

Original Article

## Etiology, treatment options and prognosis of abdominal abscesses: A tertiary hospital experience

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### Abstract

**Introduction:** The principle of abdominal abscess treatment is drainage. However, whether this drainage is percutaneous or open surgery is the choice of the specialist or center. Recently, there have been reports indicating that percutaneous drainage is superior. In this study, patients followed up and treated in a ten-year period in our clinic were evaluated for both of the methods that we applied.

**Methodology:** Cases of intra-abdominal abscess followed-up in a ten-year period were evaluated retrospectively. As well as some of the characteristics of the patients, the methods of drainage applied were recorded. The subjects who received percutaneous drainage and those undergoing open surgery were compared in terms of length of hospitalization, length of treatment and prognosis.

**Results:** The most common abscess site was intraperitoneal, and the origins of the abscesses were often hospital-based. The most commonly isolated organism, at a level of 33.8%, was *Escherichia coli*. Percutaneous drainage was applied at source control in 49 (43.8%) patients and open surgery drainage in 60 (53.6%). However, length of hospitalization, length of treatment and duration of drainage catheter use were statistically significantly higher in the percutaneous drainage group. No significant difference was observed between the groups in terms of prognosis.

**Conclusion:** We attribute these results in disagreement with the literature to more patients being recommended for percutaneous drainage due to the fact that these patients were thought to be incapable of tolerating open surgery and to the higher probability of additional disease and complications.

**Key words:** Intraabdominal abscess; surgical drainage; percutaneous drainage.

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### Introduction

Intra-abdominal infections are inflammatory responses by the peritoneum to micro-organisms resulting from the accumulation of purulent exudate in the abdominal cavity. Intra-abdominal abscesses are a particular form of intra-abdominal infection that develop depending on the type of micro-organism responsible, the amount of inoculum and the duration of infection.

Effective antibiotherapy needs to be started in intra-abdominal abscess in addition to rapid and appropriate source control [1]. The aims of antimicrobial therapy are to eradicate agent micro-organisms, prevent local and hematogenous spread, reduce the probability of recurrence, shorten the time to improvement of findings and reduce complications [2,3]. The recommended general approach in treatment involves drainage of the

abscess, and surgical or percutaneous drainage can be performed in suitable cases.

This study retrospectively examined cases of intra-abdominal abscess treated by the Department of Infectious Diseases and Clinical Microbiology and the Department of General Surgery clinics in Medical Faculty Hospital in Turkey. Cases were compared in terms of etiology, associated factors and prognosis in order to determine appropriate empirical therapeutic options and whether or not drainage methods applied at source control were superior to one another.

### Methodology

Cases of intra-abdominal abscess followed-up between in the Department of Infectious Diseases and Clinical Microbiology and Department of General Surgery clinics were examined retrospectively. One hundred and twenty patient records examined over a

specific period of time were accessed, but eight files were excluded due to insufficient records, and a total of 112 patients were finally enrolled in the study.

Patients’ demographic characteristics, presence of additional disease, the origin and site of the abscess, growing micro-organisms, antimicrobials used in treatment and the method applied in source control (percutaneous drainage and open surgery) were recorded. Subjects who received percutaneous drainage and those undergoing open surgery were compared in terms of length of hospitalization, length of treatment and prognosis.

Data were analyzed on SPSS (Statistical Package for the Social Sciences) for Windows version 16.0 software. Data were expressed as number, percentage, mean, standard deviation and minimum and maximum values. T test and Chi-square tests were used for group comparisons. Significance was set at  $p < 0.05$ .

### Results

Forty-nine (43.8%) of the 112 cases of intra-abdominal abscess were males and 63 (56.2%) were females. Mean age was  $56.25 \pm 16.52$  years.

In terms of chronic accompanying diseases, no chronic disease was present in 28 (25%) cases, while 72 (64.3%) had at least two chronic diseases and 12 (10.7%) had at least three. Diabetes mellitus, malignancy, and cardiac diseases were the most frequently observed accompanying diseases. Abscesses developed postoperatively in 16 (57.4%) of the 28 individuals with no additional disease.

The abscesses were intraperitoneal in 70 (58.8%) patients, visceral in 40 (33.6%) and retroperitoneal in 9 (7.5%). Both intraperitoneal and visceral abscesses were determined in one patient, while intraperitoneal, visceral and retroperitoneal abscesses were co-present in three. Detailed information concerning the anatomical location of the abscesses is given in Table 1. Pleural effusion was the most common (31.8%) complication in subdiaphragmatic abscess patients. Empyema developed in two patients after pleural effusion and thorax tube drainage was performed. Nosocomial pneumonia developed in one patient.

In terms of the origins of abscesses, 51 (45.5%) patients had community-acquired spontaneous abscesses, while 61 (54.5%) were cases of nosocomial abscess developing postoperatively. The operations undergone were classified as elective or emergency. Thirty-eight (62%) of the 61 patients developing postoperative abscesses had undergone emergency surgery and 21 (38%) had undergone elective surgery. When community-acquired abscesses were classified according to causes determined intraoperatively, perforated appendix was the most common cause, at a level of 47.1% ( $n = 6$ ), which was followed by perforated diverticulitis at 15.7% ( $n = 2$ ).

Abscess culture was only performed in 31 (27.7%) cases because of technical problems. Analysis of the abscess cultures revealed gram-negative bacteria in 58% and gram-positive bacteria in 33%, while a fungal agent grew in 9%. The most commonly isolated organism, at a level of 33.8%, was *Escherichia coli*. The

**Table 1.** Anatomical locations of intra-abdominal abscesses.

Abscess location		No.	%
<b>Intraperitoneal</b>		<b>70</b>	<b>58.8</b>
	Subdiaphragmatic	22	31.4
	Periapendicular	18	25.7
	Pericholecystic	14	20.0
	Perisplenic	10	14.3
	Pericyclic	3	4.3
	Pericecal	3	4.3
<b>Retroperitoneal</b>		<b>9</b>	<b>7.5</b>
	Pancreatic	5	55.5
	Perinephritic	3	33.3
	Psoas	1	11.2
<b>Visceral</b>		<b>40</b>	<b>33.7</b>
	Liver	31	77.5
		Right lobe	23
		Left lobe	5
		Bilobed	3
	Pancreas	5	12.5
	Spleen	3	7.5
	Ovary	1	2.5

distribution of micro-organisms isolated from abscess cultures is shown in Table 2.

Six of the isolated coagulase negative staphylococcus and *Staphylococcus aureus* isolates were community-acquired, while seven were isolated from nosocomial abscesses. Oxacillin resistance was present in 66.7% of community-acquired staphylococci and in 85.7% of nosocomial abscesses. Extended spectrum beta lactamase (ESBL) was observed in 72% of gram negatives isolated from postoperative abscesses.

Fifty-nine (52.3%) were initially started on empiric 3<sup>rd</sup> generation cephalosporin and nitroimidazole in combination while 36 (32.1%) patients used a single beta lactam+beta lactamase inhibitor combination drug. Eight patients were started on empiric carbapenem, six on tigecycline and three on empiric quinolone group antibiotics. Fifty-seven (50.9%) patients completed the treatment with the initial antibiotic while treatment was revised in 55 (49.1%). Treatment modification during follow-up was performed based on culture results in 32 patients and due to lack of clinical response to initial treatment in 23. Mean duration of antibiotherapy was 17.71 ± 9.11 days (minimum 3, maximum 55 days).

Percutaneous drainage was applied (Group 1) at source control in 49 (43.8%) patients and open surgery (Group 2) drainage in 60 (53.6%). In one case, percutaneous drainage was applied initially, but open surgery drainage was subsequently applied since sufficient source control could not be established. Neither drainage technique could be applied in one case due to general condition impairment, and this patient was treated with antibiotherapy alone. One patient refused to accept the drainage technique recommended and was discharged with oral antibiotherapy. These three patients were excluded from the study's statistical analysis. Open surgery was performed after

**Table 2.** Micro-organisms isolated from abscess cultures.

Micro-organism	No. (%)
<i>Escherichia coli</i>	22 (33.8)
<i>Enterococcus</i> spp.	9 (13.8)
<i>Enterobacter cloaca</i>	6 (9.3)
<i>Streptococcus</i> spp.	6 (9.3)
<i>Candida</i> spp.	6 (9.3)
Coagulase negative staphylococcus	5 (7.6)
<i>Klebsiella</i> spp.	4 (6.2)
<i>Citrobacter freundii</i>	4 (6.2)
Methicillin-resistant <i>Staphylococcus aureus</i>	1 (1.5)
<i>Proteus</i> spp.	1 (1.5)
Gram-negative non-fermenting bacilli	1 (1.5)
<b>Total</b>	<b>65</b>

percutaneous drainage in one of the 49 cases in whom we applied percutaneous drainage, and recurrence of abscess occurred in the same location in three patients.

Mean length of drainage catheterization in the two groups was 13.3 ± 12.5 days (minimum 2 days, maximum 120 days). Mean length of catheterization in patients receiving percutaneous drainage was 16.9 ± 17.2 days (minimum 4, maximum 120), while in the open surgery group, the duration was 10.3 ± 5.5 days (minimum 2, maximum 26). Mean length of hospitalization in the patients receiving percutaneous drainage was 25.1 ± 18.1 days (minimum 4, maximum 120), compared to 16.7 ± 8.0 days (minimum 3, maximum 37) in the open surgery group.

Length of hospitalization, length of treatment and duration of drainage catheter use were statistically significantly higher in the percutaneous drainage group (Table 3). Cure was achieved in 103 cases (92%), while mortality occurred in 8 (7.1%). No significant difference was observed between the groups in terms of prognosis (Table 4).

**Table 3.** Comparison of Group 1 and Group 2 in terms of duration of hospitalization, treatment and drainage.

	Group 1		Group 2		P
	Mean ± SD		Mean ± SD		
Length of hospitalization	25.1 ± 18.1		16.7 ± 8.0		0.004
Length of treatment	20.7 ± 9.9		14.9 ± 6.7		0.001
Length of drainage	16.9 ± 17.2		10.3 ± 5.5		0.013

**Table 4.** Comparison of Group 1 and Group 2 in terms of prognosis.

	Group 1		Group 2		P
	n	%	n	%	
Healthy	45	91.8	56	93.3	1.00
Mortality	4	8.2	4	6.7	
<b>Total</b>	<b>49</b>	<b>100.0</b>	<b>60</b>	<b>100.0</b>	

## Discussion

Intra-abdominal infections generally manifest as secondary peritonitis or intra-abdominal abscesses developing in association with causes such as gastrointestinal system perforations, intestinal ischemia, anastomosis leaks and abdominal trauma. Although rare, it is also possible for an infection in a distant source to cause abscess by reaching the abdomen with bacteremia.

Underlying conditions such as advanced age, malnutrition, glucocorticoid use, malignancy, diabetes and cirrhosis, massive blood transfusion, organ insufficiency and presence of hypovolemia and inappropriate antibiotic use are factors reported to facilitate the formation of intra-abdominal abscesses [4]. Diabetes and malignancy were two of the most common accompanying diseases in the patients in this study. Diabetes mellitus was present in 30 patients (26.8%) and malignancy in 26 (23.2%), making these the second and third most common diseases after heart diseases, observed in 38 cases. Our scan of the literature revealed no reports in which heart disease was described as a risk factor for intra-abdominal abscess. However, in addition to causing dysfunction in the organ concerned, chronic diseases have also been reported to have an adverse impact on neutrophil phagocytosis and chemotaxis and thus to facilitate infection in the host [5]. In terms of the 28 patients with no additional disease, the majority of these were cases of nosocomial intra-abdominal abscesses emerging following a surgical procedure.

Nosocomial intra-abdominal infections generally have a more severe course than community-acquired ones. As with all infections, these complications, known as surgical site infections, develop depending on the amount of bacterial contamination, the virulence of the bacteria and the patient's resistance and defense system. Surgical technique, foreign substances used and care over antisepsis rules shown by the operating team also affect surgical infections. Whether the surgical procedure was emergency or elective is also significant in the development of postoperative complications. In a study of 7306 cases, Pedersen *et al.* [6] have emphasized that emergency surgery is an important marker in estimating mortality risk. Numerous studies in the literature have noted an increase in the incidence of surgical site infections, and particularly pulmonary complications, and other complications following surgery under emergency conditions [7-10]. Community-acquired spontaneous abscesses were observed in 51 (45.5%) patients in this study, while nosocomial abscesses secondary to surgery developed

in 61 (54.5%). In agreement with previous studies, majority of the patients with nosocomial abscesses had undergone emergency surgery.

Intra-abdominal abscesses may occur in three regions including intraperitoneal, retroperitoneal or visceral (hepatic, splenic, pancreatic, renal, tubo-ovarian etc.). Intraperitoneal abscesses are named on the basis of their location. The most common locations are subphrenic, paracolic and pelvic region abscesses [11]. In this study, abscesses were intraperitoneal in location in 58.8% of patients, visceral in 33.6% and retroperitoneal in 7.5%. Both intraperitoneal and visceral abscesses were present in one patient and intraperitoneal, visceral and retroperitoneal abscesses in three. In terms of the location of intraperitoneal abscesses, the most common were subdiaphragmatic (31.4%), periappendicular (25.7%) and pericholecystic (20.0%). Locations of the abscesses in previous studies are similar to our findings [12,13].

Intra-abdominal abscesses are generally polymicrobial infections caused by aerobic and anaerobic micro-organisms together. The most commonly isolated aerobic agent in intraperitoneal abscesses is *Escherichia coli*, and the most commonly isolated anaerobic agent is *Bacteroides fragilis* [1]. Retroperitoneal abscesses developing secondary to renal pathologies are generally monomicrobial infections associated with gram-negative bacilli, such as *E. coli* and *Proteus* spp. Retroperitoneal abscesses of gastrointestinal origin are polymicrobial abscesses forming with agents such as *E. coli*, *Enterobacter* spp., enterococci and *Bacteroides* spp. [14]. Agents such as staphylococci, streptococci *Klebsiella* spp. and *Candida* spp. may also be determined in abscesses developing following trauma [1,11]. Similarly to intraperitoneal abscesses, agents identified in pyogenic hepatic abscesses are frequently *E. coli* and *Bacteroides* spp., while staphylococci, viridans streptococci, *Salmonella* spp. and *E. coli* are the most commonly isolated micro-organisms in splenic abscesses [15,16]. Since they are generally bacterial infections, the taking of culture specimens is recommended in intra-abdominal abscesses [2]. Culture specimens were not taken in approximately one in four patients in this study. No explanation was encountered in the records, but they may not have been taken for reasons of localization. In terms of abscess cultures, no growth was determined in 19.7%, while the most commonly isolated micro-organism, at 33.8%, was *E. coli*. As shown in Table 2, the distribution of other agents was also compatible with previous studies.

The agent micro-organisms and antibacterial sensitivities vary in community-acquired and nosocomial intra-abdominal infections. More difficult to treat resistant bacteria are generally involved in nosocomial infections. The most commonly observed micro-organisms in postoperative nosocomial infections are *P. aeruginosa*, methicillin-resistant *Staphylococcus*, *Proteus*, enterobacteriaceae, enterococci and *Candida* [17]. In terms of the micro-organisms isolated and abscess origins in this study, oxacillin resistance observed in 66.7% of the community-acquired staphylococci was seen in 85.7% of nosocomial abscesses. Similarly, resistance level was high in gram-negatives isolated from nosocomial abscesses. No GSBL enzyme was determined in community-acquired cases but a level of 72% was determined in postoperative cases.

The treatment of intra-abdominal abscesses consists of a combination of abscess drainage and appropriate antimicrobial therapy. Antibiotic therapy must be commenced before abscess drainage performed for source control and must include gram-negative bacteria, particularly *E. coli*, and also *B. fragilis* [2]. It is essential, but not by itself sufficient, to include the most commonly seen agents in empiric antibiotherapy. In addition to accurately identifying the agent, antibiotic sensitivity patterns of these agents must also be estimated correctly. Since resistance patterns can change from country to country, from region to region within the same country, from hospital to hospital in the same city and from unit to unit within the same hospital, local antibiotic sensitivity data must be known and applied. Fifty-nine (52.3%) of the patients in this study were initially started on empiric 3<sup>rd</sup> generation cephalosporin and nitroimidazole combination while 36 (32.1%) patients used a single beta lactam+beta lactamase inhibitor combination drug. Eight patients were started on empiric carbapenem, six on tigecycline and three on empiric quinolone group antibiotics. Fifty-seven (50.9%) patients completed treatment with the initial antibiotic. Treatment modification during follow-up was performed based on culture results in 32 patients (due to presence of oxacillin resistance or fungal agent or GSBL) and due to lack of clinical response to initial treatment in 23 (20.5%). Majority of the cases in which treatment was modified on the basis of culture results consisted of postoperative nosocomial abscesses. Intra-abdominal abscesses developing postoperatively suggested that antibiotics effective against resistant micro-organisms need to be selected in initial treatment.

The area surrounding the abscess is a deleterious environment for antibiotics for reasons such as the

presence of the abscess capsule, low pH and protein-binding enzymes. Drainage is therefore essential in the presence of abscess [18]. Drainage can be performed by means of percutaneous catheter or laparotomy. The advantages of percutaneous drainage are that it does not require general anesthesia, avoids laparotomy and complications deriving from long-term hospitalization and is less costly. Abscesses suitable for percutaneous drainage are generally well-defined and unilocular collections. Although limited indications were once described for percutaneous drainage, it is now thought that collections of any size, morphology, scope and etiology can be drained percutaneously. However, the presence of a surgical team capable of undertaking emergency surgery is still required in the event of complications [19]. Percutaneous drainage was applied in 49 (43.8%) cases in our patient group while 60 (53.6%) were treated with open surgery drainage. Cure was achieved in 103 cases (92%), while mortality occurred in 8 (7.1%). Mortality levels in the literature range between 2% and 19% [19-23]. Six patients (75%) in this study died from sepsis, while cardiovascular events were recorded as the cause of death in 2 (25%) patients. Kumar et al. [24] have successfully treated 104 out of 114 patients with intra-abdominal abscess using antibiotics alone or antibiotics + percutaneous drainage. Several studies have reported that treatment can be provided with percutaneous drainage, guided by ultrasound and/or computed tomography of intra-abdominal abscesses without more than two localizations or loculations, not requiring access through the bowel, pleura or diaphragm, with no persisting source of infection and in the absence of fungal abscess [21,25]. Due to adhesion of material to the abscess wall and drainage being insufficient in fungal abscesses and due to material being too thick to be aspirated through the drain in emphysematous infections, percutaneous drainage is not recommended in abscesses of this kind [25,26]. According to Pruett's criteria, complete resolution of an abscess following percutaneous drainage is defined as cure, while acute decompression of the abdominal event until elective definitive surgery is possible is defined as palliation. These were cited as criteria for therapeutic success, while failure was defined as insufficient drainage requiring surgery or recurrence of infection [27]. In our study, open surgery was performed after percutaneous drainage in one of the 49 cases in which we applied percutaneous drainage, and recurrence of abscess occurred in the same location in three patients. Our failure rate was 8.2% (4/49). Success rates for percutaneous drainage in the literature range between

80% and 100% [13,28-30], and our failure rate is therefore within acceptable limits. However, duration of hospitalization, length of drainage catheterization and length of antibiotic therapy were all significantly high in the group receiving percutaneous drainage in this study. We attribute these results in disagreement with the literature to more patients being recommended for percutaneous drainage due to the fact that these patients were thought to be incapable of tolerating open surgery and to the higher probability of additional disease and complications.

## Conclusion

In conclusion, more efforts must be made to take microbiological samples in cases of intra-abdominal abscess. Culturing is important to determine appropriate empiric antibiotic options. Each center must plan treatment in the light of its own flora. Treatment must be initiated while considering resistant bacteria in cases of postoperative nosocomial abscesses. Selection of the appropriate means of providing source control lies in the collaboration between the radiologist and surgeon.

## References

- Solamkin JS, Moulton JS, Luchette FA (2003) Diagnosis and Management of Intraabdominal Sepsis. In: Irwin RS, Rippe JM, eds. *Intensive Care Medicine*. Philadelphia: Lippincott Williams and Wilkins: 1663-1675.
- Solomkin JS, Mazuski JE, Bradley JS, Rodvold KA, Goldstein EJ, Baron EJ, O'Neill PJ, Chow AW, Dellinger EP, Eachempati SR, Gorbach S, Hilfiker M, May AK, Nathens AB, Sawyer RG, Bartlett JG (2010) Diagnosis and management of complicated intra-abdominal infection in adults and children: Guidelines by the Surgical Infection Society and the Infectious Diseases Society of America. *Clin Infect Dis* 15: 133-164.
- Blot S, De Waele JJ (2005) Critical issues in the clinical management of complicated intra-abdominal infections. *Drugs* 65: 1611-1620.
- Minei JP, Champine JG (2010) Abdominal Abscesses and Gastrointestinal Fistulas. In: Feldman M, Friedman LS, Brandt LJ, editors. *Feldman: Sleisenger and Fordtran's Gastrointestinal and Liver Disease*. 9th ed. Missouri: Saunders An Imprint of Elsevier Inc. 411-419.
- Wacha H, Hau T, Dittmer R, Ohmann C (1999) Risk factors associated with intraabdominal infections: a prospective multicenter study. *Langenbecks Arch Surg* 384: 24-32.
- Pedersen T, Eliassen K, Henriksen E (1990) A prospective study of mortality associated with anaesthesia and surgery: risk indicators of mortality in hospital. *Acta Anaesthesiol Scand* 34: 176-182.
- Smetana GW, Lawrence VA, Cornell JE (2006) Preoperative pulmonary risk stratification for noncardiothoracicsurgery: systematic review for the American College of Physicians. *Ann Intern Med* 144: 581-595.
- Smenata GW (2003) Preoperative pulmonary assessment of the older adult. *Clin Geriatr Med* 19: 35-55.
- Ugur M, Benzin F, Tozlu G, Koca YS, Cetin R (2012) Comparison of results of inguinal hernia repair operations carried out on geriatric patients under emergency or elective conditions. *Ulusal Cerrahi Dergisi* 28: 193-196.
- Bayar B, Yilmaz KB, Akinci M, Şahin A, Kulaçoğlu H (2015) An evaluation of treatment results of emergency versus elective surgery in colorectal cancer patients. *Ulus Cerrahi Derg* 32: 11-17.
- Ozkurt Z (2014) Intraperitoneal and retroperitoneal abscesses. *Turkiye Klinikleri J Inf Dis-Special Topics* 7: 45-55.
- Olson MM, Allen MO (1989) Nosocomial abscess: Result of an eight-year prospective study of 32,284 operations. *Arc Surg* 124: 356-361.
- Akinci D, Akhan O, Ozmen MN, Karabulut N, Ozkan O, Cil BE, Karcaaltincaba M (2005) Percutaneous drainage of 300 intraperitoneal abscesses with long-term follow-up. *Cardiovasc Intervent Radiol* 28: 744-750.
- Turnage RH, Badgwell B (2012) Retroperitoneal Disorders. In: Townsend CM, Beauchamp RD, Evers BM, MattoxKL, editors. *Sabiston Textbook of Surgery*. Missouri: Saunders An Imprint of Elsevier Inc 1088-1113.
- Erol S (2014) Liver abscesses *Turkiye Klinikleri J Inf Dis-Special Topics* 7: 56-62.
- Sahin-Horasan E (2014) Splenic abscess *Turkiye Klinikleri J Inf Dis-Special Topics* 7: 63-66.
- Magnuson DK, Charles CL (1993) Intra-abdominal infection and sepsis following trauma. In: Fonkalsrud EW, Krummel TM, editors. *Infectious and Immunologic Disorders in Pediatric Surgery*. Philadelphia: WB Saunders Company: 239-261.
- Brook I (2008). *Mikrobiology and management of abdominal infections*. *Dig Dis Sci* 53: 2585-2591.
- Robert B, Yzet T, Regimbeau JM (2013) Radiologic drainage of post-operative collections and abscesses. *J Visc Surg* 150: 11-18.
- Brolin RE, Noshier JL, Leiman S, Lee WS, Greco RS (1984) Percutaneous catheter versus open surgical drainage in the treatment of abdominal abscesses. *Am Surg* 50: 102-108.
- Hemming A, Davis NL, Robins RE (1991) Surgical versus percutaneous drainage of intra-abdominal abscesses. *Am J Surg* 161: 593-595.
- Levison MA, Zeigler D (1991) Correlation of APACHE II score, drainage technique and outcome in postoperative intra-abdominal abscess. *Surg Gynecol Obstet* 172: 89-94.
- Malangoni MA, Shumate CR, Thomas HA, Richardson JD (1990) Factors influencing the treatment of intra-abdominal abscesses. *Am J Surg* 159: 167-171.
- Kumar RR, Kim JT, Haukoos JS, Macias LH, Dixon MR, Stamos MJ, Konyalian VR (2006) Factors affecting the successful management of intra-abdominal abscesses with antibiotics and the need for percutaneous drainage. *Dis Colon Rectum* 49: 183-189.
- Haaga JR, Alfydi RJ, Havrilla TR, Cooperman AM, Seidelmann FE, Reich NE, Weinstein AJ, Meaney TF (1977) CT detection and aspiration of abdominal abscesses. *AJR Am J Roentgenol* 128: 465-474.
- Hau T, Haaga JR, Aeder MI (1984) Pathophysiology, diagnosis, and treatment of abdominal abscesses. *Curr Probl Surg* 21: 1-82.
- Pruett TL, Rotstein OD, Crass J, Frick MP, Flohr A, Simmons RL (1984) Percutaneous aspiration and drainage for suspected abdominal infection. *Surgery* 96: 731-737.

28. Theisen J, Bartels H, Weiss W, Berger H, Stein HJ, Siewert JR (2005) Current concepts of percutaneous abscess drainage in postoperative retention. *J Gastrointest Surg* 9: 280-283.
29. Ciftci TT, Akinci D, Akhan O (2012) Percutaneous transhepatic drainage of inaccessible postoperative abdominal abscesses. *AJR Am J Roentgenol* 198: 477-481.
30. Robert B, Chivot C, Fuks D, Gondry-Jouet C, Regimbeau JM, Yzet T (2013) Percutaneous, computed tomography-guided drainage of deep pelvic abscesses via a transgluteal approach: a report on 30 cases and a review of the literature. *Abdom Imaging* 38: 285-289.

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