Antimicrobial Drug Resistance in Salmonella-Infected Aortic Aneurysms

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Background. **Salmonella infection of the aorta and adjacent arteries is rare, but life-threatening. There is an increasing number of infections caused by antimicrobial drug resistant Salmonella. This study sought to assess the association between antimicrobial drug resistance and clinical outcomes of patients with Salmonella-infected aortic aneurysm.**

Methods. **Data were collected by retrospective chart review. Between October 1995 and October 2004, 34 patients with Salmonella-infected aortic aneurysm were included. Aneurysm-related deaths were defined as hospital deaths and late deaths due to prosthetic graft infection. Analysis was performed using the χ^2 test, Fisher's exact test, and Mann-Whitney test.**

Results. **Nineteen patients had a suprarenal and 15 patients had an infrarenal aortic infection. The most common responsible pathogen was group C Salmonella (47%). Ciprofloxacin-resistant Salmonella infection occurred since March 2001 and the rate increased from 0 per 15 in the years before March 2001 to 5 per 19 in the years after March 2001 ($p = 0.005$ by Fisher's exact test). Among the 26 patients who had combined medical and surgical therapy, 4 died in the hospital and 4 died of late prosthetic graft infection 3 to 6 months after operation, whereas 4 of the 8 who had medical therapy alone died of aneurysm rupture during hospitalization. The actuarial survival rates by the Kaplan-Meier method were 64% at 6 months, 61% at 1 year, and 56% at 5 years. The risk factors for aneurysm-related death were old age (78.5 ± 9.7 years vs 63.5 ± 11.4 years; $p < 0.001$) and ciprofloxacin-resistant Salmonella infection (4 of 5 vs 8 of 29; $p = 0.042$).**

Conclusions. **There was an increased mortality associated with ciprofloxacin resistance in infected aortic aneurysms with Salmonella. With an increasing incidence of ciprofloxacin resistant Salmonella, third generation cephalosporin is the antibiotic of choice for Salmonella-infected aneurysm.**

(Ann Thorac Surg 2005;80:530–6)

Salmonella infection of the aorta and adjacent arteries is rare, but life threatening [1, 2]. The mortality rate is extremely high without surgical treatment. Previous studies, including case reports and comprehensive literature review [1, 2], reported mortality rates of 25%–50% even when early surgery was performed. It has been suggested that surgery should be done once the diagnosis is made [3]. Of particular concern is the increasing number of infections caused by antimicrobial drug resistant Salmonella. Whether antimicrobial drug resistance contributes to enhanced illness or death in patients with infected aortic aneurysm is unclear. Previous studies [4–7] have shown that infected aortic aneurysm with Salmonella is common in Taiwan. This study sought to assess the association of antimicrobial drug resistance and the clinical outcomes of infected aortic aneurysms caused by Salmonella.

Accepted for publication Feb 15, 2005.

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Patients and Methods

Setting

The National Taiwan University Hospital (Taipei, Taiwan) is a 2,000-bed tertiary care hospital. It serves an urban population of two million people as both a first-line and tertiary facility. It serves also as a referral center for other hospitals in a country with a population of 22 million people.

Patients

Information was collected retrospectively on all patients with nontyphoid Salmonella bacteremia and infected aortic aneurysms that occurred between October 1995 and October 2004. Data on age, sex, medical comorbidities, operation, location of aortic infection, clinical outcome, and antimicrobial drug resistance were recorded.

Management

The diagnosis and management of Salmonella infection of the aorta were described previously [7]. Clinically, infected aortic aneurysm was usually preceded by infected aorta. Infected aorta was diagnosed with clinical evidence of infection (fever and leukocytosis) and periaortic soft tissue infiltration demonstrated by an imaging

Published by Elsevier Inc

0003-4975/05/$30.00
doi:10.1016/j.athoracsur.2005.02.046

Table 1. Patient Characteristics

No.	Years	Age (years)	Sex	Medical Comorbidities	Location	Operation	Hospital Outcome	Late Outcome
1	1995	88	M	Diabetes mellitus	A	No	Died	
2	1996	62	M	Diabetes mellitus	D	Yes	Alive	Alive
3	1997	59	M	None	D	Yes	Alive	Lost follow-up
4	1997	35	F	Evan's syndrome	C	No	Alive	Alive
5	1998	51	M	Hypertension, diabetes mellitus, stroke	B	Yes	Alive	Alive
6	1999	61	F	Idiopathic thrombocytopenic purpura	D	Yes	Alive	Alive
7	1999	70	M	Uremia, bladder carcinoma	G	No	Alive	Alive
8	2000	57	M	Hypertension	A	Yes	Alive	Died 4 months late infection
9	2000	58	M	None	D	Yes	Alive	Alive
10	2000	65	M	Hypertension, diabetes mellitus, pulmonary tuberculosis	F	No	Died	
11	2000	50	M	Diabetes mellitus	E	Yes	Alive	Alive
12	2001	62	M	Hypertension, alcoholism, hydrocephalus	C	Yes	Alive	Alive
13	2001	53	M	Hypertension	C	Yes	Alive	Alive
14	2001	76	F	Hypertension	D	Yes	Alive	Alive
15	2001	71	M	None	D	Yes	Alive	Alive
16	2001	83	M	Hypertension	D	No	Died	
17	2001	59	M	Idiopathic thrombocytopenic purpura, uremia	C	Yes	Alive	Alive
18	2001	86	M	Diabetes mellitus, hypertension	C	No	Died	
19	2001	72	M	Liver cirrhosis, hepatocellular carcinoma, Pure red cell aplasia,	D	Yes	Alive	Died 14 months tumor rupture
20	2002	82	M	Hypertension	C	Yes	Died	
21	2002	51	M	Bentall operation	F	No	Alive	Alive
22	2002	81	F	Diabetes mellitus	B	Yes	Alive	Died 11 months organ failure
23	2003	85	M	Hypertension, stroke	D	Yes	Alive	Died 6 months late infection
24	2003	69	M	None	D	Yes	Alive	Died 3 months late infection
25	2003	84	M	Coronary artery disease, pulmonary tuberculosis, stroke	B	Yes	Died	
26	2003	59	M	Diabetes mellitus	D	Yes	Alive	Alive
27	2003	79	M	Pulmonary tuberculosis	A	Yes	Alive	Died 3 months late infection
28	2003	76	M	Hypertension, diabetes mellitus, coronary artery disease	C	No	Alive	Alive
29	2003	77	M	Hypertension	D	Yes	Alive	Alive
30	2003	66	F	Hypertension, diabetes mellitus, coronary artery disease	A	Yes	Alive	Alive
31	2003	85	M	Hypertension, chronic lung disease, uremia	C	Yes	Died	
32	2003	74	M	Hypertension	D	Yes	Alive	Alive
33	2004	74	M	None	B	Yes	Alive	Alive
34	2004	79	F	Coronary artery disease, stroke	D	Yes	Died	

A = proximal descending thoracic aorta; B = distal descending thoracic aorta; C = suprarenal abdominal aorta; D = infrarenal abdominal aorta; E = iliac artery; F = ascending aorta; G = aortic arch.

study with either computed tomography or magnetic resonance imaging. Imaging studies were considered in those patients with age greater than 50 years and localized pain. Once the diagnosis of aortic infection was made, a third generation cephalosporin, ceftriaxone, was commenced. In patients who had a good response to antibiotic treatment (no fever, declining white cell count, and C-reactive protein), surgical intervention was considered 4 to 6 weeks later. Early surgical intervention was performed only for uncontrolled infection (persistent