

The role of percutaneous abscess drainage in adult patients with perforated appendicitis

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Abstract

Objectives: To evaluate the effectiveness of ultrasound (US) guided percutaneous abscess drainage in the treatment of adult patients with perforated appendicitis and to estimate the success rate.

Material and methods: Pre-interventional computed tomography examinations of patients (n=63) who had abscess formation due to perforated appendicitis were reviewed retrospectively. A total of 15 patients [6 (40%) women and 9 (60%) men] with a mean age of 42±21 (SD) years who underwent US-guided percutaneous abscess drainage were enrolled in this study. Abscess volume, location, catheter duration and follow-up results were recorded. The treatment effectiveness of US-guided percutaneous abscess drainage was investigated.

Results: A total of 15 patients were included. Abscess formations were in right lower quadrant (n=10) and deep pelvic area (n=5). The mean abscess volume was 235 mm³ (range: 20 - 1180). The mean catheter duration was 12.2 ± 7.8 days (range: 3 - 30). Five patients (5/15, 33%) were treated non-surgically with complete response. In remaining 10 patients (10/15, 67%), surgical management was required because of recurrent abscess (3/15, 20%) and progression in abscess volume (7/15, 47%). The technical success rate and the clinical success rate was 100%, and 33%, respectively.

Conclusion: Because of our low clinical success rate with 33%, we recommended US-guided percutaneous abscess drainage in perforated appendicitis for some selected patients with high risk surgery.

Key words: abscess, appendicitis, interventional radiology, percutaneous drainage, ultrasound

ЖАРЫЛҒАН СОҚЫРШЕКПЕН АУЫРАТЫН ЕРЕСЕК ПАЦИЕНТТЕРДЕ АБЦЕССИ ТЕРІ АСТЫНА ДРЕНАЖДАУ РӨЛІ

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ТҰЖЫРЫМДАМА

Мақсаттары: Жарылған соқыршекпен ауыратын ересек пациенттерді емдеуде ультрадыбыстық бақылаудағы іріңдік ағынының тиімділігін бағалау және тиімділік көрсеткіштерін анықтау.

Материалы және әдістері: Жарылған соқыршектен кейін абсцесі бар науқастардың интервенцияға дейінгі компьютерлік томографиясының (n = 63) зерттеулеріне ретроспективті талдау жүргізілді. Бұл зерттеуге ультрадыбыстық сканерлеудің бақылауымен абсцессі тері астына дренаж жасалған орташа жасы 42 ± 21 (орташа ауытқу) жыл болған 15 пациент [6 (40%) және 9 (60%) ер адамдар кірді. Деректер абсцесс көлемі, орналасуы, катетерді қолдану ұзақтығы және бақылау нәтижелері бойынша жазылды. Ультрадыбыстық зерттеу арқылы бақылаумен абсцессті тері астына дренаждау тәсілімен емдеу тиімділігі зерттелді.

Нәтижелері: Зерттеуге барлығы 15 пациент енгізілді. Абсцесстер төменгі оң жақ квадрантта (n = 10) және терең ішек аймағында (n = 5) болды. Абсцесстің орташа мөлшері 235 мм³ құрады (диапазоны: 20 - 1180). Катетерді қолданудың орташа ұзақтығы 12,2 ± 7,8 күнді құрады (ауқымы: 3 - 30). Бес пациент (5/15, 33%) толық емделумен отасыз ем алды. Қалған 10 науқасқа (10/15, 67%) қайталанған абсцесс (3/15, 20%) және абсцесс көлемінің ұлғаюына байланысты операция қажет болды (7/15, 47%). Техникалық тиімділік көрсеткіші және клиникалық тиімділік көрсеткіші сәйкесінше 100% және 33% құрады.

Қорытынды: Клиникалық тиімділік деңгейі 33% төмен болғандықтан, асқынған аппендицит жағдайында ультрадыбыстық бақылау бойынша абсцессті тері астына дренаждауды жоғары тәуекелді операциялары бар жеке науқастарға ұсынамыз.

Негізгі сөздер: іріңдік, соқыршек, интервенциялық радиология, тері арқылы құрғату, ультрадыбыстық зерттеу

РОЛЬ ЧРЕСКОЖНОГО ДРЕНИРОВАНИЯ АБСЦЕССА У ВЗРОСЛЫХ ПАЦИЕНТОВ С ПЕРФОРАТИВНЫМ АППЕНДИЦИТОМ

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РЕЗЮМЕ

Цели: Оценить эффективность чрескожного дренирования абсцесса под контролем ультразвукового исследования в лечении взрослых пациентов с перфоративным аппендицитом и определить показатели эффективности.

Материал и методы: Проведен ретроспективный анализ обследований прединтервенционной компьютерной томографии пациентов (n=63) с абсцедированием после перфоративного аппендицита. В настоящее исследование было включено всего 15 пациентов [6 (40%) женщин и 9 (60%) мужчин], средний возраст которых составил 42±21 (среднее стандартное отклонение) лет, которым проводилось чрескожное дренирование абсцесса под контролем ультразвукового исследования. Записывались данные об объеме, локализации абсцесса, длительности использования катетера и результаты наблюдения. Была изучена эффективность лечения чрескожным дренированием абсцесса под контролем ультразвукового исследования.

Результаты: Всего 15 пациентов было включено в исследование. Абсцедирования были обнаружены в правом нижнем квадранте (n=10) и глубоко в паховой области (n=5). Средний объем абсцесса составил 235 мм³ (диапазон: 20 - 1180). Средняя продолжительность использования катетера составила 12.2 ± 7.8 дней (диапазон: 3 - 30). Пять пациентов (5/15, 33%) получили безоперационное лечение с полным ответом. Остальным 10 пациентам (10/15, 67%) потребовалось хирургическое вмешательство из-за повторного абсцесса (3/15, 20%) и прогрессирования в объемах абсцесса (7/15, 47%). Показатель технической эффективности и показатель клинической эффективности составил 100% и 33% соответственно.

Заключение: Вследствие низкого показателя клинической эффективности в 33%, мы рекомендуем чрескожное дренирование абсцесса под контролем ультразвукового исследования в случаях перфоративного аппендицита для некоторых отдельных пациентов с хирургией высокого риска.

Ключевые слова: абсцесс, аппендицит, интервенционная радиология, чрескожное дренирование, ультразвуковое исследование

Introduction

Acute appendicitis is a common emergency requiring immediate surgery. Imaging modalities such as ultrasound (US) and computed tomography (CT) are frequently used for diagnosis of acute and complicated appendicitis. Ultrasound is easily applicable but operator dependent modality. CT provides us more detailed information with high spatial resolution especially in the diagnosis and treatment planning of complicated appendicitis. The complications of appendicitis such as gangrenous appendicitis, phlegmon, perforation, abscess, peritonitis, and sepsis increase the risk of morbidity and mortality [1-8]. Therefore, early and optimal treatment is necessary in complicated appendicitis. The conservative treatment with only antibiotics, interventional treatment with percutaneous drainage plus antibiotics and surgery are the treatment options of complicated appendicitis [1-8]. Despite of benefits of non-invasiveness or minimal invasiveness, there are some disadvantages of non-surgical treatment such as prolonged hospitalization, requirement of multiple interventional and imaging procedures. Moreover, surgery is mandatory in patients resistant to non-surgical treatment [4-10].

The optimal treatment for complicated appendicitis is still controversial. Thus, aims of our study were to evaluate the effectiveness of US-guided percutaneous abscess drainage in the treatment of adult patients with perforated appendicitis and to estimate the success rate. We aimed to present our results about percutaneous abscess drainage in patients with perforated appendicitis.

Material and methods

The Institutional Review Board approved this retrospective study and informed consent was waived. The pre-interventional CT examinations of adult patients (n=63) who had abscess formation due to perforated appendicitis were reviewed between January 2013 and May 2019 from picture archiving and communications system. The patients without follow-up (n=3) and patients who treated with immediate surgery (n=45) were excluded. A total of 15 patients [6(40%) women and 9(60%) men] with a mean age of 42±21 (SD) years who underwent US-guided percutaneous abscess drainage and had pre-interventional CT examination were enrolled in this study. Abscess volume, abscess location (right lower quadrant/deep pelvis), the existence of appendicolith on CT

were recorded by an experienced radiologist (F.K.).

The pre-interventional abdominal CT examinations were performed on a multi-slice helical scanner (Somatom Sensation 40, Siemens Medical Solutions, Erlangen, Germany). Scanning parameters for intravenous contrast-enhanced CT images were as follows: tube voltage, 120 kVp; tube current, 20 mAs, helical thickness, 2.5 mm, interval, 2.5 mm, pitch, 1.5 and reconstruction slice thickness 1.25 mm.

US-guided percutaneous abscess drainage was performed on Toshiba Aplio 300 US system (Toshiba Medical Systems, Tokyo, Japan). Seldinger technique was used for insertion of catheter and saline solution was administered for irrigation. Abscesses were controlled by performing US and when required by fluoroscopy for follow-up. Catheter removal criteria were daily drainage less than 10 cc, clinical improvement of patient and no visible abscess on US or fluoroscopic control. The catheter duration and follow-up results were noted from hospital information system. The outcome (progression, recurrence and complete response) of patients with US-guided percutaneous abscess drainage was investigated. Outcomes of patients were classified into two categories as complete response group and surgical management required group. The patient without complication during percutaneous drainage procedure indicates the technical success. The clinical improvement of patient without abscess formation on US or fluoroscopy depicts the clinical success of treatment or complete response.

The findings of patients between two groups were analyzed. Kruskal-Wallis test or Mann-Whitney U test were used, where appropriate, and p<0.05 was used to determine statistical significance. Statistical analysis was done by using MedCalc statistical software 12.1.4.0. Technical and clinical success rates were estimated.

Results

A total of 15 patients with percutaneous abscess drainage due to perforated appendicitis and pre-interventional CT examinations were included. There were 6 women and 9 men with a mean age of 42±21 (SD) years (range: 18-82 years). Of 15 patients, abscess formations were in right lower quadrant (n=10) and deep pelvic area (n=5). The mean abscess volume was 235 mm³ (range: 20 - 1180mm³). Of 15, two patients had appendicolith on CT.

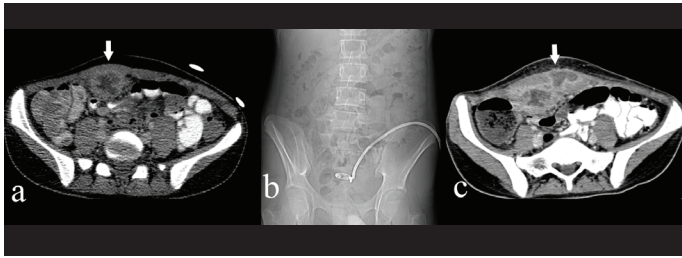


Figure 1 - Abscess formation (arrow) on pre-interventional CT (a), the drainage catheter on X-ray during scopic control (b) and the progression in abscess volume (arrow) on post-interventional CT (c) 17 days after percutaneous drainage in 18-year-old man with perforated appendicitis.

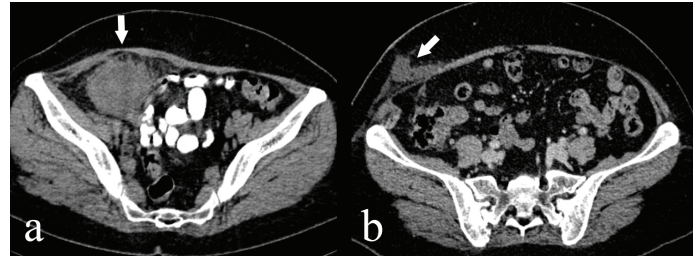


Figure 2 - Abscess (arrow) in right lower quadrant on pre-interventional CT (a) and recurrent abscess formation (arrow) in catheter trace on post-interventional CT (b) 6 months after percutaneous drainage in 51-year-old woman with perforated appendicitis.

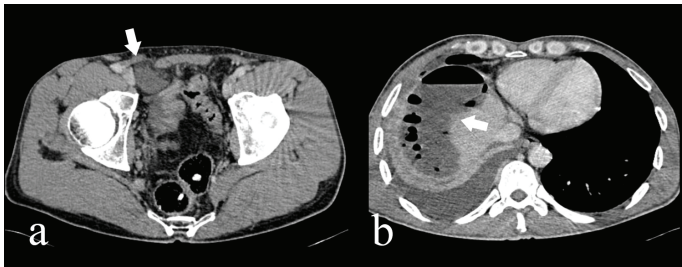


Figure 3 - Abscess formation (arrow) on pre-interventional CT (a) and the progression in abscess volume (arrow) on post-interventional CT (b) 20 days after percutaneous drainage in 36-year-old man with perforated appendicitis.

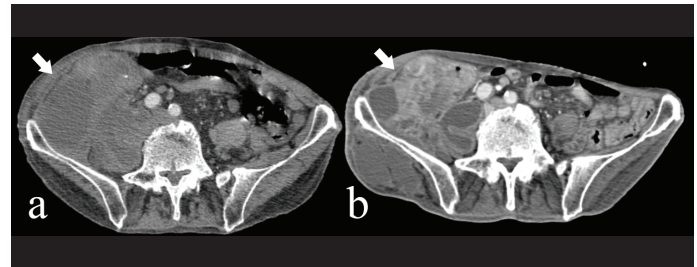


Figure 4 - Abscess formation (arrow) on pre-interventional CT (a) and the progression in abscess volume with previously unknown cecal tumor (arrow) on post-interventional CT (b) 7 days after percutaneous drainage in 82-year-old man with perforated appendicitis.

All US-guided percutaneous drainage procedures were performed without complication. The mean catheter duration was 12.2 ± 7.8 days (range: 3 – 30 days). Five patients (5/15, 33%) were treated non-surgically with complete response. In remaining 10 patients (10/15, 67%), surgical management was required because of recurrent abscess (3/15, 20%) and progression in abscess volume (7/15, 47%) (Figure 1). Two patients had recurrent abscess in the previous catheter location/ subcutaneous fat tissue of anterior abdominal wall extending into abdomen between 6 months and 2 years after percutaneous drainage (Figure 2). One patient had intraabdominal recurrent abscess in right lower quadrant. Patients with progression of abscess underwent surgery within one month after drainage (Figure 3). Of 10 patients in surgical

management required group, 9 patients showed clinical recovery after surgery and one patient (1/15, 6.6%) had 30-day mortality due to previously unknown cecal tumor (Figure 4). Although the catheter duration in complete response group (7.4 ± 2.5 days) was shorter than surgical management required group (14.6 ± 8.6 days), there was no statistically significant difference between two groups ($p > 0.05$). No significant difference about abscess volume was observed between complete response group (258 mm³) and surgical management required group (223 mm³) ($p > 0.05$). In our study, the technical success rate and the clinical success rate was 100%, and 33%, respectively. The comparison of findings between complete response and surgical management required groups is shown in Table 1.

Table 1

The comparison of findings between complete response and surgical management required groups

	Complete response	Surgical management required	p*
Patient number	5	10	
Mean age of patients (year)	40 ± 16	43 ± 24	> 0.05
Gender (Male / Female)	2/3	7/3	
RLQa/ deep pelvis abscess	4/1	6/4	
Existence of appendicolith	1	1	
Mean abscess volume (mm ³)	258	223	> 0.05
Mean catheter duration (day)	7.4 ± 2.5	14.6 ± 8.6	> 0.05

a RLQ: Right lower quadrant location of abscess

* Mann Whitney U Test, $p < 0.05$ was used to determine statistical significance.

Discussion

Perforated appendicitis with abscess formation is seen approximately 2%-7% of patients with acute appendicitis [10]. Complicated appendicitis can be treated with operative or non-operative management. Both operative and non-operative treatment have some hitches. The surgical approach can be difficult due to inflammation, adhesion and surrounding tissues in

complicated appendicitis. Sometimes, ileocectomy is required instead of simple appendectomy because of anatomical distortion. However, non-operative treatment can lead longer hospitalization, repeated interventional and radiological procedures, recurrence of appendicitis or abscess and surgery. Therefore, immediate and accurate management decision is essential. The decision of appropriate treatment for complicated appendicitis is still

conflicting because of various results of previous studies [4-15].

In literature, several studies have been conducted to investigate the role of percutaneous drainage in patients with perforated appendicitis. Kim et al. [10] detected low recurrence rate after conservative treatment (only antibiotics and percutaneous drainage plus antibiotics) in complicated appendicitis. But most of patients (26/48, 54%) had planned interval appendectomy after conservative treatment. Of residual 20 patients without interval appendectomy, three patients had recurrent appendicitis. They recommended conservative treatment for complicated appendicitis and regular follow-up for early detection of recurrence [10]. Narvaez et al. [11] also advised the conservative treatment for initial treatment of perforated appendicitis and abscess with a recurrence rate of 33%. Contrarily, in our complete response group, no patient underwent interval appendectomy.

Nimmagadda et al. [12] compared the outcomes between patients underwent immediate operation (n=65) and treated with nonoperative management (n=36). High success rate with 86% was estimated in patients with non-operative management. They also detected longer hospitalization in patients with failure of non-operative management than those with immediate surgery [12].

Dong et al. [13] analyzed the results of laparoscopic surgery and conservative treatment in patients with perforated appendicitis and abscess formation. Higher recovery rate, shorter hospitalization and lesser recurrence rate in laparoscopic surgery group were found compared to conservative treatment group [13]. Some previous studies detected better quality of life and lower hospital costs in children with perforated appendicitis who underwent early appendectomy than those with initial non-operative treatment plus interval appendectomy [14,15].

Several studies investigated the factors effecting drainage failure and recurrent appendicitis. Marin et al. [9] reported that approximately 10–25% of patients with perforated appendicitis were resistant to treatment with percutaneous drainage. Liang et al. [4] depicts some independent factors for recurrent appendicitis such as young age, male sex and receiving percutaneous abscess drainage. Horn et al. [16] reported that the risk factors of abscess drainage failure in perforated appendicitis were patient complexity, female sex, earlier drainage and Hispanic race.

They observed failure of drainage treatment in approximately 25% of patients [16]. In contrast, male sex was more prevalent and drainage treatment failure ratio with 67% was higher in our surgical management required group. Fagenholz et al. [17] declared that CT-guided drainage and trans-gluteal approach increased opportunity of successful percutaneous drainage. In a previous study, no significant difference was detected between irrigation of saline solution and tissue plasminogen activator during percutaneous abscess drainage [18]. In our study, all patients had US-guided percutaneous drainage with irrigation of saline solution.

We achieved high technical success rate of 100% but, low complete response (clinical success) rate of 33%. In our study, no interval appendectomy was performed for complete response group. Most of patients (13/15, 87%) had no appendicolith. Male/female ratio was higher and abscesses located in deep pelvis were more prevalent in surgical management required group. Mean catheter duration was shorter in complete response group. However, no statistically significant relationship about patient's age, abscess volume and catheter duration were detected between complete response and surgical management required groups. One patient (1/15, 6.6%) had 30-day mortality due to cecal tumor in our study. Awareness of the possibility of underlying malignancy in the diagnosis of perforated appendicitis is important especially in >40 years old patients [19-21].

Our study has several limitations. Retrospectively collected data was analyzed and sample size was small. For objective evaluation of abscess only patients with pre-interventional CT examinations were included in this study. It can lead a possible bias.

In conclusion, the clinical success rate in our study was low with 33%. Thus, we recommended US-guided percutaneous abscess drainage in perforated appendicitis for selected patients with high risk surgery. Moreover, possibility of tumoral obstruction should be kept in mind particularly in patients who do not respond to percutaneous drainage.

Disclosures: There is no conflict of interest for all authors.

References

1. Becker P, Fichtner-Feigl S, Schilling D. Clinical Management of Appendicitis. *Visc Med.* 2018; 34(6):453-458. <https://doi.org/10.1159/000494883>
2. Bhangu A, Søreide K, Di Saverio S, Assarsson JH, Drake FT. Acute appendicitis: modern understanding of pathogenesis, diagnosis, and management. *Lancet.* 2015; 386(10000):1278-1287. [https://doi.org/10.1016/S0140-6736\(15\)00275-5](https://doi.org/10.1016/S0140-6736(15)00275-5)
3. Pinto Leite N, Pereira JM, Cunha R, Pinto P, Sirlin C. CT evaluation of appendicitis and its complications: imaging techniques and key diagnostic findings. *AJR Am J Roentgenol.* 2005; 185(2):406-17. <https://doi.org/10.2214/ajr.185.2.01850406>
4. Liang TJ, Liu SI, Tsai CY, Kang CH, Huang WC, Chang HT, et al. Analysis of recurrence management in patients who underwent nonsurgical treatment for acute appendicitis. *Medicine (Baltimore).* 2016; 95(12):e3159. <https://doi.org/10.1097/MD.0000000000003159>
5. Bae SU, Jeong WK, Baek SK. Single-port laparoscopic interval appendectomy for perforated appendicitis with a periappendiceal abscess. *Ann Coloproctol.* 2016; 32(3):105-10. <https://doi.org/10.3393/ac.2016.32.3.105>
6. Tannoury J, Abboud B. Treatment options of inflammatory appendiceal masses in adults. *World J Gastroenterol.* 2013; 19(25):3942-50. <https://doi.org/10.3748/wjg.v19.i25.3942>
7. Augustin T, Cagir B, Vandermeer TJ. Characteristics of perforated appendicitis: effect of delay is confounded by age and gender. *J Gastrointest Surg.* 2011; 15(7):1223-31. <https://doi.org/10.1007/s11605-011-1486-x>
8. Simillis C, Symeonides P, Shorthouse AJ, Tekkis PP. A meta-analysis comparing conservative treatment versus acute appendectomy for complicated appendicitis (abscess or phlegmon). *Surgery.* 2010; 147(6):818-29. <https://doi.org/10.1016/j.surg.2009.11.013>
9. Marin D, Ho LM, Barnhart H, Neville AM, White RR, Paulson EK. Percutaneous abscess drainage in patients with perforated acute appendicitis: effectiveness, safety, and prediction of outcome. *AJR Am J Roentgenol.* 2010; 194(2):422-9. <https://doi.org/10.2214/AJR.09.3098>
10. Kim JK, Ryoo S, Oh HK, Kim JS, Shin R, Choe EK, et al. Management of appendicitis presenting with abscess or mass. *J Korean Soc Coloproctol.* 2010; 26(6):413-9. <https://doi.org/10.3393/jksc.2010.26.6.413>

11. Aranda-Narváez JM, González-Sánchez AJ, Marín-Camero N, Montiel-Casado C, López Ruiz P, Sánchez-Pérez B, et al. Conservative approach versus urgent appendectomy in surgical management of acute appendicitis with abscess or phlegmon. *Rev Esp Enferm Dig.* 2010; 102(11):648-52. <https://doi.org/10.4321/S1130-01082010001100005>
12. Nimmagadda N, Matsushima K, Piccinini A, Park C, Strumwasser A, Lam L, et al. Complicated appendicitis: Immediate operation or trial of nonoperative management? *Am J Surg.* 2019; 217(4):713-717. <https://doi.org/10.1016/j.amjsurg.2018.12.061>
13. Dong Y, Tan S, Fang Y, Yu W, Li N. Meta-analysis of laparoscopic surgery versus conservative treatment for appendiceal abscess [in Chinese]. *Zhonghua Wei Chang Wai Ke Za Zhi.* 2018; 21(12):1433-1438.
14. Church JT, Klein EJ, Carr BD, Bruch SW. Early appendectomy reduces costs in children with perforated appendicitis. *J Surg Res.* 2017; 220:119-124. <https://doi.org/10.1016/j.jss.2017.07.001>
15. Cheng Y, Xiong X, Lu J, Wu S, Zhou R, Cheng N. Early versus delayed appendectomy for appendiceal phlegmon or abscess. *Cochrane Database Syst Rev.* 2017; 6:CD011670. <https://doi.org/10.1002/14651858.CD011670.pub2>
16. Horn CB, Coleoglou Centeno AA, Guerra JJ, Mazuski JE, Bochicchio GV, Turnbull IR. Drain failure in intra-abdominal abscesses associated with appendicitis. *Surg Infect (Larchmt).* 2018; 19(3):321-325. <https://doi.org/10.1089/sur.2017.224>
17. Fagenholz PJ, Peev MP, Thabet A, Michailidou M, Chang Y, Mueller PR, et al. Abscess due to perforated appendicitis: factors associated with successful percutaneous drainage. *Am J Surg.* 2016; 212(4):794-798. <https://doi.org/10.1016/j.amjsurg.2015.07.017>
18. St Peter SD, Shah SR, Adibe OO, Sharp SW, Reading B, Cully B, et al. Saline vs tissue plasminogen activator irrigations after drain placement for appendicitis-associated abscess: A prospective randomized trial. *J Am Coll Surg.* 2015; 221(2):390-6. <https://doi.org/10.1016/j.jamcollsurg.2015.03.043>
19. Sceats LA, Ku S, Coughran A, Barnes B, Grimm E, Muffly M, et al. Operative versus nonoperative management of appendicitis: A long-term cost effectiveness analysis. *MDM Policy Pract.* 2019; 4(2):2381468319866448. <https://doi.org/10.1177/2381468319866448>
20. Salminen P, Paajanen H, Rautio T, Nordström P, Aarnio M, Rantanen T, et al. Antibiotic therapy vs appendectomy for treatment of uncomplicated acute appendicitis: The APPAC Randomized Clinical Trial. *JAMA.* 2015; 313(23):2340-8. <https://doi.org/10.1001/jama.2015.6154>
21. Charfi S, Sellami A, Affes A, Yaïch K, Mzali R, Boudawara TS. Histopathological findings in appendectomy specimens: a study of 24,697 cases. *Int J Colorectal Dis.* 2014; 29(8):1009-12. <https://doi.org/10.1007/s00384-014-1934-7>

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