the

parenchymatous organs or in retroperitoneum. In this respect, it is quite remarkable that in most German hospitals immediate appendectomy of appendicitis with abscess is still the dominant therapy.

Limitations of the study

Our study has some limitations. Patients who went to another facility in the event of readmission could not be tracked. Furthermore, the study was retrospective; a prospective study can provide more reliable information. Due to the multicenter character, different standard operating procedures at different hospitals may also have had an influence on results.

Another limitation of the study is the outpatient therapy costs, which could not be captured by the study due to its retrospective nature. Theoretically, these could have had an impact on the overall costs of the therapies. However, we consider this impact to be very unlikely, as the necessities of outpatient treatment for both groups are likely to be similar. The large study population and the multicenter design of the study reduce the potential for bias from the abovementioned factors.

Conclusion

Although the majority of patients initially treated conservatively received appendectomy at a later time point, our results show that emergency appendectomy for the treatment of appendicitis with abscess is associated with significantly higher morbidity and mortality, as well as significantly higher loss in quality of life and hospital costs. Due to the medical and health economic superiority of conservative therapy, an abscess should be evaluated during primary emergency diagnostics and ruled out before deciding on an emergency appendectomy. Patients with abscess should initially receive conservative treatment.

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