Original Article

Infected aortic and iliac aneurysms: Clinical manifestations in the emergency departments of two hospitals in southern Taiwan, China

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BACKGROUND: Accurate diagnosis of infected aortic and iliac aneurysms is often delayed, hampering timely treatment and potentially resulting in a fatal consequence. The aim of this study was to discover useful clinical features that can help physicians to identify these patients.

METHODS: We reviewed the discharge notes from two hospitals and identified all patients who had a diagnosis of infected aneurysms of the thoracoabdominal aorta and iliac arteries between July 2009 and December 2013. Eighteen patients, aged from 41 to 93, were reviewed. Only 6 patients were diagnosed accurately in their first visit to our ED.

RESULTS: Most patients had at least one underlying illness, and it took 1 to 30 (9.9±6.5) days for physicians to diagnose their infected aneurysm. Localized pain and fever were the two most commonly presented symptoms. The majority (92%) of isolated microorganisms were gram-negative bacilli, including *Salmonella spp*, *Klebsiella pneumoniae*, and *Escherichia coli*. Two of the 3 patients who underwent non-operative therapy died, and all of the patients who underwent a combination of medical and operative therapies survived.

CONCLUSION: We suggest that physicians liberally use computed tomography scans on patients with unknown causes of pain and inflammatory processes. A combination of surgical and medical treatments is indicated for all patients with infected aortic and iliac aneurysms.

KEY WORDS: Infected aneurysm; Salmonella; Misdiagnosis; Emergency department; Clinical manifestation

INTRODUCTION

Infected aneurysms of the aorta and iliac arteries remain dreadful diseases, with in-hospital mortality rates of 11%–44%.[1,2] Aneurysm rupture and overwhelming sepsis constitute the vast majority of deaths.[1–3] However, the reported presentations of infected aneurysms varied, and many of the symptoms were non-specific, including pain, fever, malaise, syncope, nausea, and dyspnea.[4,5] An accurate diagnosis of an infected aneurysm is often delayed, hampering timely treatment and potentially resulting in a fatal consequence.

We reviewed our experience from the emergency departments (ED) of two hospitals in southern Taiwan regarding infected aneurysms of the aorta and iliac arteries. From the clinical manifestations and hospital courses of these cases and comparison between patients with accurate and inaccurate diagnoses in the ED, we anticipate discovering suitable therapies, diagnostic clues and tools that can help physicians to treat these patients.

METHODS

This study was approved by the Institutional Review Board of Chi-Mei Medical Center. We reviewed the discharge notes from the department of cardiovascular surgery in Chi-Mei Medical Center and Chi-Mei hospital in Liouying and identified all patients with a diagnosis of infected aneurysms of the thoracoabdominal aorta and iliac arteries between July 2009 and December 2013. An infected aneurysm was defined according to clinical evidence of acute infection (e.g., fever, leukocytosis, positive results of blood cultures) plus one of the following criteria: (1) radiographic presentations of an infected aneurysm (a focal, contrast-enhanced arterial dilatation, periarterial edema, a periarterial soft-tissue mass, and periarterial gas);[6] (2) operative findings (inflammation and purulence); and (3) positive aneurysmal wall cultures. The infected aneurysm may result from an infection of a pre-existing aneurysm or from an infection on arterial wall which developed a pseudoaneurysm.

On each patient, we collected the following information: demographic characteristics, clinical presentations, vital signs at ED admission, laboratory tests, image studies, underlying medical illness, bacteriological results, treatment and clinical outcomes regarding complications, the requirements for ward or intensive care unit admission, and mortality.

Eighteen patients, including 13 males (72%) and 5 females, were reviewed during the 4.5-year study period. The age range was 41 to 93 years old, and the mean age was 71 years. Only 6 patients were diagnosed accurately in their first visits to our ED.

Five cases had been admitted to other hospitals for 4–10 days and then were transferred to our ED after the discovery of infected aneurysms. Seven other cases were admitted to wards and infected aneurysms were discovered during the course of the hospital stay. The average number of days of diagnostic delay was 6.8 (range 2–10 days). The first 6 patients were classified as the accurate group, and the latter 12 were classified as the inaccurate group.

Statistical analyses were performed using the Statistical Package for Social Science (SPSS, Inc., Chicago, IL) software package. We applied Fisher's exact tests to evaluate differences in categorical variables and Student's *t*-test to evaluate differences in the continuous variables between the accurate and inaccurate groups. Continuous data results are presented as average±standard deviation.

RESULTS

General descriptions

Most patients (94%) had at least one underlying illness, including hypertension (67%), diabetes mellitus (44%), cardiovascular disease (28%), cancer (17%), cerebral infarction/dementia (11%), liver cirrhosis (11%), previous aortic aneurysm (11%), spinal abnormalities (11%), or chronic obstructive pulmonary disease (6%) (Figure 1). All patients were symptomatic, and it took 1 to 30 (9.9±6.5) days for physicians to diagnose their infected aneurysm. Localized pain (72%) and fever (44%) were the two most commonly presented symptoms. Other clinical manifestations were respiratory symptoms (dyspnea/cough/hemoptysis) (28%), malaise (22%), gastrointestinal symptoms (vomiting/diarrhea/constipation) (17%), anorexia (17%), lower limb weakness (17%), and hypotension (11%) (Figure 2).

Management and hospital course

Seven patients had aneurysms in the thoracic aorta, 8 had aneurysms in the abdominal region, and 3 had
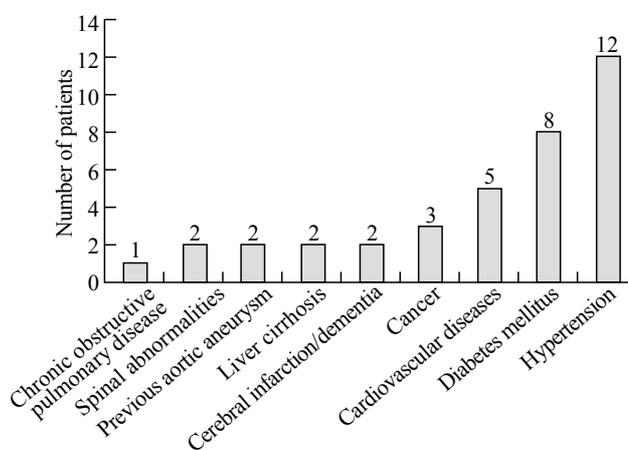

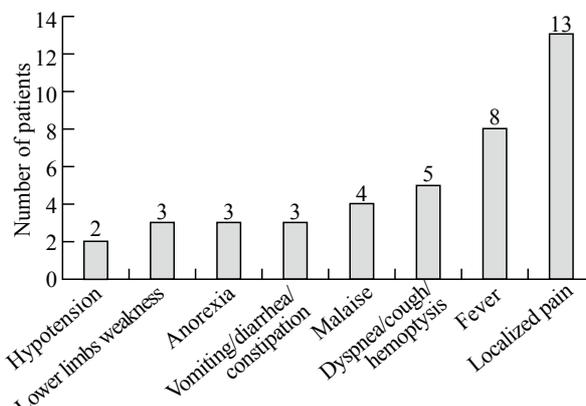**Figure 1.** Comorbidities of patients.

Figure 2. Presenting symptoms of patients.

aneurysms in iliac arteries (Figure 3). Fifteen cases had blood culture examinations and we were able to isolate causative bacteria in 12 patients, including 7 *Salmonella spp*, 3 *Klebsiella pneumoniae*, 1 *Escherichia coli* and 1 *Staphylococcus aureus* (Figure 4). Gram-positive cocci bacteremia was only found in one patient concomitant with a thoracolumbar spinal epidural abscess, and the infected abdominal aortic aneurysm was considered to be an extension of the spinal infection. Only 3 positive results of arterial wall culture were discovered, including 2 *Salmonella spp* and 1 *Staphylococcus aureus*. The results of the arterial wall culture were all in agreement with the blood culture results.

All cases underwent intravenous antibiotic treatment, and 15 of the 18 cases underwent surgical interventions. Two of the 3 patients who refused surgery and underwent non-operative therapy died. On the contrary, all patients who underwent a combination of medical and operative therapies survived. The mortality rate was 11%. Four conventional surgeries (CS: debridement, aneurysmectomy and graft) and 11 endovascular aneurysm repairs were conducted. Three free aneurismal
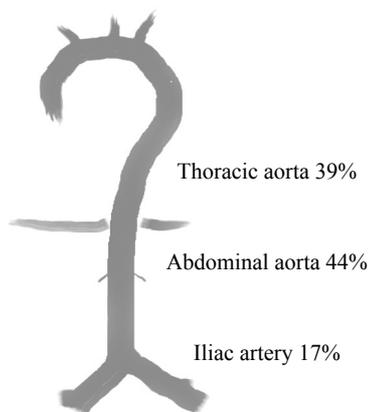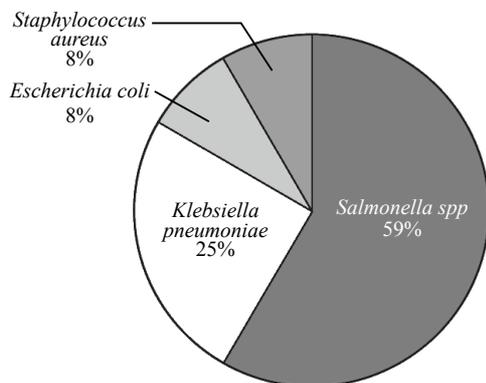
ruptures and 8 contained aneurismal ruptures were discovered during surgery. Three complications, including one chyloperitoneum, one cerebral infarction, and one drug fever, were discovered after surgery. The median follow-up periods of survived patients were 8 months (ranged from 2 months to 2 years). None of the surgically treated patients required a secondary operation for failed surgery or graft infection.

Differences between the accurate and inaccurate groups

We evaluated the differences between the accurate and inaccurate groups. The two groups showed similar demographics, vital signs on admission, and hospital courses (Table 1). The accurate group exhibited a higher white cell count (accurate vs. inaccurate, 16 980 vs. 9 230 cell/μL, *P*=0.001). All of the white cell counts in the accurate group were elevated (above 10 000 cell/μL), and in half of the cases in the inaccurate group, the white cell counts were within normal limits (between 4 000 to 10 000 cell/μL). Additionally, the accurate group showed a trend towards diagnosing the infected aneurysms earlier than in the inaccurate group (accurate vs. inaccurate, 5.8 vs. 12.0 days, *P*=0.058) and having a higher level of CRP (accurate vs. inaccurate, 181.5 vs. 119.3, *P*=0.092). Elevated CRP levels were discovered in all patients in both groups (Table 2).

Figure 3. Distribution of infected aneurysms.

Thoracic aorta 39%

Abdominal aorta 44%

Iliac artery 17%

Figure 4. Isolated bacteria from blood cultures.

Staphylococcus aureus 8%

Escherichia coli 8%

Klebsiella pneumoniae 25%

Salmonella spp 59%

Table 1. Comparisons of the demographics and vital signs on admission of the accurate and inaccurate groups

Variables	Accurate group	Inaccurate group	*P*
Gender (M/F)	4/2	9/3	
Age (years)	74.3±14.6	69.3±14.8	0.507
Systolic pressure (mmHg)	144.8±40.1	139.8±35.4	0.787
Diastolic pressure (mmHg)	86.0±17.8	76.6±20.3	0.350
Temperature (°C)	36 8±0.9	37.1±0.9	0.502
Respiratory rate (beats/minute)	19.3±3.5	18.6±2.2	0.586
Symptoms to diagnosis (days)	5.8±3.0	12.0±7.0	0.058

Table 2. Comparison of the laboratory tests and hospital courses between the accurate and inaccurate groups

Variables	Accurate group	Inaccurate group	*P*
Laboratory tests			
WBC (×100 cell/μL)	169.8±31.1	92.3±41.2	0.001
Hemoglobulin (g/L)	11.6±1.7	11.7±2.7	0.919
Platelet (×1000 cell/μL)	358.3±69.0	231.7±149.0	0.068
C-reactive protein (g/L)	181.5±50.4	119.3±123.3	0.092
Glucose (mmol/L)	171.3±76.5	153.4±100.0	0.706
Sodium (mmol/L)	129.6±5.7	133.7±5.0	0.136
Potassium (mmol/L)	4.1±0.4	3.7±0.4	0.066
Blood urea nitrogen (g/L)	26.4±11.2	24.9±14.2	0.839
Creatinine (g/L)	1.3±0.2	1.3±0.4	0.976
Aspartate transaminase (IU/L)	35.0±12.4	51.3±34.1	0.378
Alanine transaminase (IU/L)	69.2±60.0	34.8±19.5	0.087
Hospital course (only patients underwent operation)			
Hospital stay (days)	36.0±9.4	40.1±13.1	0.580
Intensive care unit stay (days)	5.0±4.1	8.0±6.1	0.387
Diagnosis to operation (days)	2.5±1.7	6.4±5.4	0.190

DISCUSSION

From our reviewed cases, we found that only one-third of patients were accurately diagnosed in the ED. Most of the reported patients were elderly, and comorbidities were found in 94% of all cases. Age- or disease- related consequences limit their ability to express their symptoms; therefore, the diagnosis of an infected aneurysm was often overlooked in the ED.[7,8] Delayed diagnosis means delayed surgical treatment. The infected aneurysm may rupture or progress to profound sepsis. As a result, the patients have to undergo emergency surgery in an unstable hemodynamic state for either hemorrhagic or septic shock. Experiences from America and Taiwan demonstrated that emergency surgery is a major risk factor for aneurysm-related death.[1,3,9]

The symptoms of infected aneurysms of great vessels come from three pathways. First, more than 90% of the reported cases had localized pain in the chest, back, abdomen or inguinal regions. The pain resulted from an enlarged or leaking aneurysm, which also implicated that further catastrophic rupture of an aneurysm is inevitable. Second, the infectious process caused systemic illness, such as fever, malaise, anorexia or hypotension. Third, the aneurysm may irritate neighboring organs and incur varied respiratory, gastrointestinal and musculoskeletal symptoms. To emergency physicians, it is crucial to keep an infected aneurysm of the arteries as a differential diagnosis of varied pain, to look for signs of the infectious process or elevations of inflammatory markers, and to vigilantly search for an enlarged silhouette of the great vessels on images. Six of seven patients with a thoracic aortic aneurysm showed mediastinal widening on a roentgenogram of the chest, which provided a practical suspicion for the formation of a thoracic aortic aneurysm. Nevertheless, a computed tomography scan remains the best diagnostic image for infected aortic and iliac artery aneurysms.[3–6] Once a patient presents to the emergency department with unexplained chest, back, abdominal and groin pain combinations, an unknown infectious process is suspected. Emergency physicians should liberally use computed tomography scans on patients who are suspected of having an aneurysm to discover infected aneurysms of great vessels.

The infecting organisms of infected aneurysms of great vessels in East Asia are different from those in Western countries. Gram-negative bacilli infections, specifically of *Salmonella* spp., constituted 92% of all cultured organisms. The only Gram-positive cocci infection was *Staphylococcus aureus*, which comes from the nearby infected spondylitis. Previous reports from Taiwan and Thailand showed similar infecting organisms.[3,5,10] Therefore, the chosen antibiotics should at least treat *Salmonella* spp. and *Enterobacteriae*. Then, antibiotics should be appropriately adjusted according to the results of the cultures.

For patients with minor symptoms, close follow-up of the severity of pain, levels of inflammatory markers, and results of blood cultures are crucial to identify occult infected aneurysms of the aorta and iliac arteries. Compared to the white cell count, the CRP seems to be a more sensitive inflammatory marker for infected aneurysms of great vessels. Whenever *Salmonella* bacteremia is discovered, the patients' area of pain should undergo image studies for infected aneurysms.

Infected aneurysms of aortic and iliac arteries require both medical treatment and surgical management.[1–3,5,9] Two of 3 patients who underwent medical treatment died as a result of profound sepsis, which indicates that intravenous antibiotics alone are not sufficient to eradicate the infecting organisms. With the evolution of surgical techniques, the prognosis of surgery has improved dramatically, even in the geriatric population.[3]

CONCLUSION

Infected aneurysms of the thoracoabdominal aorta and iliac arteries are commonly overlooked in the emergency department. Protean clinical presentations and the limited ability of elderly with multiple comorbidities preclude physicians from an early diagnosis. Pain in the involved areas are common symptoms, and most patients showed varied levels of systemic inflammations, such as fever or elevations of white cell counts and CRP. In East Asia, *Salmonella spp.* and *Enterobacteriae* are the predominant infecting microorganisms. We suggest that physicians liberally use computed tomography scanning on patients who are suspected of having an aneurysm. A combination of surgical and medical treatments is indicated for all patients with infected aortic and iliac aneurysms.

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