

Clinical characteristics and predictors of mortality in 67 patients with primary pyomyositis: a study from North India

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Abstract Primary pyomyositis is infection of the skeletal muscles in the absence of adjacent skin, soft tissue, and bone infection. This study was undertaken to look at the spectrum of clinical presentations, therapeutic interventions, and their outcomes and also to evaluate the association of various risk factors with mortality. This was a retrospective study in which the patients admitted with the diagnosis of primary pyomyositis from January 2000 to June 2007 were included. Their demographic details, clinical and laboratory data, Sequential Organ Failure Assessment (SOFA) score at presentation, treatment instituted, complications encountered, and hospital outcome were recorded. Sixty-seven patients (42 males and 25 females) with a diagnosis of primary pyomyositis were included. Median age at the time of presentation was 37 years (interquartile range=25–50 years). Common presenting symptoms were myalgias [50 (74.62%)] and fever [49 (73.13%)]. Twenty-six patients had underlying predisposing medical conditions. The commonest muscle group involved was iliopsoas muscles in 31 (46.26%)

patients. Methicillin-sensitive *Staphylococcus aureus* was the commonest organism isolated from the pus. Twenty-eight patients developed sepsis and seven died. On univariate analysis, there was a statistically significant association between higher SOFA score, lower Glasgow coma scale, higher pulse rate, lower blood pressure, raised blood urea, raised serum creatinine, higher serum glutamic pyruvate transaminase, raised total bilirubin at presentation, and development of sepsis during hospital stay with mortality. In our study, the patients were seen almost a decade later than those seen in other studies from the region. Evidence of organ dysfunction at presentation and sepsis was associated with increased mortality.

Keywords India · Mortality · Primary pyomyositis · Sepsis · SOFA score

Introduction

Pyomyositis is a primary infection of the skeletal muscles commonly presenting as a local abscess but may sometimes present as a diffuse inflammatory or a rapidly progressing myonecrotic process [1]. Though it has been frequently reported from tropical regions of Asia and Africa, resulting in up to 1–4% of all hospital admissions, it is also being increasingly recognized in temperate climates [2–9]. The pathogenesis of pyomyositis is not clearly understood. Various factors like trauma, malnutrition, parasitic infestation, geography, and comorbid conditions reportedly predispose to development of pyomyositis [1–9]. *Staphylococcus aureus* is the most common organism isolated from these abscesses [1–10]. As there is a paucity of recent data from Indian subcontinent describing the clinical presentation, complica-

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tions, and predictors of mortality in these patients, this study was undertaken to look at the spectrum of clinical presentations, comorbid conditions, predisposing factors, hospital course, treatment instituted, complications encountered, and hospital outcome of these patients. Association of various factors with mortality was also evaluated.

Materials and methods

This was a retrospective study of patients who were diagnosed with primary pyomyositis from January 2000 to June 2007 and admitted to the Postgraduate Institute of Medical Education and Research, Chandigarh, India, a tertiary care referral hospital in northwest India. The catchment area of this hospital is the various adjacent states of Himachal Pradesh, Punjab, Haryana, Uttrakhand, Uttar Pradesh, and Jammu Kashmir.

Primary pyomyositis was defined as an intramuscular infection involving one or more of the skeletal muscle groups in the absence of adjacent skin, soft tissue, or bone infection [2]. Radiological investigations including ultrasonography, computed tomography, and magnetic resonance imaging reports where available were noted in a pre-designed instrument. Age, sex, occupation, history of muscle trauma, duration of illness, presenting manifestations, comorbid conditions, predisposing factors, hospital course, treatment instituted, complications encountered, and hospital outcome of these patients were recorded in a pre-designed instrument. Glasgow coma scale and Sequential Organ Failure Assessment (SOFA) score was calculated at presentation. Glasgow coma scale, sometimes also known as the Glasgow Coma Score, a neurological scale, is a reliable objective way of recording the conscious state of a person. A patient is assessed against the criteria of the scale, and the resulting points give a patient scores between 3 (indicating deep coma) and 15 (normal sensorium) [11]. SOFA score is based on six different scores, one each for respiratory, cardiovascular, hepatic, coagulation, renal, and neurological system [12]. Investigations including complete blood count, differential blood count, erythrocyte sedimentation rate (ESR), liver and renal function tests, chest X-ray, dorsolumbar spine X-ray, ultrasound, 2-D echo, computed tomography, and magnetic resonance imaging (MRI) scans were noted; gram stain, acid fast bacilli (AFB) stain, culture of the pus from muscles, and blood culture reports were also recorded.

Sepsis was defined as the presence of a clinically identified site of infection and two or more of the following: temperature $>38^{\circ}\text{C}$ or $<36^{\circ}\text{C}$; heart rate >90 beats per minute; respiratory rate >20 breaths per minute or $\text{PaCO}_2 <32$ mmHg; and WBC count $>12 \times 10^9/\text{l}$, $<4.0 \times 10^9/\text{l}$, or >0.10 immature forms (i.e., bands; American College

of Chest Physicians/Society of Critical Care Medicine Consensus Conference) [13]. Acute respiratory distress syndrome (ARDS) was defined as acute onset of severe hypoxemia, appearance of bilateral diffuse opacities on frontal chest radiograph, and ratio of arterial PO_2 to inspired oxygen fraction ($\text{PaO}_2/\text{FiO}_2$) of <200 mmHg without any evidence of left atrial hypertension (American European Consensus Conference) [14]. Various laboratory abnormalities were defined using cutoff values as follows: anemia, hemoglobin <10 g/dl; leukocytosis, total leukocyte count $>10 \times 10^9/\text{l}$; elevated ESR, >20 in the first hour; hypoalbuminemia, albumin <3.5 g/dl; impaired renal function, blood urea nitrogen >50 mg/dl and/or serum creatinine >1.20 mg/dl.

Statistical analysis was done using the statistical software *SPSS version 13.0* (SPSS Corp, Chicago, IL, USA). Data are presented as mean \pm standard deviation (SD) when distributed normally and as median with interquartile range (IQR) if the distribution was skewed. Study group was divided into two subgroups of survivors and nonsurvivors, and various parameters between these two subgroups were compared to identify the predictors of mortality. Continuous variables were analyzed using Student's *t* test, whereas Fisher's exact test was used to compare the ordinal variables.

Results

Sixty-seven patients with a diagnosis of tropical pyomyositis were admitted during the study period (January 2000 to June 2007); 236,633 patients were admitted during the study period, and pyomyositis constituted 0.03% of these patients. Other infections encountered in this region are tuberculosis, malaria, dengue, and various skin/soft tissue infections. Various clinical characteristics are shown in Table 1. There were 42 male and 25 female patients. Thirty-five patients (52.2%) were in the age group between 25 and 50 years. The most common presenting symptom was myalgia in 50 (74.6%) patients. Fever was noted in 49 (73.1%) of the patients. Majority (90%) of the patients presented in the suppurative stage. All patients during the hospital stay progressed to the suppurative stage. Twenty-two patients were homemakers; 14 were students; 12 had government jobs; ten had private jobs, and nine were laborers. Various predisposing factors noted were history of trauma to the affected muscle ($n=13$), diabetes mellitus ($n=12$), chronic renal failure ($n=4$), human immunodeficiency virus (HIV) infection ($n=4$), immunosuppressive drugs ($n=3$), solid organ malignancies ($n=2$), and chronic liver disease ($n=1$). Mean respiratory rate at presentation was $23.8 \pm 5.7/\text{min}$, mean pulse rate $90.7 \pm 16.7/\text{min}$, mean systolic blood pressure 114.9 ± 18.4 mmHg, and mean diastolic blood pressure 71.3 ± 10.9 mmHg. Mean SOFA score at presentation was 1.3 ± 1.9 in survivors and 5.6 ± 3.9

Table 1 Clinical characteristics of 67 cases of primary pyomyositis

Age (year; mean \pm SD)	37.1 \pm 15.2
Male to female ratio	1.6:1.0
Fever {n (%)}	49 (73.1%)
Myalgias	50 (74.6%)
Generalized	17 (25.4%)
Localized	33 (49.3%)
Low backache	7 (10.4%)
Signs of muscle inflammation	46 (68.7%)
History of trauma	13 (19.4%)
Location {n (%)}	
Iliopsoas muscles	31 (46.3%)
Gluteal muscles	24 (35.8%)
Thigh muscles	19 (28.4%)
Number of locations {n (%)}	
Single-muscle group	30 (44.8%)
Two-muscle group	21(31.3%)
Three- or more-muscle group	16 (23.9%)
Predisposing factors	
Diabetes mellitus	12
HIV infection	4
Chronic kidney disease	4
Immunosuppressive drugs	3
Solid organ malignancy	2
Chronic liver disease	1
Duration of fever [days ; median, interquartile range (IQR)]	15 (7–30)
Duration of muscle swelling [days ; median, interquartile range (IQR)]	15 (9–30)

in nonsurvivors. Mean hemoglobin in 38 patients who were anemic was 7.9 \pm 1.4 g/dl. Mean leukocyte count in 44 patients having leukocytosis was 17 \pm 0.7 \times 10⁹/l with range being 10 \times 10⁹–48 \times 10⁹/l. Mean ESR was 40.4 \pm 9.5 in the first hour with range being 24–67 in patients having elevated ESR, and similarly mean serum albumin in 56 patients with hypoalbuminemia was 2.7 \pm 0.5 g/dl with range being 1.2 to 3.47 g/dl. Mean blood urea was 110.6 \pm 64.9 with range being 54–280 mg/dl in 22 patients with raised blood urea, and mean serum creatinine was 2.8 \pm 1.8 with range being 1.4–8.6 mg/dl in 18 patients with raised serum creatinine at presentation.

Patients with underlying predisposing conditions were significantly older (mean age=41.9 \pm 2.5 years) compared to patients with no predisposing conditions [(mean age=34.6 \pm 16.3; *p* value<0.05)]. Fever was noted in 16 patients with associated medical conditions as compared to 41 patients with no predisposing conditions. Myalgias were noted in 19 patients in this group, while 31 patients having no associated medical condition had myalgias. Median duration of fever in patients with predisposing conditions

was 13 (IQR=5.3–26.3), while in other group it was 15 (IQR=7–30) days. Median duration of muscle swelling in patients with predisposing conditions was 20 (IQR=7–30), while in other group it was 15 (IQR=10–23) days. Fifteen patients with predisposing medical conditions had signs of muscle inflammation as compared to 31 patients in other group. These parameters were not significantly different between them. Various other parameters including Glasgow coma scale, respiratory rate, pulse rate, blood pressure, serum creatinine, total serum protein, and albumin were compared between the two groups, but none of them were significantly different.

Out of 40 patients (59.7%) in whom pus culture was positive, methicillin-sensitive *S. aureus* (MSSA) was grown in 22, *Escherichia coli* in five, methicillin-resistant *S. aureus* (MRSA), and *Pseudomonas aeruginosa* in four each, *Acinetobacter* and *Klebsiella pneumoniae* in two each, and *Candida albicans* in one patient. AFB staining and mycobacterial culture of pus were positive in two patients. None of these patients had evidence of bone involvement on imaging studies. Blood culture was positive in three patients, MRSA in two and MSSA in one. All MSSA isolates were sensitive to cloxacillin, methicillin, cefotaxime, and amikacin. Ciprofloxacin had activity against isolates from 17 patients; 12 MSSA isolates were sensitive to gentamicin, seven each to clindamycin, netilmicin, and erythromycin; four isolates of *E. coli* were sensitive to amikacin, ceftazidime, cefoperazone sulbactam, and piperacillin tazobactam. Two each were sensitive to cefotaxime, gentamicin, and netilmicin. Two isolates of *Klebsiella* were sensitive to imipenem cilastatin and piperacillin tazobactam, while one isolate was sensitive to chloramphenicol. Ceftazidime and piperacillin tazobactam were effective against four isolates of *Pseudomonas*, while only two isolates were sensitive to amikacin, and one isolate was sensitive to gentamicin, netilmicin, and ciprofloxacin. Vancomycin was effective against all four isolates of MRSA, while three isolates were sensitive to chloramphenicol and rifampicin each. Two isolates of *Acinetobacter* were sensitive to piperacillin tazobactam, ceftazidime, and cefoperazone sulbactam. Among patients with iliopsoas pyomyositis, 15 patients had positive pus culture report. MSSA was the most common microorganism isolated in eight patients followed by *E. coli* in three and *K. pneumoniae*, *P. aeruginosa*, *Acinetobacter*, and *C. albicans* in one patient each. Contrast-enhanced CT (CECT) of the abdomen/spine was available in all 31 patients of iliopsoas pyomyositis. This imaging modality showed bulky muscle and central area of low attenuation in all of 31 patients. Rim enhancement after intravenous contrast injection was noted in 20 patients. Imaging in 15 patients showed involvement of adjacent muscles, while loculation/septations were noted in 13 patients. Internal echoes were seen in 16 patients and air

specs in five, and subcutaneous changes were noted in two patients. There was no vertebral involvement in any of these patients. All patients received either single or combination of antibiotics. The four most commonly prescribed initial antibiotics were cloxacillin, ciprofloxacin, and metronidazole. Commonly used antibiotic prescribed were metronidazole in 22 patients, cloxacillin in 19 patients, ciprofloxacin in 14, vancomycin in nine patients, amoxicillin–clavulanic acid in six patients, amikacin in five, piperacillin tazobactam and clindamycin in three each, crystalline penicillin, gentamicin, cefepime, levofloxacin, cefotaxime, teicoplanin, cefoperazone sulbactam in two patients each, amoxicillin, ceftriaxone, linezolid, ceftazidime, and gatifloxacin in one each. Out of 40 patients with positive pus culture and antibiotic sensitivity report, 26 patients received initial appropriate antibiotics, while the remaining 14 patients had received inappropriate antibiotics initially. The definitive antibiotic was cloxacillin in 13 patients, ciprofloxacin in ten, piperacillin tazobactam in two patients, and vancomycin in one patient. Sepsis compounded the condition of eight patients who had received inappropriate initial antibiotics. Transthoracic echocardiography revealed evidence of infective endocarditis in one patient. Drainage of the abscess was done in 64 patients; 42 patients underwent surgical drainage, while 22 underwent pig tail drainage. One-time needle aspiration of the pus was done in two patients. One patient improved with intravenous antibiotic therapy only. Difference in mortality between subgroups based on type of intervention used (surgical drainage versus pig tail drainage) for drainage of abscess was not statistically significant.

Out of 67 patients, 28 had features of sepsis, and seven died during the course of hospital stay. Eighteen patients had evidence of severe sepsis, and six patients ultimately developed septic shock. Only two patients out of seven who died had associated comorbidity in the form of type 2 diabetes mellitus and chronic liver disease, respectively.

Pus grew microorganism in five of them. Importantly, the most common organism isolated was *E. coli* in three and *Pseudomonas* in remaining two patients. Out of seven patients who died, three had evidence of sepsis at presentation. Six patients later during the course of hospital stay went on to develop features of severe sepsis. All of these patients later also developed septic shock preterminally. Among patients who died, three received cloxacillin and metronidazole each; piperacillin tazobactam and amikacin were prescribed in two patients; one patient each received amoxicillin–clavulanic acid, cefotaxime, vancomycin, cefepime, levofloxacin, and teicoplanin, respectively. Four of these seven patients had received inappropriate antibiotics initially.

Various other complications including bronchopneumonia (14.9%), acute (11.9%) or acute on chronic renal failure (5.9%), acute respiratory distress syndrome (5.9%), disseminated intravascular coagulation (5.9%), intravascular hemolysis (5.9%), pericardial effusion (4.5%), empyema of pleural cavity (4.5%), septic arthritis (2.9%), choroidal abscess (1.5%), endophthalmitis (1.5%), breast abscess (1.5%), infective endocarditis involving native mitral valve (1.5%), and lung abscess (1.5%) were encountered during the hospital stay in these patients.

On univariate analysis (Table 2), there was a statistically significant association between higher SOFA score, lower Glasgow coma scale, higher pulse rate, lower blood pressure, raised blood urea, raised serum creatinine, higher serum glutamic pyruvate transaminase, raised total bilirubin at presentation, and presence of sepsis with mortality.

Discussion

The objective of this study was to describe the clinical presentation, predisposing causes, microbial diagnosis,

Table 2 Comparison of characteristics between survivors and nonsurvivors in 67 cases of primary pyomyositis

Factors	Survivors (mean ± SD)	Nonsurvivor (mean ± SD)	P value
Glasgow coma scale	14.9±.7	14.1±1.9	0.024
Pulse rate	88.1±14.1	113.0±21.7	0.023
Initial first-day urea (mg/dl)	51.9±51.1	104.0±48.1	0.028
First-day creatinine (mg/dl)	1.2±1.2	2.2±1.1	0.040
First-day SGPT (IU/L)	15.7±9.9	27.4±23.6	0.016
Total bilirubin (mg/dl)	1.4±1.3	3.2±3.0	0.026
Systolic blood pressure (mmHg)	116.6±10.2	101.4±49.5	0.038
Diastolic blood pressure (mmHg)	72.4±6.4	60.0±29.7	0.007
No. of patients developing sepsis during hospital stay	21/60 (35%)	7/7 (100%)	0.001
Sequential Organ Failure Assessment (SOFA) score at presentation	1.3±1.2	5.6±3.9	0.025

SGPT serum glutamic pyruvic transaminase

imaging findings, complications, and predictors of mortality in the patients of primary pyomyositis. Median age of presentation of our patients was 37 years, our patient group being older than those previously described. The most common site of infection was iliopsoas muscles followed by gluteal and thigh muscles. Majority of cases were due to *S. aureus*. Evidence of organ dysfunction at presentation and sepsis was associated with increased mortality.

In previous studies, the age of presentation of patients with primary pyomyositis has differed in different studies. In an analysis of 676 patients published in English literature from 1960 to 2002, the presentation was commonest in the first and second decade of life [1]. A study of 112 patients from Nigeria reported higher incidence in children and adults in the age group between 35 and 40 years [4]. In an analysis of pyomyositis in HIV-negative patients from the USA, the mean age of presentation was 43 years in patients with underlying medical condition and 23 years in patients with no underlying medical condition [5]. A study from Spain showed a bimodal distribution with peaks between 30–50 and 60–70 years [9]. Median age of presentation of our patients was 37 years. Thus, primary pyomyositis reported from tropical countries like India is being increasingly seen in older age groups like those seen in temperate climates. The possible reasons could be increasing life expectancy leading to higher number of elderly people in developing world and increasing incidence of diabetes mellitus/ HIV infection and greater use of immunosuppressive medications for various purposes. Further studies would be required to substantiate this.

Male predominance seen in this study is similar to that reported previously [1, 4, 5, 9, 10]. The commonest site of infection was iliopsoas muscles followed by gluteal and thigh muscles. These three muscle groups were the commonest site of infection in a review of 676 patients of pyomyositis [1]. In the largest series of pyomyositis from a tropical area, the most common site of involvement was quadriceps muscle followed by gluteal and iliopsoas muscles [4]. This observation has been reported in many other studies [15–21]. The possible reason for the involvement of muscle of pelvic girdle and lower extremities could be the greater degree of movement, which may cause subclinical trauma to the muscles making them susceptible to infection by bacteria spread from an obvious or occult source of infection [1, 5, 22, 23]. Computerized axial–tomographic scanning is preferred for the diagnosis of an abscess of the iliopsoas muscle as it provides better delineation of muscle structure. The features of an abscess of the iliopsoas muscle on a computerized axial–tomographic scan include asymmetric enlargement of the muscle belly associated with a focal area of low attenuation or gas formation. Enhancement of the rim of the wall of the abscess after intravenous injection of contrast medium is another

useful sign. Our study findings showed similar changes on CECT imaging. The most common findings noted in our study were bulky muscle and central area of low attenuation [1, 24–26]. MRI is also an important imaging tool for the diagnosis of pyomyositis involving iliopsoas muscles. It demonstrates diffuse muscle inflammation as well as any subsequent abscess formation. Diffuse muscle enlargement along with an increase in signal intensity on T2-weighted images can be seen on MRI images. Gadolinium enhancement facilitates detection of an abscess [1, 25, 27, 28].

Most cases of bacterial pyomyositis are due to *S. aureus* including primary pyomyositis of iliopsoas muscles as well. *S. aureus* was the most common microorganism causing primary iliopsoas in a large case series of 124 patients of iliopsoas abscess. In a study, *S. aureus* was the most common etiological organism noted in 14 patients of nonspinal pyogenic psoas abscess. Culture of the purulent material revealed *S. aureus* in six patients in a study of nine patients with primary pyogenic abscess of the psoas muscle reported from an Indian subcontinent [20, 26, 29]. Our study also demonstrated the predominance of *S. aureus* as a cause of iliopsoas pyomyositis.

The etiological factors of primary pyomyositis are not clearly established. Trauma has been regarded as one of the etiological factors in many cases [1, 4, 9, 10, 18]. It has been postulated that trauma alters local muscle tissue structure, thereby creating a locus minoris for implantation of bacteria. In the study by Chiedozi, 25% of the patients had a history of obvious trauma [4]. In various other studies, the percentage of history of trauma to the affected muscles ranged from less than 5% to 46% [1, 9, 10, 18, 21, 26, 29]; 19.40% of the patients in this study had a history of trauma to the affected muscles.

Malnutrition is another predisposing factor for the development of pyomyositis. Anemia and hypoproteinemia were seen in a significant proportion of patients in a study from Nigeria [4]. Similarly, 84.6% of patients had hypoalbuminemia in an earlier study reported from this institute [10]. In this study too, 84% patients had hypoalbuminemia, and 56.70% patients were anemic at presentation. These studies highlight the fact that malnutrition is an important predisposing factor in the development of pyomyositis.

As compared to some past studies from tropical countries, we did not find significant eosinophilia in peripheral blood [4]; 38.80% of patients had at least one comorbid condition known to predispose to the development of primary pyomyositis. In a study from the USA, 48% patients with primary pyomyositis who are non-HIV-infected had at least one underlying medical condition [5].

Clinical presentation with fever, painful muscle swelling, and back pain is similar to that reported in other series [1, 4, 5, 9, 10, 18]. Majority of our patients had leukocytosis and raised ESR, highlighting the fact that, in patients presenting

with muscular swelling and no other clinical features of infection but having the above laboratory findings, pyomyositis should be suspected.

Majority (90%) of our patients presented in suppurative stage like that reported by Chiedozi, Malhotra et al., and IS Gambhir et al. [4, 10, 31]. In our study, all patients during the hospital stay progressed to suppurative stage.

As reported previously in many studies, MSSA was the commonest organism grown in pus in this study as well [1–10]. Other microorganisms grown were *E. coli*, *Acinetobacter*, *K. pneumoniae*, and *Pseudomonas*. Previous studies also have reported the growth of these bacteria [1, 5, 10, 17, 30–34]. MRSA was seen in four of our patients.

Forty-four patients developed various complications during the course of hospital stay. These complications like bronchopneumonia, empyema, renal failure, disseminated intravascular coagulation, septic arthritis, ARDS, and intravascular hemolysis seen in this series have been reported previously in few case series and reports [1, 4, 10, 31, 32]. Pericardial effusion as one of the complications reported by Gambhir et al., Kulpati et al. was seen in three of our patients [31, 36]. One patient had an uncommon complication in the form of bilateral choroidal abscesses and right endogenous ophthalmitis, while another patient developed breast abscess.

The treatment of the choice of pyomyositis is intravenous antibiotics and drainage of pus. Patient with pyomyositis must be given cover for MSSA as it was the most common microorganism isolated from them in the present study. Isolation of gram-negative organisms in substantial number of patients besides MSSA noted in our study will have clinical implication for clinicians at the time of antibiotics prescription. The drainage of pus can be done either by image-guided pigtail drainage or by open surgical method. In this study, both open surgical and pigtail drainage methods were used. There was no difference in mortality based on the methods of drainage of pus.

In various studies, mortality rates have varied from 0.89% to 23% [4, 5, 9, 10, 31, 37]. Mortality from tropical countries is higher as compared to that reported from temperate countries. In this study, mortality rate was 10.44%. Sepsis compounded condition of eight patients who had received inappropriate initial antibiotics, and four of them later died. Inappropriate initial antibiotics prescription therefore was one of the important factors responsible for mortality in these patients.

In conclusion, primary pyomyositis reported from tropical countries like India is being increasingly seen in older age groups and patients with underlying medical conditions. Iliopsoas muscles are the most commonly involved muscle groups. A significant percentage of patients had anemia and hypoalbuminemia indicating

underlying chronic malnutrition. Majority of patients had leukocytosis and raised ESR highlighting the fact that, in patients presenting with muscular swelling and no other clinical features of infection but having the above laboratory findings, pyomyositis should be suspected. There was no difference in mortality based on the methods of drainage of pus. Evidence of organ dysfunction at presentation and sepsis was associated with increased mortality.

Disclosures None

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