Fatal Pyomyositis
A Report of 8 Autopsy Cases

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Abstract: Pyomyositis is an acute bacterial infection manifesting as pyemic abscess formation in the skeletal muscles. We examined 8 autopsy cases (seven males, one female; age range 21–75 years) of fatal nontropical pyomyositis to better describe individual case characteristics and pathologic features of this rare disease. The pathogen most frequently involved was *Staphylococcus aureus*. In most cases, there were several abscesses and multiple sites involved. The trunk, shoulder girdle, and thigh muscles were most frequently affected and involvement of multiple sites was a common finding. In 6 cases, a recent trauma had occurred to the anatomic location where the pyemic abscesses were found. Three deceased were known as intravenous drug abusers. Except for the presence of pyomyositis, liver diseases such as cirrhosis in 3 cases, and a fatty liver in 2 cases were the most frequent autopsy findings. Death was due to sepsis in all cases. Because pyomyositis may develop in association with intravenous catheterization in the clinical setting, the question whether pyomyositis was caused by an infected or improperly placed indwelling intravenous catheter may be of forensic importance in the light of alleged medical malpractice. According to our observations, severe underlying illnesses seem not always necessary for fatal outcome of pyomyositis. Because a detailed dissection of superficial as well as deep skeletal muscles during autopsy is a prerequisite for the diagnosis, the disease may be overlooked when this essential step is not performed.

Key Words: pyomyositis, *Staphylococcus aureus*, sepsis, trauma, autopsy, forensic pathology

(*Am J Forensic Med Pathol* 2008;29: 131–135)

Pyomyositis is an acute bacterial infection manifesting as pyemic abscess formation in the skeletal muscles. Pyomyositis has a male predominance and affects single muscles and muscle groups. The disease occurs endemically in climatically warmer regions as so-called "tropical" pyomyositis, whereas it is only rarely found in restrained climate-zones (referred to there as "nontropical" or "temperate" pyomyositis).[1–5]

Because pyomyositis with fatal outcome may have been caused by or related to trauma or may have developed as a sequel of intravenous catheterization, there is a broad spectrum of medicolegal implications related to the disease that are of interest to the forensic pathologist and medical examiner, respectively. However, while a number of studies has dealt with the clinical picture, course, and outcome of pyomyositis in the clinical setting, to the best of our knowledge no systematic autopsy approach towards the subject has been carried out so far. Therefore, it was the objective of this autopsy-based study to better describe individual case characteristics and pathologic features of fatal cases of pyomyositis.

MATERIALS AND METHODS

Eight cases of fatal pyomyositis that were autopsied at the Institute of Legal Medicine, University of Hamburg, Germany, between 1999 and 2004 were included in the study. Individual cases were analyzed as to the gender, age, previous medical history, history of a preceding trauma and other factors predisposing to pyomyositis, localization of intramuscular abscess formation, responsible pathogen as identified by microbiological culture, autopsy findings, and cause of death. In each case a thorough histologic examination of the internal organs as well as the affected skeletal musculature was performed.

RESULTS

Of the 8 deceased, 7 were male. They ranged in age from 21 to 75 years with a mean age of 46.5 years. All individuals were white. Based on information obtained from police files, none of the deceased had a history of recent travel to or imigration from a tropical region.

In all except for 1 case, microbiological culture results from swabs obtained from the muscle abscesses during autopsy were available. *Staphylococcus aureus* was cultured in 6 cases, but no methicillin-resistant *S. aureus* strains were identified. Histologic examination of Gram-stained slides revealed clusters of Gram-positive cocci within the affected musculature in a seventh case. In 1 case, *Streptococcus pneumoniae* was cultured from the abscess.

The previous medical history was unremarkable in all cases. In 6 cases, a recent trauma (only blunt force trauma without any open wounds or fractures) had occurred to the

Received for publication May 5, 2006; accepted June 29, 2006.
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All figures can be viewed in color online at http://www.amjforensicmedicine.com
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ISSN: 0195-7910/08/2902-0131
DOI: 10.1097/PAF.0b013e318173f024

TABLE 1. Individual Case Characteristics of 8 Autopsy Cases of Fatal Pyomyositis

Case No.	Sex (M/F)	Age (yr)	Localization of Abscess(es) in Muscles of . . .	Main Autopsy Findings Other Than Pyomyositis	Pathogen as Identified by Culture	History of Trauma/Type of Traumatization	Risk Factors Predisposing to Pyomyositis	Cause of Death
1	M	60	Shoulder girdle, both upper arms, right hip	Fatty liver	*Streptococcus pneumoniae*	Yes/traffic accident (deceased was driver of a truck)	—	Sepsis
2	M	41	Abdominal wall, both hips	Fatty liver	*S. aureus*	—	Intravenous drug abuse	Sepsis
3	M	62	Posterior trunk (paravertebral)	—	*S. aureus*	Yes/fall	—	Sepsis
4	M	21	Both thighs	—	*S. aureus*	Yes/assault	Intravenous drug abuse	Sepsis
5	M	40	Abdominal wall, left chest	Liver cirrhosis, esophageal varicosis, bronchopneumonia	*S. aureus*	—	—	Sepsis
6	F	75	Left thigh	Bronchitis	*S. aureus*	Yes/fall leading to fracture of neck of left femur	—	Sepsis
7	M	48	Right foot	Liver cirrhosis, esophageal varicosis	[Microbiological investigations were not performed in this case. Histology revealed Gram-positive cocci within the abscesses]	Yes/minor trauma to right foot	—	Sepsis
8	M	36	Left chest	Liver cirrhosis	*S. aureus*	Yes/traffic accident (deceased was driver) pedestrian hit by car; fracture of left humerus	Intravenous drug abuse	Sepsis

anatomic location where the muscle(s) affected by pyomyositis were situated.

Three deceased were known as intravenous drug abusers but an intoxication causing or contributing to death was excluded by toxicological analysis. Except for the presence of pyomyositis, liver diseases such as cirrhosis in 3 cases and a fatty liver in 2 cases were the most frequent autopsy findings. Death was due to sepsis in all cases. The individual case characteristics are given in Table 1.

At gross examination, pyomyositis presented as suppurative muscular lesions (Fig. 1) ranging from 1 cm to 18 cm in diameter. In most cases (n = 6), there were several abscesses and multiple sites involved. The trunk, shoulder girdle, and thigh muscles were most frequently affected. Figure 2 gives the anatomic location of the abscesses. Histologically, the picture ranged from edematous separation of myofibrils with occasional patchy myocytolysis to complete disintegration of myofibers with loss of muscle striation, coagulation necrosis, dense infiltration by white blood cells, mostly granulocytic neutrophils, and the finding of Gram-positive cocci, partly seen in macrophages and granulocytes as intracytoplasmatic inclusions (Figs. 3, 4).

FIGURE 1. Gross appearance of pyomyositis affecting the abdominal wall muscles (case no. 5).

DISCUSSION

In the present study, we examined 8 autopsy cases of fatal pyomyositis. There was a clear male predominance (male to female ratio = 7:1) and the age distribution was broad (21–75 years). Muscles of the trunk, shoulder girdle, and thighs were most frequently affected and involvement of multiple sites was a common finding. Because none of the deceased had a history of recent travel to or imigration from the tropics, all 8 cases investigated here can be considered as the nontropical form of the disease.

According to the literature, the pathogen most frequently involved in pyomyositis is *S. aureus* (accounting for 70%–94% of reported cases).[2–4,6–8] This is well in line with the results of the present autopsy study where *S. aureus* was the organism most commonly cultured. Other more rarely identified pathogens causing pyomyositis include *Streptococ-*

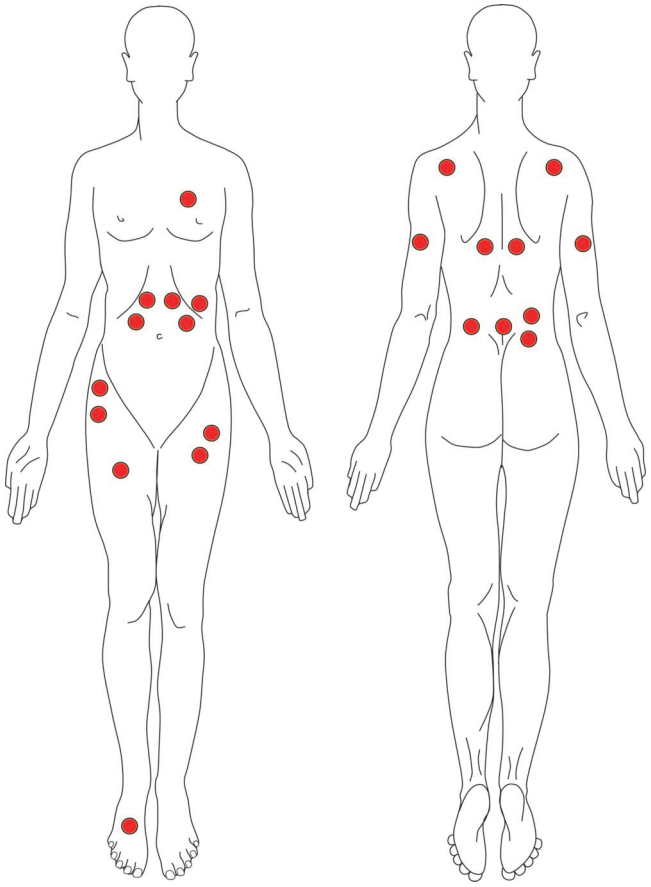

FIGURE 2. Anatomic location of pyemic abscesses in 8 autopsy cases of fatal pyomyositis.

cus pyogenes, *Streptococcus pneumoniae*, *Streptococcus* groups B, C, and G, *Escherichia coli*, *Mycobacterium avium, Neisseria gonorrhoeae, Yersinia enterocolica, Klebsiella oxytoca*, *Klebsiella pneumoniae*, *Haemophilus influenzae*, *Staphylococcus epidermidis*, *Proteus mirabilis*, or different salmonella species.[2,6,8–15]

Although pyomyositis is not limited to the immunocompromised host, defects in host immunity render such individuals more susceptible to the disease. HIV- and AIDS-associated pyomyositis is a well-recognized entity.[3–6,8,15,16] Other pathologic conditions that result in immune suppression of the host and that therefore may predispose to the disease include intravenous drug abuse, diabetes mellitus, leukemia, asplenia, lupus erythematosus, different viral infections, sickle cell anemia, and chemotherapy for malignant neoplasms.[2,3,6,8] In the present study, 3 deceased were chronic intravenous drug abusers. However, no other of the aforementioned risk factors predisposing to the disease could be detected in the present series.

Occasionally, pyomyositis has been reported to develop in association with intravenous catheterization.[2,3] In the light of alleged medical malpractice, the question whether pyomyositis was caused by an infected or improperly placed indwelling intravenous catheter may therefore be of forensic importance.

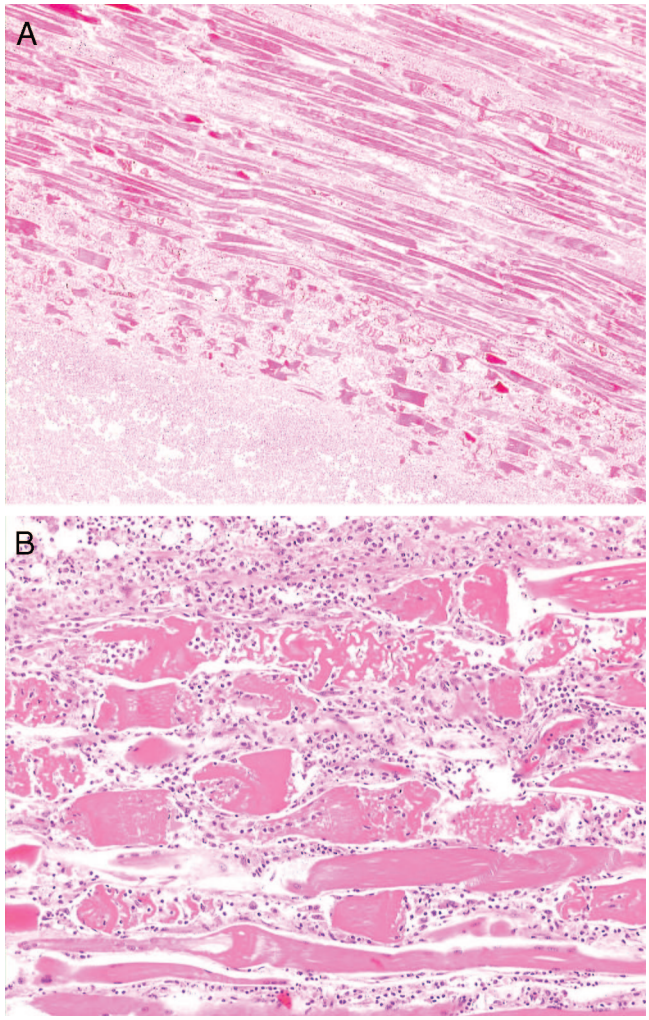

FIGURE 3. Representative histologic sections of skeletal muscle affected by pyomyositis. A, Panoramic view of dense infiltration of skeletal musculature by white blood cells. B, High power view of disintegration of myofibers with loss of muscle striation and coagulation necrosis and a dense inflammatory cellular infiltrate.

In tropical regions, myositis from parasitic infection has been reported to represent another predisposing factor to pyomyositis.[4] In addition, unproved hypotheses have attempted to connect the development of tropical pyomyositis to malaria, filariasis, arbovirus infection, and leptospirosis. However, no epidemiological differences have been found between cases reported in tropical climates and cases observed in temperate climates[10] and none of the pathologic conditions previously described in association with pyomyositis or the pathogenetic mechanisms they may induce can satisfactorily answer the question which factors induce the development of the disease in one person but not in the other.

In 20% to 54% of previously published cases, a recent trauma had occurred to the muscle(s) affected by pyomyositis or a vigorous exercise of the involved muscles was apparent from the previous history.[2,4,8,17–20] In the present autopsy-based study, a recent blunt force trauma had occurred to the

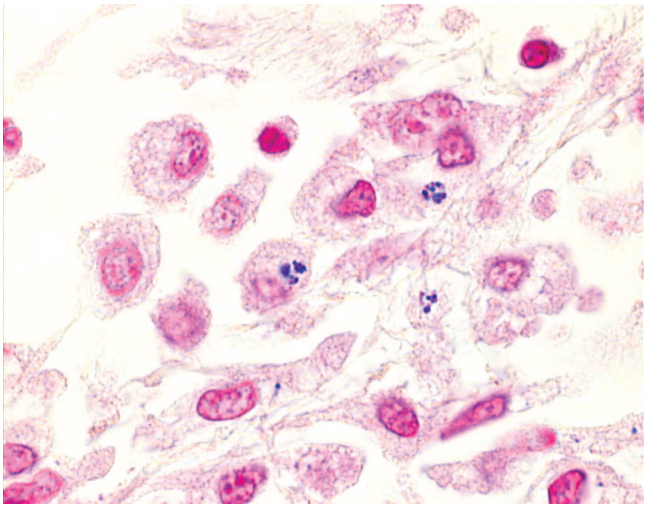

FIGURE 4. Pyomyositis. High power view of macrophages with intracytoplasmatic inclusions of Gram-positive cocci.

anatomic location where the muscle(s) were affected by pyomyositis in 6 cases.

Normal skeletal musculature is remarkably resistant to infection and intramuscular abscess formation, even during severe sepsis, is extremely rare.[21,22] As early as 1904, Miyake was able to show that muscle trauma is necessary before experimentally induced bacteremia causes pyomyositis in animals.[23] Therefore, it has to be considered highly unusual if pyomyositis develops in healthy muscles by per continuitatem spread or via a hematogenous route from soft tissue infection or infected skin or during a period of transient bacteremia, eg, from intestinal sources.

In contrast to the postmortem diagnosis of pyomyositis that usually presents no difficulties because of the possibility of a detailed dissection of the skeletal muscles in layers during autopsy, the clinical diagnosis may present problems because of the highly variable symptomatology of the disease. In the clinical setting, the exact diagnosis is often delayed because other diagnoses such as appendicitis, Crohn disease, deep vein thrombosis, septic arthritis, synovitis, osteomyelytis, or muscle hematoma are first considered.[6,8,24–26]

In clinical practice, pyomyositis is categorized into 3 stages: the invasive stage, the purulent stage, and the late or septic stage. Although intravenous antibiotics are the mainstay of treatment, surgical drainage of the abscesses is often necessary. In the present study, all 8 cases presented as the septic, fatal stage of the disease. Although clinical studies suggest that severe preexisting illnesses seem to influence the outcome of pyomyositis,[6,8,24] in the present autopsy study none of the individuals suffered from a serious underlying disease that may have predisposed to the development of pyomyositis. In our series, liver diseases such as cirrhosis in 3 cases and a fatty liver in 2 cases were frequent autopsy findings. As a result, one may be tempting to speculate that impaired humoral immunity due to liver disease and/or prolongation of prothrombin time as a result of failure of sufficient hepatic synthesis of clotting factors may have contributed to development of the disease in the respective cases. The latter fits into the hypothesis that blunt muscle injury with bleeding makes the affected muscle susceptible to hematogenous invasion by bacteria with subsequent abscess formation.[8] However, whether liver diseases represent specific pathologic constellations or purely coincidental findings in the cases presented remains speculative.

CONCLUSIONS

The results of the present autopsy study of fatal pyomyositis add to the reported clinical experience of a disease only rarely encountered in temperate climates by the forensic pathologist and medical examiner, respectively. Because a detailed dissection of superficial as well as deep skeletal muscles during autopsy is a prerequisite for the diagnosis, the disease may be overlooked when this essential step is not performed. Increased awareness of pyomyositis by the forensic pathologist and medical examiner will increase the number of cases diagnosed postmortem.

Fatal cases of nontropical pyomyositis seen in the forensic pathologic setting seem to be caused by or related to trauma such as a traffic accidents, falls, or assaults in most cases. The pathogen most frequently involved is *S. aureus*. The muscles most commonly affected are those of the trunk, shoulder girdle, and thighs. Involvement of multiple sites is a frequent finding. According to our observations, severe underlying illness seem not always necessary for fatal outcome of the disease.

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