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Pelvic abscess drainage: outcome with factors affecting the clinical success

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PURPOSE
We aimed to evaluate the success and complication rates of image-guided pelvic abscess drainage with emphasis on factors affecting the clinical success.

METHODS
During a 7-year period, 185 pelvic abscesses were treated in 163 patients under ultrasonography and fluoroscopy (n=140) or computed tomography (n=45) guidance with transabdominal (n=107), transvaginal (n=39), transrectal (n=21) and transgluteal (n=18) approaches. Abscess characteristics (etiology, number, size, intrastructure, microbiological content, presence of fistula), patient demographics (age, sex, presence of malignancy, primary disease, antibiotic treatments), procedure-related factors (guidance method, access route, catheter size) and their effects on clinical success, complications, and duration of catheterization were statistically analyzed.

RESULTS
Technical and clinical success rates were 100% and 93.9%, respectively. Procedure-related mortality or major complications were not observed. Minor complications such as catheter dislodgement, obstruction, or kinking were detected in 6.7% of the patients. Clinical failure was observed in 10 patients (6.1%). Fistulization was observed in 14 abscesses. Fistulization extended the duration of catheter use ($P < 0.001$) and decreased the clinical success rate ($P < 0.001$). The presence of postoperative malignant, complex-multilocular abscesses, and fungus infection in the cavity extended catheter duration ($P < 0.001$, $P = 0.018$, and $P = 0.007$, respectively), whereas the presence of sterile abscess and endocavitary catheterization reduced the catheter duration ($P = 0.009$ and $P = 0.011$, respectively).

CONCLUSION
Image-guided pelvic abscess drainage has high clinical success and low complication rates. The only factor affecting the clinical success rate is the presence of fistula.

Laparotomy with lavage or surgical incision and drainage through the rectal or vaginal walls were used as conventional surgical treatment methods for pelvic abscesses. During the last three decades, percutaneous imaging-guided pelvic abscess drainage has been reported as an effective alternative to surgical techniques. Thanks to advances in imaging modalities (ultrasonography [US] and computed tomography [CT]), drainage techniques (transrectal, transvaginal, and transgluteal approaches) and catheter technology, imaging-guided pelvic abscess drainage improved and gained worldwide acceptance (1–9).

Technical approaches for pelvic abscess drainage and clinical success rates on patient series were widely reported in the literature; however, studies on factors affecting the clinical success are limited (10–16). The purpose of this study was to evaluate the success and complication rates of image-guided pelvic abscess drainage, with emphasis on factors affecting the clinical success, including abscess, patient, and procedure characteristics.

Methods

Data collection

In this retrospective study, we included all patients who underwent image-guided drainage of pelvic abscesses and had at least one year of follow-up. All relevant clinical informa-

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tion was collected from our institutional database. A total of 188 deep pelvic abscesses were drained in 166 consecutive patients; three patients were excluded as their long-term follow-up information was not available. Informed consent for the procedure was obtained from each patient. All patients were treated as inpatient. Long-term follow-up information was gathered from the institutional database or by talking to the patient or clinician of the patient. Follow-up information extended to at least one year in all patients to verify the clinical outcome after drainage. Institutional review board approval was obtained for this study.

Inclusion criteria

Criteria for drainage were as follows: i) fluid associated with pus and bad smell or positive culture; ii) fluid associated with clinical findings like fever, local pain, and positive microscopic results even if the culture was negative. Sterile fluid collections such as ascites, lymphocele, and hematoma were excluded from the analysis.

Procedures and follow-up

Any coagulopathy (INR>1.5, platelet count <50,000/mm^3) was appropriately corrected before the procedure by administration of platelet concentrates, fresh frozen plasma and/or vitamin K. All patients received prophylactic broad-spectrum intravenous antibiotics unless they were already having antibiotics. All procedures were performed by an interventional radiologist in an interventional suite or CT unit under intravenous sedation. All catheters were placed with Seldinger technique via transabdominal, transvaginal, transrectal, or transgluteal routes as previously described in the literature (3, 10, 17, 18). According to Gram stain and culture results appropriate antibiotics were administered. The patient status, catheter, and drainage were inspected during daily rounds. To keep the catheter patent, daily catheter irrigation was performed with 5–10 mL of saline. Patients were evaluated in the interventional radiology unit for catheter-related complications and fistulous communications. US, CT, and abscessogram were used in order to evaluate the reduction of abscess cavity and any possible fistula formation. The catheter was withdrawn when clinical, laboratory, and radiologic improvements were observed and the amount of daily drainage was less than 10 mL/24 h.

Main points

- Image-guided pelvic abscess drainage has high clinical success and low complication rates.
- The only factor affecting the clinical success rate is the presence of fistula.
- Postoperative malignant, complex/multilocular abscesses and the presence of fistula or yeast in the cavity increase the mean duration of catheter use.
- When the transabdominal route is limited, endocavitary routes may be preferred to transgluteal route due to their lower minor complication rates.

Definitions, outcome measures and statistical analysis

Curative drainage was defined as complete resolution of abscess and no further intervention (10-12). Partial success was defined as either adequate drainage of the abscess with surgery subsequently performed to repair an underlying problem or as temporizing drainage performed to stabilize the patient prior to surgery (12). Clinical success covered both curative drainage and partial success. Failure was defined as the need for open surgical drainage before complete resolution of the pelvic abscess. Sepsis-related mortality or any recurrences were also considered as failure. Complications were classified as major or minor according to the Society of Interventional Radiology criteria (19).

Statistical analysis

SPSS 22 package program for windows (IBM Corp.) was used for statistical analysis. The variables were investigated using visual (histograms, probability plots) and analytical methods (Kolmogorov-Smirnov) to determine whether they are normally distributed. Descriptive analyses were presented using tables of frequencies for the nominal variables, median and minimum-maximum values for the non-normally distributed numeric variables, means and standard deviation for the normally distributed numeric variables. Patients treated by simple aspiration and with partial success were not included in statistical analyses. In essence, the variables affecting the duration of catheter use, success and complication rates were evaluated. Statistically analyzed variables and their details were as follows: i) patient characteristics: age, gender, presence of single or multiple abscesses, presence of malignancy, underlying etiology (spontaneous or postoperative); ii) abscess characteristics: volume, structure (complex multilocular or simple unilocular), microbiologic content (nonmicrobial, unimicrobial polymicrobial, presence of yeast), presence of fistula; iii) procedure characteristics: guidance method (US or CT), access route (transabdominal, transvaginal, transrectal, transgluteal) and catheter size.

The univariate analyses to identify variables associated with duration of the catheter, success and complication rates were investigated as follows:

Since the measurement of the duration of catheter was not normally distributed, Mann-Whitney U and Kruskal-Wallis tests were conducted to compare this parameter with nominal variables of patient characteristics, abscess characteristics, and procedure characteristics. The Mann-Whitney U test was performed to test the significance of pairwise differences using Bonferroni correction to adjust for multiple comparisons. Student t test was conducted in order to compare age factor in different groups due to its normal distribution.

The chi-square test and Fisher's exact test (when chi-square test assumptions do not hold due to low expected cell counts) were used to compare the success and complication proportions in different groups.

While investigating the association between duration of catheter and abscess volume, the correlation coefficient and its significance were calculated using the Spearman test.

An overall %5 type 1 error level was used to infer statistical significance.

Results

A total of 185 pelvic abscesses were drained in 163 patients (55 male, 108 female; mean age, 49.1±16.5 years). Of the patients, 142 had one abscess, 20 patients had two abscesses and 1 patient had three abscesses. A total of 144 abscesses occurred in the postoperative period, whereas 41 abscesses in 38 patients occurred spontaneously. Seventy postoperative abscesses occurred due to gastrointestinal causes (colorectal cancer, n=37; appendectomy, n=8; viscus perforation, n=8; stomach or small intestine cancer, n=7; hepatobiliary, n=3; intestinal obstruction, n=2; morbid obesity, n=2; internal hernia, n=1; hydatic cyst, n=1; Crohn disease, n=1); 70 postoperative abscesses occurred due to genito-

Table 1. Patient, abscess, and procedural characteristics of failed procedures

Age (yrs), gender	Cause of failure	Etiology	Underlying disease	Surgery	Abscess structure	Abscess volume (mL)	Guidance modality and access route	Catheter duration (day)	Microbiology	Type of microorganism	Communication with surrounding structures	Additional interventions
75, F	Mortality	Postoperative	Ovarian carcinoma	TAH/BSO	Simple unilocular	294	TA, US	15	Polymicrobial	*E. coli, Enterococcus faecium, Staphylococcus aureus, Candida*	No communication	No additional intervention
60, M	Surgery	Postoperative	Colon carcinoma	Low anterior resection	Simple unilocular	1000	TA, US	8	Polymicrobial	*E. coli, Enterococcus faecium, Pseudomonas aeroginosa*	Communication with colon	Surgery due to leakage
69, F	Mortality	Postoperative	Periampullary carcinoma	Whipple Surgery	Simple unilocular	194	TA, CT	20	Polymicrobial	*Morganella morgagni, E. coli*	Communication with jejunum	No additional intervention
72, F	Recurrence after 1 month	Postoperative	Colon carcinoma	Low anterior resection	Simple unilocular	560	TG, CT	15	Polymicrobial	*Klebsiella oxytoca, Klebsiella pneumoniae*	No communication	Successful recatheterization
54, F	Recurrence after 7 days	Postoperative	Rectum carcinoma	Low anterior resection	Complex multilocular	166	TV, US	5	Unimicrobial	*E. coli*	No communication	Successful recatheterization
40, F	Recurrence after 6 months	Spontaneous	PID-related tubovarian abscess	–	Complex multilocular	378	TV, US	5	Unimicrobial	*E. coli*	No communication	Surgery (TAH/BSO) due to recurrence
52, F	Recurrence after 7 days	Postoperative	Uterine leiomyoma	TAH/BSO	Complex multilocular	100	TR, US	5	Unimicrobial	*E. coli*	No communication	Successful recatheterization
44, F	Recurrence after 1 month	Spontaneous	Idiopathic	–	Simple unilocular	121	TG, CT	4	Nonmicrobial	None	No communication	Surgery (TAH/BSO) due to recurrence
30, F	Recurrence after 15 days	Spontaneous	Idiopathic	–	Complex multilocular	212	TA, US	16	Unimicrobial	*E. coli*	Communication with rectum	Successful recatheterization
35, M	Recurrence after 1 month	Spontaneous	Crohn disease	–	Complex multilocular	504	TA, US	22	Polymicrobial	*E. coli, Streptococcus viridans*	Communication with jejunum	Successful recatheterization

F, female; M, male; TAH/BSO, total abdominal hysterectomy and bilateral salpingo-oophorectomy; TA, transabdominal; US, ultrasonography; CT, computed tomography; TG, transgluteal; TV, transvaginal; PID, pelvic inflammatory disease; TR, transrectal.

urinary causes (cervix-ovarian-endometrium cancer, n=38; myoma, n=14; ovarian cyst, n=3; urinary cancer, n=3; sectio, n=2; pelvic relaxation, n=2; adenomyosis, n=2; dilatation and curettage, n=2; uterine rupture, n=1; transrectal US-guided biopsy, n=1; renal transplantation, n=1; ectopic pregnancy, n=1); 4 postoperative abscesses occurred due to pelvic bone tumor (Ewing sarcoma, n=2; giant cell tumor, n=2); and 41 abscesses occurred spontaneously (tubo-ovarian abscess related to pelvic inflammatory disease, n=12; periapendicular abscess, n=8; peridiverticular abscess, n=6; idiopathic, n=5; Crohn disease, n=2; endometriosis, n=2; acute pancreatitis, n=1; secondary to peritoneal dialysis, n=1; infected hydatid cyst, n=1; Fournier gangrene, n=1; traumatic, n=1; tuberculosis, n=1).

An underlying malignancy was present in 82 of 163 patients (50.3%). A total number of 36 comorbidities affecting the immune status of the patient was observed in 27 of 163 patients (16.6%). The observed comorbid conditions were diabetes mellitus (n=9), active tuberculosis (n=2), active Crohn disease (n=2), radiotherapy (n=2), chemotherapy (n=4), end-stage chronic renal failure (n=6), active Behcet disease (n=2), active HIV infection (n=1), Child's class C cirrhosis (n=3), steroid use (n=3), renal transplantation (n=1), and pancytopenia (n=1). Broad-spectrum antibiotics were already prescribed to 102 of 163 patients before the procedure.

Median abscess volume was 141.7 mL (9–780 mL). Of 185 abscesses, 100 had simple, unilocular structure, whereas 85 had complex, multilocular structure. According to culture results, 94 and 63 abscesses were unimicrobial and polymicrobial, respectively, while no agents were isolated from 28 abscesses. Yeast was isolated from 18 abscesses (9.7%). *Escherichia coli* (n=80, 43.2%), *Enterococcus species* (spp.) (n=35, 18.9%), *Klebsiella* spp. (n=17, 9.2%), *Staphylococcus* spp. (n=16, 8.6%), *Streptococcus* spp. (n=16, 8.6%), *Pseudomonas aeruginosa* (n=10, 5.4%), *Bacteroides* spp. (n=8, 4.3%), *Enterobacter* spp. (n=6, 3.2%), *Proteus* spp. (n=6, 3.2%), *Serratia* spp. (n=4, 2.2%), *Morganella* spp. (n=3, 1.6%), *Mycobacterium* spp. (n=2, 1.1%), and *Acinetobacter* spp. (n=2, 1.1%) were isolated. These patients had been treated with antibiotics with a mean duration of 8.2 days prior to the identification of yeast and antifungal treatment.

Locking pigtail catheters (8–16 F; Flexima, Boston Scientific Corporation; Skater, Argon Medical Devices) were placed in 178 of 185

abscesses. In 22, 61, 44, 41, 10 abscesses, 8, 10, 12, 14, 16 F catheters were used, respectively. Seven small (<3 cm) and interloop abscesses were treated with simple aspiration without catheterization. Guidance modality was US in 140 and CT in 45 abscesses. Transabdominal, transvaginal, transrectal, and transgluteal access routes were preferred in 107, 39, 21, and 18 abscesses, respectively.

Technical success rate was 100%. No major complications were detected. Minor complications such as catheter dislodgement, kinking, and obstruction were observed 15 times in 13 abscesses (6.7%) and were managed by catheter exchange. The median duration of catheter use was 8 days (3–45 days). Of 163 patients, 149 (91.6%) had curative drainage and 4 (2.5%) had partial success (resulting in 93.9% overall clinical success rate), while 10 (6.1%) had clinical failure. Reasons for clinical failure were recurrence (n=7), mortality secondary to septic process (n=2) and need for open surgery (n=1).

Fourteen abscesses had fistulous communication with colon (n=5), rectum (n=3), small intestine (n=2), vagina (n=2), ureter (n=1), or bladder (n=1). The median duration of catheter use for these 14 abscesses was 20 days (8–45 days). All abscesses with fistula to the genitourinary system (vagina, ureter, and bladder) were treated with clinical success. In two patients who had an abscess in communication with vagina, no secondary intervention was necessary. In one patient whose abscess was in communication with ureter, percutaneous nephrostomy and antegrade double pigtail ureteral stent were placed, drainage catheter in the cavity was removed and the abscess was cured. In one patient who had an abscess in communication with urine bladder, elective bladder repair was performed after the septic process was resolved by abscess drainage and this was accepted as partial success. Six abscesses that had fistulous communication with the gastrointestinal system were cured with prolonged catheter drainage and parenteral nutrition whereas the remaining four abscesses were accepted as failure.

In seven patients abscesses recurred following a successful drainage procedure. Six of them were treated with successful re-catheterization and one of them was treated with open surgical drainage. In one patient who underwent an operation due to periampullary tumor, ileum perforation occurred during the surgery. In this patient, pelvic abscess was detected and catheterized during the first week of the postprocedural period. The fistula to the small intestine at the perforation site was detected and the patient died due to uncontrolled sepsis 20 days after the percutaneous drainage. In one patient who underwent surgery due to ovarian cancer, the pelvic abscess was catheterized 10 days after the surgery. The patient died 15 days after the drainage procedure because of septic complications. In the other patient who underwent an operation due to the intestinal obstruction caused by a colonic tumor, the pelvic abscess was detected in the postoperative period and catheterization was performed. In this patient, fistulous communication with colon was observed and the patient was re-operated for fistula repair and open surgical abscess drainage was performed simultaneously. Patient, abscess and procedural characteristics of failed procedures are summarized in Table 1.

The factors related to patient and procedure characteristics were found to have no effect on success rate. The only factor affecting the success of the procedure was the presence of fistula ($P < 0.001$). The procedural failure rate was 30.8% (n=4) for patients with fistulous communication, whereas it was 3.8% (n=6) for patients without any fistulas. Comparison of variables between successful and failed drainage procedures are summarized in Table 2.

Table 2. Comparison of patients with curative and failed drainage procedures

Variable		Curative drainage	Failure	*P*
Age (years)	Mean±SD	49.9±16.5	53.1±15.8	0.56
Abscess volume (mL)	Median (min–max)	94 (9–780)	126 (50–500)	0.18
Sex	Male	57 (96.6)	2 (3.4)	0.33
	Female	106 (93)	8 (7)	
Number of abscess	Single	127 (93.4)	9 (6.6)	0.36
	Multiple	36 (97.3)	1 (2.7)	
Underlying etiology	Spontaneous	33 (89.2)	4 (10.8)	0.14
	Postoperative	130 (95.6)	6 (4.4)	
Comorbid conditions	Spontaneous	32 (88.9)	4 (11.1)	0.19
	Postoperative-benign	50 (98)	1 (2)	
	Postoperative-malign	81 (94.2)	5 (5.8)	
Abscess structure	Single-unilocular	90 (94.7)	5 (5.3)	0.74
	Complex-multilocular	73 (93.6)	5 (6.4)	
Microbiologic content	Nonmicrobial	25 (96.2)	1 (3.8)	0.49
	Unimicrobial	86 (95.6)	4 (4.4)	
	Multimicrobial	52 (91.2)	5 (8.8)	
Presence of yeast	Present	14 (93.3)	1 (6.7)	0.87
	Absent	149 (94.3)	9 (5.7)	
Presence of fistula	Present	9 (69.2)	4 (30.8)	<0.001
	Absent	154 (96.3)	6 (3.8)	
Guidance method	US	125 (94.7)	7 (5.3)	0.62
	CT	38 (92.7)	3 (7.3)	
Access route	Transabdominal	97 (95.1)	5 (4.9)	0.62
	Transvaginal	34 (94.4)	2 (5.6)	
	Transrectal	19 (95)	1 (5)	
	Transgluteal	13 (86.7)	2 (13.3)	
Complication	Absent	153 (94.4)	9 (5.6)	0.62
	Minor	10 (90.9)	1 (9.1)	

Data are presented as n (%) unless otherwise noted.
SD, standard deviation; US, ultrasonography; CT, computed tomography.

Postoperative malignant and complex/multilocular abscesses and abscesses with fistula or yeast required a longer duration of catheterization, whereas the presence of sterile abscesses or endocavitary catheterization reduced the duration significantly (Table 3). Postoperative-malign abscesses required a median of 11.5 days (3–45 days) of catheterization whereas spontaneous and postoperative-benign abscesses required a median of 6 days (3–22 days) and 6 days (3–38 days) of catheterization, respectively ($P < 0.001$). Complex-multilocular abscesses required a median of 10 days (3–45 days) of catheterization whereas single-unilocular abscesses required a median of 7 days (3–40 days) of catheterization ($P = 0.018$). Abscesses with fistulous communication required a median of 20 days (8–45 days) of catheterization whereas the absence of fistulas reduced the duration to a median of 7 days (3–32 days) ($P < 0.001$). The presence of yeast in the abscess cavity required a median of 15 days (3–40 days) of catheterization whereas absence of yeast required a median of 7 days (3–45 days) of catheterization ($P = 0.007$). The sterile abscesses reduced the duration of catheterization to a median of 5.5 days (3–20 days) whereas unimicrobial and multimicrobial abscesses required a median of 7 days (3–45 days) and 11 days (3–40 days), respectively ($P = 0.009$). The endocavitary route reduced the duration of catheterization to a median of 6 days (3–40 days) whereas transabdominal and transgluteal catheterization required a median of 10 (3–45) and 8.5 days (4–45 days) ($P = 0.003$). There was no significant correlation between the abscess volume and duration of catheterization ($P = 0.17$; r=0.10). Drainage durations among different subgroups are summarized in Table 3.

Table 3. Duration of drainage in different subgroups

Variable		Duration of drainage (days) median (min–max)	*P*
Sex	Male	7 (3–40)	0.39
	Female	8 (3–5)	
Number of abscesses	Single	8 (3–45)	0.84
	Multiple	8 (3–32)	
Underlying etiology	Spontaneous	6 (3–22)	0.61
	Postoperative	8 (3–45)	
Comorbid conditions	Spontaneous	6 (3–22)	<0.001[a]
	Postoperative-benign	6 (3–38)	
	Postoperative-malign	11.5 (3–45)	
Abscess structure	Single-unilocular	7 (3–40)	0.018
	Complex-multilocular	10 (3–45)	
Microbiologic content	Nonmicrobial	5.5 (3–20)	0.009[b]
	Unimicrobial	7 (3–45)	
	Multimicrobial	11 (3–40)	
Presence of yeast	Present	15 (3–40)	0.007
	Absent	7 (3–45)	
Presence of fistula	Present	20 (8–45)	<0.001
	Absent	7 (3–32)	
Guidance method	Ultrasound	7.5 (3–40)	0.63
	Computed tomography	9 (3–45)	
Access route	Transabdominal	10 (3–38)	0.003[c]
	Transvaginal	6 (3–20)	
	Transrectal	5 (3–40)	
	Transgluteal	8.5 (4–45)	
Complication	Absent	8 (3–40)	0.45
	Minor	10 (3–45)	
Result	Success	8 (3–45)	0.47
	Failure	11.5 (4–22)	

[a]Significance due to postop-malign abscess catheterization ($P < 0.017$ by Bonferroni correction).
[b]Significance due to nonmicrobial abscess catheterization.
[c]Significance due to duration endocavitary catheterization ($P < 0.017$ by Bonferroni correction).

No major complication was observed in this study. When catheter-related minor complications were analyzed, patient-, abscess-, or procedure-related factors did not exhibit significant heterogeneity among the groups (Table 4).

Mean follow-up period for 163 patients was 43.7 months (0.5–97.4 months). During the first 30 days of the procedure 6 patients died due to sepsis (n=2), multiorgan failure (n=1) and primary underlying disease (n=3). After the first 30 days, another 35 patients died due to their primary underlying diseases. For the remaining 123 patients mean follow-up period was 51.6 months (12–97 months).

Discussion

According to the results of this study, image guided pelvic abscess drainage has high clinical success (93.9%) and low rates of minor complications (6.7%). The only factor affecting clinical success was the presence of fistula. The success rate was 96.3% in abscesses having no communication with adjacent structures, whereas it was 69.2% in abscesses with fistulous communication. All abscesses with fistula to the genitourinary system were successfully treated, while 4 of 10 abscesses with fistula to the gastrointestinal system resulted in failure (40%). Our results confirm the results of other studies which had lower success rates with percutaneous drainage in the presence of enteric fistula (10, 11, 16, 20, 21). The time necessary to heal the enteric tear extends the duration of catheter use (11, 20). Parenteral nutrition and intravenous support are often essential in addition to catheter drainage (20). In this study, 6 of 10 abscesses having communication with the gastrointestinal system were cured with prolonged catheter drainage and parenteral nutrition whereas 4 of them resulted in procedural failure.

Giangreco et al. (22) reported that the only significant variable related to unsuccessful outcome was abscess complexity,

Table 4. Complication rates among groups

Variables		Complications		
		None, n (%)	Minor, n (%)	*P*
Sex	Male	56 (94.9)	3 (5.1)	0.62
	Female	106 (93)	8 (7)	
Number of abscess	Single	126 (92.6)	10 (7.4)	0.30
	Multiple	36 (97.3)	1 (2.7)	
Underlying etiology	Spontaneous	36 (97.3)	1 (2.7)	0.32
	Postoperative	126 (92.6)	10 (7.4)	
Comorbid conditions	Spontaneous	35 (97.2)	1 (2.8)	0.53
	Postoperative-benign	48 (94.1)	3 (5.9)	
	Postoperative-malign	79 (91.9)	7 (8.1)	
Abscess structure	Single-unilocular	87 (91.6)	8 (8.4)	0.22
	Complex-multilocular	75 (96.2)	3 (3.8)	
Microbiologic content	Nonmicrobial	24 (93.6)	2 (6.4)	0.89
	Unimicrobial	85 (94.4)	5 (5.6)	
	Multimicrobial	53 (93)	4 (7)	
Presence of yeast	Present	15 (100)	0 (0)	0.29
	Absent	147 (93)	11 (7)	
Presence of fistula	Present	12 (92.3)	1 (7.7)	0.83
	Absent	150 (93.8)	10 (6.2)	
Guidance method	Ultrasound	124 (93.9)	8 (6.1)	0.77
	Computed tomography	38 (92.7)	3 (7.3)	
Access route	Transabdominal	98 (96.1)	4 (3.9)	0.43
	Transvaginal	33 (91.7)	3 (8.3)	
	Transrectal	18 (90)	2 (10)	
	Transgluteal	13 (86.7)	2 (13.3)	
Duration of catheterization	Median (min–max) days	8 (3–40)	10 (3–45)	0.45
Result	Success	153 (93.9)	10 (6.1)	
	Failure	9 (90)	1 (10)	0.62

while advanced age, malnutrition, presence of cancer, and a high APACHE II score were significant predictors of mortality. Betsch et al. (15) showed that percutaneous drainage has good long-term results as long as abscesses are singular, small, and located in easily accessible regions in combination with low APACHE scores. Benoist et al. (23) showed that an abscess greater than 5 cm in diameter and absence of antibiotic therapy were significant predictors of percutaneous drainage failure. Mehendiratta et al. (14) found that antibiotic administration prior to the procedure resulted in a high cure rate. Additionally, they also noted that catheter drainage was associated with a significantly higher cure rate compared with needle aspiration. Golfieri et al. (24) performed a PubMed search of outcomes for percutaneous abdominal abscesses drainage, searching among papers published from 1981 to 2006 and reported that percutaneous drainage is a permanent curative treatment of simple abscesses in the absence of enteric communications or after the closure of existing fistulas. The success rate in abdominal abscess was high under favorable conditions such as lesions situated in the periphery of the abdomen, uncomplicated access routes through the abdominal wall, homogeneous fluid collections in undivided or communicating spaces, and etiology of postoperative complications without a primary intra-abdominal disease.

In the present study, the only factor affecting the success of the procedure was found to be the presence of fistula ($P < 0.001$). Postoperative malignant and complex/multilocular abscesses and abscesses with fistula or yeast required a longer duration of catheterization, whereas the presence of sterile abscesses or endocavitary catheterization reduced the duration significantly. When catheter-related minor complications were analyzed, patient-, abscess- or procedure-related factors did not exhibit significant heterogeneity among groups. The preferred access route had an effect on duration of catheterization although it did not have a direct influence on clinical success and complication rates. Endocavitary catheterization reduced the duration significantly.

According to published reports, minor complications such as bacteremia, and catheter-related problems, occur in around 3% of cases (1, 10, 11, 21). In the present study, minor complications such as accidental catheter removal, obstruction and kink were observed in 6.7% of abscesses. When minor complications were analyzed, catheter-related minor complication rates were found to be 3.9%, 8.3%, 10%, and 13.3% for transabdominal, transvaginal, transrectal and transgluteal access routes, respectively. We suggest that endocavitary approaches if convenient should be preferred due to lower rates of minor complication rates rather than transgluteal approach when transabdominal route is somehow not possible.

The overall mortality, major complication, minor complication and recurrence rates related with the infectious process or drainage procedure (1.3%, 0%, 6.7%, and 4.3%, respectively) in the present study were in accordance with previous reports in the literature (1, 10–13, 15, 24–28).

Our study has some limitations. It is a retrospective study and the effects of patients' scores according to scoring systems such as APACHE to statistical results were not taken into consideration.

In conclusion, image-guided pelvic abscess drainage showed high clinical success and low complication rates. The only factor affecting the clinical success rate was the presence of fistula. Postoperative malignant and complex/multilocular abscesses and abscesses with fistula or yeast required a longer duration of catheterization. In addition, our results suggest that when the transabdominal route is limited, endocavitary routes should be preferred to transgluteal route due to shorter duration of catheterization.

Conflict of interest disclosure

The authors declared no conflicts of interest.

References

1. Men S, Akhan O, Koroglu M. Percutaneous drainage of abdominal abscess. Eur J Radiol 2002; 43:204–218. [Crossref]
2. Maher MM, Gervais DA, Kalra MK, et al. The inaccessible or undrainable abscess: How to drain it. Radiographics 2004; 24:717–735. [Crossref]
3. Sudakoff GS, Lundeen SJ, Otterson MF. Transrectal and transvaginal sonographic inter-vention of infected pelvic fluid collections. Ultrasound Q 2005; 21:175–185. [Crossref]
4. McGahan JP, Wu C. Sonographically guided transvaginal or transrectal pelvic abscess drainage using the trocar method with a new drainage guide attachment. AJR Am J Roentgenol 2008; 191:1540–1544. [Crossref]
5. Harisinghani MG, Gervais DA, Maher MM. Transgluteal approach for percutaneous drainage of deep pelvic abscesses: 154 cases. Radiology 2003; 228:701–705. [Crossref]
6. Lee DH, Kim GC, Ryeom HK, Kim JY, Kang DS. Percutaneous paracoccygeal catheter drainage of deep pelvic abscesses using a combination of sonographic and fluoroscopic guidance. Abdom Imaging 2008; 33:611–614. [Crossref]
7. Saokar A, Arellano RS, Gervais DA. Transvaginal drainage of pelvic fluid collections: Results, expectations, and experience. AJR Am J Roentgenol 2008; 191:1352–1358. [Crossref]
8. Granberg S, Gjelland K, Ekerhovd E. The management of pelvic abscess. Best Pract & Res Clin Obstet Gynaecol 2009; 23 667–678. [Crossref]
9. Gazelle GS, Haaga JR, Stellato TA, Gauderer MWL, Plecha DT. Pelvic abscesses: CT-guided transrectal drainage. Radiology 1991; 181:49–51. [Crossref]
10. Akinci D, Akhan O, Ozmen MN, et al. Percutaneous drainage of 300 intraperitoneal ab-scesses with long-term follow-up. Cardiovasc Interv Radiol 2005; 28:744–750. [Crossref]
11. Lambiase RE, Deyoe L, Cronan JJ, Dorfman GS. Percutaneous drainage of 335 consecu-tive abscesses: results of primary drainage with 1-year follow-up. Radiology 1992; 184:167–179. [Crossref]
12. Wallace MJ, Chin KW, Fletcher TB, et al. Quality improvement guidelines for percutaneous drainage/aspiration of abscess and fluid collections. J Vasc Interv Radiol 2010; 21:431-435. [Crossref]
13. Cinat ME, Wilson SE, Din AM. Determinants for successful percutaneous image-guided drainage of intra-abdominal abscess. Arch Surg 2002; 137:845–849. [Crossref]
14. Mehendiratta V, McCarty BC, Gomez L, Graviss EA, Musher DM. Computerized tomography (CT)-guided aspiration of abscesses: Outcome of therapy at a tertiary care hos-pital. J Infect 2007; 54:122–128. [Crossref]
15. Betsch A, Wiskirchen J, Trübenbach J, et al. CT-guided percutaneous drainage of intra-abdominal abscesses: APACHE III score stratification of 1-year results. Eur Radiol 2002; 12:2883–2889.
16. Gee MS, Kim JY, Gervais DA, Hahn PF, Mueller PR. Management of abdominal and pelvic abscesses that persist despite satisfactory percutaneous drainage catheter place-ment. AJR Am J Roentgenol 2010; 194:815–820. [Crossref]
17. Alexander AA, Eschelman DJ, Nazarian LN, Bonn J. Transrectal sonographically guided drainage of deep pelvic abscesses. AJR Am J Roentgenol 1994; 162: 1227–1230. [Crossref]
18. Harisinghani MG, Gervais DA, Hahn PF, et al. CT-guided transgluteal drainage of deep pelvic abscesses: indications, technique, procedure-related complications, and clinical outcome. Radiographics 2002; 22:1353–1367. [Crossref]
19. Sacks D, McClenny TE, Cardella JF, Lewis CA. Society of Interventional Radiology clinical practice guidelines. J Vasc Interv Radiol 2003; 14:199–202. [Crossref]
20. Papanicolaou N, Mueller PA, Ferrucci Jr. JT, et al. Abscess-fistula association: Radiolog-ic recognition and percutaneous management. AJR Am J Roentgenol 1984; 143:811–815. [Crossref]
21. Laganà D, Carrafiello G, Mangini M, et al. Image-guided percutaneous treatment of ab-dominal-pelvic abscesses: a 5-year experience. Radiol Med 2008; 113:999–1007. [Crossref]
22. Giangreco L, Di Palo S, Castrucci M, Angeli E, Staudacher C. Abdominal abscesses: their treatment and the study of prognostic factors. Minerva Chir 1997; 52:369–376.
23. Benoist S, Panis Y, Pannegeon V, et al. Can failure of percutaneous drainage of postop-erative abdominal abscesses be predicted? Am J Surg 2002; 184:148–153. [Crossref]
24. Golfieri R, Cappelli A. Computed tomography-guided percutaneous abscess drainage in coloproctology: review of the literature. Tech Coloproctol 2007; 11:197–208. [Crossref]
25. Golfieri R, Cappelli A, Giampalma E, et al. CT-guided percutaneous pelvic abscess drainage in Crohn's disease. Tech Coloproctol 2006; 10:99–105. [Crossref]
26. Kim SH, Kim SH, Han H, et al. Image-guided transvaginal drainage of pelvic abscesses and fluid collection using a modified seldinger technique. Acta Radiol 2008; 49:718–723. [Crossref]
27. Gervais DA, Ho CH, Mary J. O'Neill MJ. Recurrent abdominal and pelvic abscesses: In-cidence, results of repeated percutaneous drainage, and underlying causes in 956 drainages. AJR Am J Roentgenol 2004; 182:463–466. [Crossref]
28. Ciftci TT, Akinci D, Akhan O. Percutaneous transhepatic drainage of inaccessible postop-erative abdominal abscesses. AJR Am J Roentgenol 2012; 198:477–481. [Crossref]