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## Brief communication

# Therapeutic impact of CT-guided percutaneous catheter drainage in treatment of deep tissue abscesses

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### ABSTRACT

Combination therapy of CT-guided percutaneous drainage and antibiotics is the first-line treatment for abscesses. Its effectiveness has been demonstrated. However, the therapeutic impact of this procedure for infection treatment has never been reported.

We retrospectively analyzed all 47 patients who received CT-guided percutaneous drainage for infection treatment. Patients' characteristics, pathogens isolated, antibiotics administered, technical and clinical outcomes, complications related to this procedure and therapeutic impacts were investigated. Patients were 26 males and 21 females. The mean age was 63.5 years ( $\pm 18.7$ ). The diseases targeted were 19 retroperitoneal abscesses, 18 intra-abdominal abscesses, three pelvic abscesses, and seven others. As for technical outcomes, all of the 54 procedures (100%) were successful. As for clinical outcomes, 44 (93.6%) were cured and three patients (6.4%) died. No complications related to this procedure were found in this study. A total of 42 patients (88%) had a change in the management of their infection as a result of CT-guided percutaneous drainage, such as selection and discontinuation of antibiotics. In conclusion, CT-guided percutaneous drainage is a safe and favorable procedure in the treatment of deep tissue abscesses. Therapeutic impact of these procedures helped physicians make a rational decision for antibiotics selection.

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In general, superficial and deep intramuscular abscesses as septic joints, discitis, and epidural abscess are most commonly treated with a combination of antibiotics and surgical incision and drainage.<sup>1–4</sup> While patients with diseases need optimal management, a majority of them are not able to tolerate surgical procedures due to a poor general condition. These infections such as iliopsoas abscess used to be considered rare. However, the number of these patients is on the rise.<sup>5</sup>

Currently, CT-guided percutaneous drainage procedure is a valuable tool in the diagnosis of malignancy, infectious discitis, or treatment of deep intramuscular and musculoskeletal abscesses.<sup>6–8</sup> The American College of Radiology has reported an 80% success rate for CT-guided percutaneous abscess drainage, with success defined as complete drainage with no further procedures required.<sup>1</sup> This procedure is considered useful because it is less invasive than a surgical incision

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and drainage and is tolerable for patients in poor condition. While the need of this procedure continues to increase, its effectiveness, risk of complications related to procedure and outcomes are not well known. Some previously reported the efficacy of CT-guided percutaneous drainage in the treatment of deep tissue abscesses; improving outcomes with acceptable tolerability.<sup>9</sup> However, the therapeutic impact of this procedure for antibiotics selection has never been demonstrated as far as we have searched. This retrospective study is the first report documenting the therapeutic impact of CT-guided percutaneous drainage for deep soft-tissue infection.

We retrospectively analyzed all patients who received CT-guided percutaneous drainage procedures for the treatment of deep tissue abscesses between January 2006 and September 2011, at Kameda Medical Center. Patients' characteristics (age, sex, underlying disease), treatments, pathogens isolated, outcomes (technical and clinical success rates) and complications related to this procedure were evaluated.

Percutaneous catheter drainage was considered a clinical success if the patient was cured and discharged from the hospital without surgical drainage, and a clinical failure if the patients required surgical drainage or died.

All drainage procedures were performed with CT guidance by an interventional radiologist and an attending doctor of the ward or a resident at the department of radiology. Sedation was not routinely used in this procedure. The experience of the staff radiologists who performed these procedures ranged from 4 to 25 years at the time of their initial involvement with patient treatment in this study.

Comparisons of group means were made by unpaired or paired t-tests or Mann-Whitney U-test. Contingency tables were evaluated by Fisher's exact test. *p*-Values < 0.05 were considered significant.

A total of 54 CT-guided percutaneous drainages were performed in 47 patients over six years at our hospital. The characteristics of the 47 patients who underwent CT-guided percutaneous drainages or aspirations are shown in Table 1. Among patients were 26 males and 21 females. The mean age was 63.5 years  $\pm$  18.7 [SD] (range 15-87). The most common disease was intra-abdominal abscess (*n* = 18, 38.3%), followed by iliopsoas abscess (*n* = 13, 27.7%). Six iliopsoas abscess patients were complicated by infectious discitis. The most common underlying diseases were malignancy (*n* = 15, 31.9%) and spinal disease (*n* = 13, 27.7%). Diabetes mellitus was associated in nine patients (19.1%).

Catheter insertions into the abscesses were technically successful in all 54 procedures (100%). No patients required any further surgical intervention. Among clinical outcomes, 44 patients were cured (44/47, 93.6%) and three patients died (6.4%). No adverse events related to drainage procedures were found in this study. The most common initial antibiotics administered were  $\beta$ -lactams alone (*n* = 27, 57.4%), followed by combination of  $\beta$ -lactams/carbapenem and new quinolones (*n* = 8, 17%) and combination of  $\beta$ -lactams/carbapenem and vancomycin (VCM) (*n* = 6, 12.8%).

Cultures of the drainage material were positive in 38 of the 47 patients (80.9%). Bacteriological results are shown in Table 1. The most common pathogen isolated was *Escherichia coli*, followed by *Bacteroides fragilis*. Blood cultures were performed in 39 patients (83%, *n* = 47) before drainage

**Table 1 – Patients' characteristics.**

Variables	All patients ( <i>n</i> = 47)
<b>Sex (male/female)</b>	26/21
<b>Mean age, years (<math>\pm</math>SD)</b>	63.5 ( $\pm$ 18.7)
Range	15-87
<b>Target diseases</b>	
Retroperitoneal abscess	19
Iliopsoas abscess	13 (27.7%)
Renal abscess	4
Pancreatic abscess	2
Intra-abdominal abscess	18
Pelvic abscess	3
Others <sup>a</sup>	7
<b>Underlying diseases</b>	
Diabetes mellitus	9 (19.1%)
Spinal disease	13 (27.7%)
Renal dysfunction	12 (25.5%)
Malignancy	15 (31.9%)
<b>Technical outcomes (<i>n</i> = 47)</b>	
Success	54 (100%)
Failure	0 (0%)
<b>Clinical outcomes</b>	
Survival	44 (93.6%)
Death	3 (6.4%)
Positive culture from abscess by drainage	38 (80.9%)
Positive blood cultures	12/39 (30.8%)
Antibiotics administered before drainage	33 (70.2%)
Duration of antibiotic therapy, mean days	38
Range ( $\pm$ SD)	2-168 ( $\pm$ 30.2)
<b>Initial antibiotics at the start of treatment</b>	
$\beta$ -Lactams alone	27
Carbapenem alone	5
$\beta$ -Lactams/carbapenem + VCM	6
$\beta$ -Lactams/carbapenem + NQs	8
$\beta$ -Lactams + other	1
De-escalation	14 (29.8%)
Mean size of abscess (mm)	62.7
Range ( $\pm$ SD)	19-169.2 ( $\pm$ 31.8)
No. (%) of subjects with pathogens	38 (80.9%)
No. (%) of subjects with single pathogens	20 (42.6%)
No. (%) of subjects with multiple pathogens	18 (38.3%)
<b>No. (%) of isolates of</b>	
<i>Escherichia coli</i>	13
<i>Bacteroides fragilis</i>	7
<i>Staphylococcus aureus</i>	
Oxacillin susceptible	6
Oxacillin resistant	1
<i>Pseudomonas aeruginosa</i>	5
<i>Klebsiella pneumoniae</i>	3
<i>Citrobacter freundii</i>	3
Koseri	1
<i>Streptococcus pneumoniae</i>	1
Constellatus	2
Sanguis	1
Milleri	2
<i>Enterobacter faecium</i>	1
Others <sup>b</sup>	4

VCM, vancomycin; NQs, new quinolones.

<sup>a</sup> Others include thoracic abscesses and splenic abscess.

<sup>b</sup> Others include *Peptococcus* species, *Proteus mirabilis*, *Enterococcus raffinosus*, *Lactobacter* species.

**Table 2 – Comparison between survivors and non-survivors.**

Variables	Non-survivors (n = 3)	Survivors (n = 44)	p-Value
Sex (male/female)	2/1	23/21	1.000
Age ( $\pm$ SD)	62.1 ( $\pm$ 4.7)	83.3 ( $\pm$ 18.9)	0.062
Duration of antibiotics (days)	27 ( $\pm$ 20.3)	39.5 ( $\pm$ 31.3)	0.504
De-escalation	2 (66.7%)	11 (23.4%)	0.181
Positive cultures by drainage procedure	3 (100%)	35 (79.5%)	0.61
Complications			
Malignancy	2	14	0.264
Diabetes mellitus	1	8	0.48
Vertebral disease	1	12	0.57
Renal disease	2	10	0.156

SD, standard deviation.

procedure and were positive in 12 patients (30.8%, n = 39). Pathogens isolated by blood culture were identical to those isolated by drainage (from abscess) in four of the 12 patients (33.3%). Empiric antibiotic therapies were started before diagnosis was made (isolate was elucidated) in 33 patients (70.2%).

Table 2 shows the comparison between survivors and non-survivors. There were no significant differences in the two groups.

The results of positive cultures led to a change in management in 14 patients (29.8%) as follows. Three patients (6.4%) were confirmed as non-infections and this resulted in discontinuation of antibiotic therapy. Escalation and de-escalation of antibiotics occurred in two (4.3%) and 13 (27.7%) patients respectively. Twenty-four patients (51.1%) continued receiving the same antibiotics based on the results of drug susceptibility when the drugs administered were considered appropriate.

Combination therapy of antibiotics and surgical incision used to be the optimal treatment for deep intramuscular and musculoskeletal abscess.<sup>1–4</sup> CT-guided percutaneous drainage could be the first-line treatment for abscesses in the abdomen and pelvis in adults as well as in children.<sup>1,2</sup> Previous studies demonstrated that CT-guided percutaneous drainage showed high success rate for infection treatment and saved patients from more invasive surgical intervention.<sup>9</sup> In our study, none of the patients required any further surgical intervention without any complications related to drainage procedures. In addition, clinical success rate was extremely high (93.6%, n = 47), which is similar to prior studies.<sup>9</sup>

Although it is not our regular policy to start antibiotics before confirming the etiologic pathogens, 33 of the 47 patients (70.2%) received empiric antibiotics before drainage procedure. This study demonstrated that many wards are practicing empiric antibiotic therapy before drainage procedures. In general, the growth rate of bacteria is lower in patients for whom antibiotics were already started. However, it is striking that positive cultures were found in 28 of the 33 patients (84.8%). The high rate of positive cultures might suggest that antibiotic penetration to abscess was not high enough for bacterial eradication even though high-dose antibiotics were administered.

Only four (33.3%) pathogens isolated by blood culture were identical to those isolated by drainage specimen from abscesses. Blood culture is one of the most sensitive methods for detection of bacteremia, including sepsis, infective endocarditis and biliary infections.<sup>10</sup> However, some

physicians previously documented that blood culture would not be a mandatory exam for decision-making in the management of respiratory infections.<sup>11–13</sup> We wish to emphasize that blood culture is not the only reliable tool to make a rational decision for infection treatment.

We found that 24 of the 47 patients (51.1%) were more than 65 years old and 44 of the 47 patients (93.6%) had been admitted or received some antibiotic therapy in our study. In the treatment of deep intramuscular abscesses such as iliopsoas abscess in elderly patients, VCM or carbapenem should be indicated to provide coverage for *Staphylococcus aureus* or anaerobic bacteria such as *Bacteroides* species. However, VCM and carbapenem antibiotics were initially used in six (12.8%) and 19 patients (40.4%) respectively. As described above regarding therapeutic impact, we wish to emphasize that CT-guided percutaneous drainage led to a change of physicians' selection of antibiotics. In addition, de-escalation of antibiotic therapy was completed in thirteen cases (n = 47, 27.7%). When the pathogen was sensitive to antibiotic therapy and initial empirical treatment was effective, it had been reported that de-escalation of antibiotic therapy improved the outcomes in terms of both death and treatment failure rates even for immunosuppressed patients.<sup>14</sup> Thus, isolation of pathogens is very important for selecting adequate antibiotics and a successful de-escalation of antibiotic therapy. In addition, in the treatment of deep intramuscular and musculoskeletal abscesses, at least two to six weeks of antibiotic therapy following drainage is recommended for these infections.<sup>15–17</sup> It is often difficult to distinguish abscess and cyst by radiographic imaging alone.<sup>18,19</sup> Three cases (6.4%, n = 47) were diagnosed as not being an intra-abdominal abscess, but rather a cyst, resulting in discontinuation of long-term antibiotic therapy. The management of infection in 42 patients (89.3%) was influenced by this procedure. We suggest that CT-guided percutaneous drainage helped us making a more rational decision and it is a recommended treatment tool for infections.

In terms of non-survivors, two of the three non-survivors had malignancy that was uncontrolled. Although the therapies for the infections were appropriate, there was no improvement, and death resulted. All of the 3 patients were in a cachexic state due to malignancy or chronic kidney disease. These circumstances might have contributed to their death. Cronin et al. described that malignancy is considered to be one of the prognostic factors in the treatment of deep

intramuscular and musculoskeletal abscess.<sup>9</sup> Unfortunately, our study did not prove or disprove that malignancy is one of the prognostic factors in the treatment of the diseases, and further studies are necessary.

The limitation of our study is that it is a retrospective analysis of a very small sample. Retrospective studies may be less reliable in terms of data collection particularly for data such as physical examination. Prospective study will be necessary and more cases are to be expected.

In conclusion, CT-guided percutaneous drainage is a safe and favorable treatment for deep intramuscular and musculoskeletal abscesses, even for patients who are elderly and/or compromised hosts with limited tolerability. Considering the high clinical success rate based on the bacteriological effects such as the identification of the putative bacteria or appropriate usage of antibiotics, this procedure could be effective and tolerable for elderly and compromised hosts.

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### Conflict of interest

The authors declare no conflict of interest.

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