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J Biomed Clin Res Volume 6 Number 1, 2013

DOI: 10.1515/jbcr-2015-0102

Original Article

LATE PROSTHETIC VASCULAR GRAFT INFECTIONS AFTER RECONSTRUCTIONS ON AORTOILIAC SEGMENT: AN ELEVEN YEARS EXPERIENCE

Lyubomir Ts. Beshev, Valentina E. Edreva-Besheva[1], Mariya P. Sredkova[1], Dobromir D. Nguen[2]

Department of Vascular Surgery
[1]Department of Microbiology and Medical Genetics
[2] Student, Faculty of Medicine
Medical University – Pleven

Corresponding Author:
Lyubomir Ts. Beshev
Department of Vascular Surgery
Medical University – Pleven
1, St. Kliment Ochridski str.
5800, Pleven
Bulgaria
e-mail: lyubomir_beshev@yachoo.com

Received: January 25, 2013
Revision received: February 18, 2013
Accepted: June 26, 2013

Summary

The purpose of the study was to evaluate the frequency and etiology of late prosthetic vascular graft infections after reconstructions on aortoiliac segment. From 2001 to 2011, 545 primary reconstructions were performed on 545 consecutive patients. We had 18 cases of late intracavitary graft infections in 14 of them. A total of 58 clinical specimens collected from patients before, during and after reoperation were analyzed. Pathogens were isolated using conventional methods for aerobic and anaerobic bacteria. The isolates were identified down to species level by conventional biochemical methods, VITEK 2 and mini API Systems (bioMereux, France). During an 11-year period after prosthetic grafting of the abdominal aorta and aortoiliac segment the incidence of late (more than 4 months after implantation) infection was 3.11%. The mean interval between the initial operation and development of infection was 39.2 months (range 4 to 84). Positive microbial cultures were found in 46 clinical specimens. A total of 66 microbial isolates were cultured, comprising 27 clinical strains. Gram-positive bacteria were predominant – 15 (55.55%) strains, followed by Gram-negative bacteria – 9 (33.33%), *Candida albicans* – 2 (7.4%) and *Bacteroides fragilis* – 1 (3.7%). In 7 cases, the infection was monobacterial, caused predominantly by *Staphylococcus* species. In the rest of the cases, the infections were polymicrobial, caused by association between two microbial species. Mortality rate was 35.71% (5 cases) – in 4 of them the infection was caused by association between two species of Gram-negative bacteria or between Gram-negative bacteria and *Candida albicans*. The incidence of late intracavitary vascular graft infection was low. The average period for development of this complication was about 3 years after reconstruction. Among the causative agents, Gram-positive microorganisms had a predominant role but infections caused by Gram-negative bacteria, especially when they were in association, had a worse outcome.

Key words: vascular graft, aortoiliac segment, late infection

Introduction

Infection of a vascular prosthesis is a relatively uncommon, but probably the most serious complication of vascular surgery that may occur

after implantation and dramatically affect outcome [1].

Despite aggressive antibiotic administration, surgical treatment and a complex of antiseptic precautions, overall mortality rates in aortic graft infection remain between 10 and 50%, and overall amputation rates range between 15 and 60% [2].

It is commonly agreed that prosthetic graft infection should be classified as early (< 4 months after graft implantation) and late (> 4 months after graft implantation) [3].

The purpose of this study was to evaluate the etiology and epidemiology of late vascular graft infection in patients treated in Department of Vascular Surgery of University Hospital of Pleven for an 11-year period and evaluate correlation between causative organisms and outcome.

Patients and Methods

Population

From January 1, 2001 to December 31, 2011, a total of 14 patients with 18 episodes of late prosthetic graft infection were treated in the Department of Vascular Surgery, University Hospital - Pleven. The initial operation was performed to treat atherosclerotic aortoiliac occlusive disease or aortic aneurysm. The primary procedures were aortobifemoral, aortofemoral or aortoiliac reconstructions. The average age of the patients was 64.3 years (range 49-78 years) and the men: women ratio was 13:1.

Methods

The diagnosis of prosthetic graft infection was based on patient history, clinical examination, laboratory tests, microbiological findings, ultrasonography and computed tomography in all patients. Fibrogastroscopy was performed in two cases. The digital subtraction angiography or computed tomography angiography were performed in all patients indicated for re-operation.

Bacteriological tests were performed for all 18 cases. A total of 58 specimens for microbiological examination were collected preoperatively, intra-operatively and post-operatively. Specimens for bacteriological culture were collected by aspiration with a needle and syringe (blood for blood culture, serous and purulent fluids around prosthesis, pus, drainage), or by excision and biopsy (pieces of infected tissue or prosthesis). Swabs were rarely used (Table 1).

Table 1. Type of specimen for microbiological examination

Specimen	With bacterial growth	No growth	Total
Pieces of prostheses	11	1	12
Periprosthetic tissue	6	3	9
Wound discharge	18	3	21
Lavage fluid	3	2	5
Blod culture	4	2	6
Drainage	3	-	3
Fistulas	1	1	2
Total	**46**	**12**	**58**

All specimens were inoculated onto blood agar (5% sheep blood), eosin-methylene blue agar and trypticase soy broth for aerobic incubation and onto Schaedler agar for anaerobic incubation.

Blood cultures were performed with BACTEC 9200 System (Becton Dickinson, USA). The isolates were identified down to species level by conventional biochemical methods, VITEK 2 and mini API Systems (bio Merieux, France). Antimicrobial susceptibility testing was performed by agar diffusion test or by determination of minimum inhibitory concentrations.

Results

Table 2 shows the demographic characteristics and clinical features of our patients.

Of the 14 patients included in the study, 13 were male. The mean age of the patients was 64.3 years (range 49-78 years).

Table 2. Demographic characteristics and clinical features of patients

Initials	Age	Sex	Primary reconstruction	Time until complication	Type of complication
HKH	52	m	Bypass aorto-bifemoralis	36 months	Abscessus paraprosthesis
HKH*	53	m	Bypass aorto-bifemoralis	6 months	Abscessus paraprosthesis
VSA	58	M	Bypass aorto-biiliacus	32 months	Absc. paraprosth. Sepsis. Fistula prostheso-coecalis
EVE	53	m	Bypass aorto-bifemoralis	48 months	Suppuratio prosthesis
EVE*	56	m	Bypass aorto-bifemoralis	44 months	Abscessus paraprosthesis
NIN	63	m	Bypass aorto-bifemoralis	24 months	Fistula paraprosthesis
NIN*	66	m	Bypass aorto-bifemoralis	45 months	Fistula paraprosthesis
GAP	59	m	Bypass aorto-bifemoralis	84 months	Abscessus paraprosthesis
NAD	49	m	Bypass aorto-bifemoralis	34 months	Abscessus paraprosthesis
BSE	68	m	Bypass aorto-bifemoralis	48 months	Abscessus paraprosthesis
NTN	66	m	Bypass aorto-bifemoralis	n.d.	Abscessus paraprosthesis
AKC	55	m	Bypass ao-femoralis sin.	36 months	Abscessus paraprosthesis
AKC*	57	M	Bypass ao-femoralis sin.	60 months	Abscessus paraprosthesis.Sepsis
PTT	64	m	Bypass ilio-femoralis	4 months	Abscessus paraprosthesis
MTP	71	m	Bypass aorto-bifemoralis	30 months	Fistula aorto-duodenalis
MVK	63	m	Bypass aorto-bifemoralis	36 months	Fistula aorto-duodenalis
IDH	78	m	Bypass ilio-fem-poplitealis	36 months	Abscessus paraprosthesis
EIM	63	F	Bypass aorto-bifemoralis	24 months	Fistula ao-duoden. Sepsis. Bleeding - GIT

* one patient with 2 episodes of infection in different time after primary reconstruction

Ten patients developed only one episode of infection after the primary reconstruction. Each of the other four patients developed two episodes of infection in different time periods after primary reconstruction. The mean interval between initial operation and development of infection was 39.2 (range 4 to 84) months. The incidence of late prosthetic graft infection in this study was 3.11%. This complication occurred after 545 primary reconstructions on aortoiliac segment performed during the study period. The frequency of this complication was relatively low in comparison with other complications after reconstructions in this area, such as thrombosis of prosthesis or development of anastomotic aneurysms (Figure 1).

The clinical presentations of intracavitary graft infection varied. In the majority of the cases (12), paraprosthetic abscesses occurred. Focal wound infection, fluid collection or draining sinus tract (fistulas) occurred in 6 cases, prosthetic-duodenal or prosthetic-enteral fistulas and erosions – in 4 cases (Figure 2); and sepsis – in 3 cases.

Positive bacterial findings were registered in 46 samples. A total of 66 microbial isolates were cultured (Table 3), comprising 27 clinical strains. Gram-positive bacteria were predominant – 15 strains (55.55%), followed by Gram-negative bacteria – 9 strains (33.33%), yeasts – 2 (7.4%) and anaerobic bacteria – 1 (3.7%) (Figure 3). *Staphylococcus aureus* was the most common Gram-positive organism cultured, followed by beta-haemolytic streptococci, enterococci, *Streptococcus viridans* and diphtheroids. Among Gram-negative bacteria, members of family *Enterobacteriaceae* were predominant (7 strains), followed by other Gram-negative rods as *Pseudomonas aeruginosa* and *Acinetobacter baumannii*.

In one of the episodes the results from microbiological examination remained negative. The infection was monobacterial in 7 cases (Table 4). Gram-positive microorganisms played a predominant role in the cases with mono-bacterial infections (5 out of 7 cases). The dominant pathogen was *S.aureus* (3 out of 5 cases). There were no lethal outcomes in the cases with mono-bacterial infection. In the rest ten cases, the infection was polymicrobial,

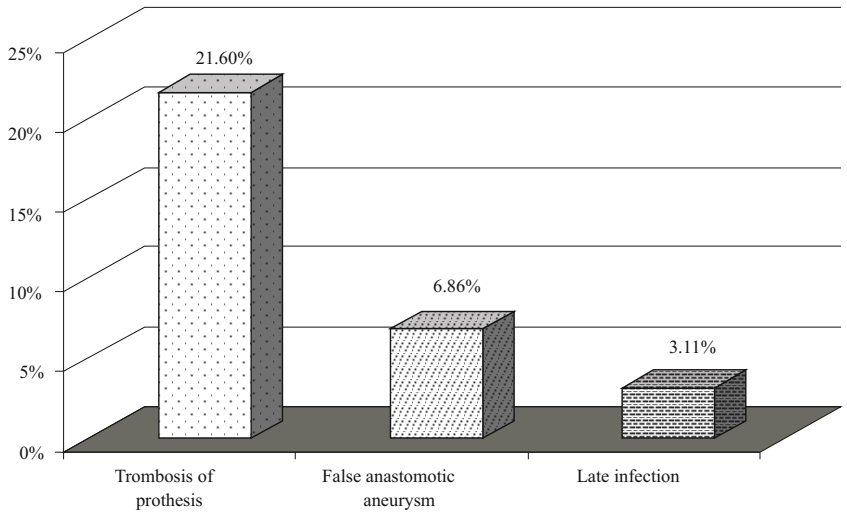

Figure 1. Frequency of complications after reconstructions of AOIS

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caused by association between two types of microorganisms (Table 5). The polymicrobial infection was caused by two types of Gram-positive microorganisms in 5 cases. Association between Gram-positive and Gram-negative bacteria was established in one case, and

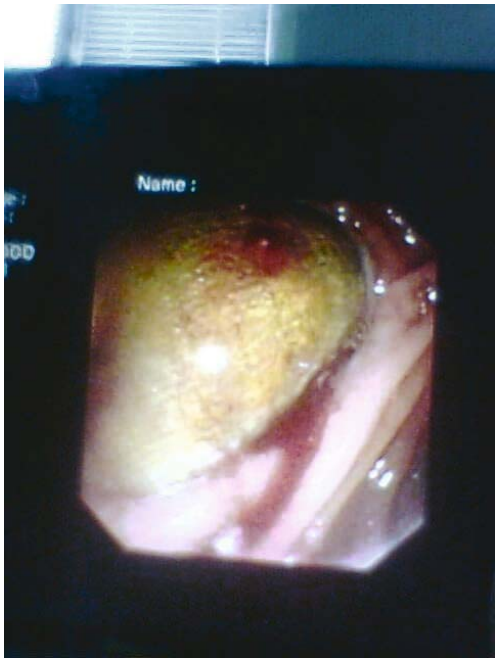

Figure 2. Fistula proteso-dudenalis (fibrogastroscopy)

between Gram-negative bacteria and yeasts – in another case. In three cases, there was association between two types of Gram-negative bacteria.

The clinical manifestation was more severe and with signs of sepsis in cases of association, formed by two types of Gram-negative microorganisms. In one case, where the causative agent identified was *P.aeruginosa,* the colloid cover in the infected segment of prosthesis was totally destroyed (Figure 4). In the cases with *Candida albicans*, the clinical signs of the infection were fistula protheso-coecalis or aorto-duodenalis.

Five perioperative deaths were related to graft infection; the other death was due to an unrelated cause (acute myocardial infarction). Overall, 35.71% of the perioperative mortality rate in our study was related to infection. In four of the five cases with exitus letalis, the infection was caused by microbial association between two types of Gram-negative bacteria, or between Gram-negative bacteria and *Candida albicans.*

Table 3. Bacteriology of prosthetic vascular graft infection (isolates from 46 collected specimens with bacterial growth)

Isolates	Prosthesis	Tissue	Wound	Lavage	Blood	Drainage	Fistulas	Total
S.aureus	3	0	8	1	2	0	1	15
S.epidermidis	0	0	1	0	0	0	0	1
Str. nonAnonB	1	0	2	0	0	0	0	3
S.agalactiae	1	0	1	1	0	0	0	3
S.viridans	1	0	1	0	0	0	0	2
E.faecalis	1	0	2	0	0	0	0	3
E.casseliflavis	0	0	2	0	0	1	0	3
C.xerosis	0	0	1	0	0	0	0	1
E.coli	1	0	0	0	0	0	0	1
K.pneumoniae	1	3	1	1	1	1	0	8
E.cloacae	4	2	2	0	1	2	0	11
C.freundii	1	0	0	0	1	2	0	4
P.mirabilis	0	0	1	1	0	0	0	2
P.aeruginosa	1	0	0	0	0	0	0	1
A.baumannii	0	0	1	0	0	0	0	1
B.fragilis	1	0	0	0	0	0	0	1
C.albicans	1	3	1	0	0	1	0	6
Total	**17**	**8**	**24**	**4**	**5**	**7**	**1**	**66**

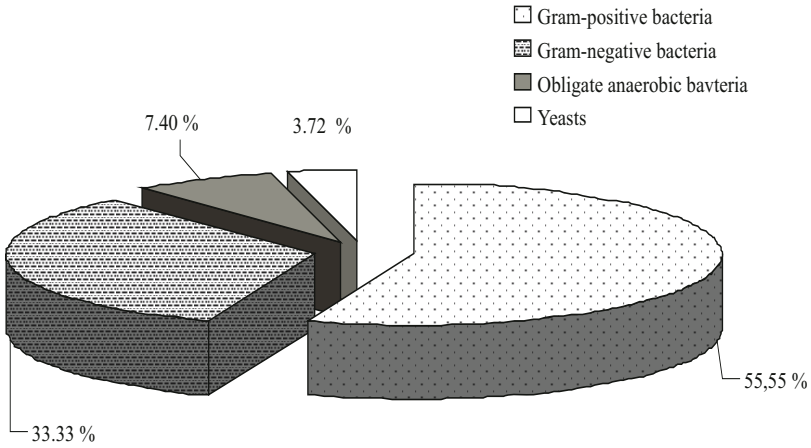

Figure 3. Microbial strains isolated from clinical specimens

Table 4. Etiological agents of monobacterial prosthetic graft infection

Initials	Microorganism	Time for development	Outcome
NIN	*S.aureus*	24 months	good
NIN*	*S.viridans*	45 months	good
EVE	*E.faecalis*	44 months	good
NTN	*E.cloacae*	n.d.	good
AKC	*S.aureus*	36 months	good
PTT	*S.aureus*	4 months	good
IDH	*B.fragilis*	36 months	good

Table 5. Microorganisms isolated from patients with polymicrobial prosthetic graft infection

Initials	Microorganisms	Time for development	Outcome
HKH	*P.mirabilis+P.aeruginosa*	36 months	**death**
VSA	*K.pneumoniae+C.albicans*	32 months	**death**
EVE	*S.aureus+Strept.beta-haemolyt.*	48 months	good
GAP	*S.aureus+S.agalactiae*	84 months	good
NAD	*E.cloacae+E.coli*	34 months	**death**
AKC	*S.aureus+Strept.beta-haemolyt.*	60 months	**death**
MPT	*E.casseliflavus+C.albicans*	30 months	good
MVK	*S.epidermidis+C.xerosis*	36 months	good
EIM	*C.freundii+E.cloacae*	24 months	**death**
ACC	*S.aureus+A.baumanii*	60 months	good

Figure 4. Destroyed colloid cover of prosthesis

Discussion

The reported incidence of infection involving vascular prosthesis varies. Infections occur after 0.2% to 5% of operations, and depends on implant site, indication for intervention, underlying disease, and host defense mechanisms [4]. Draus and Bergamini have reported frequency from 1% to 6% with an average of 2.1% [5]. Our results correlated with the ones cited above. In a comprehensive review, Linda Reilly cited data of Cilligaro [6] and Ricco [7]. They reported infection rates of less than 1% in cases of intra-abdominal aorto-aortic or aortoiliac bypass graft. However, she concluded that reported prosthetic vascular graft infection rates probably represented a minimal incidence, since complete patient follow-up is necessary to determine the actual rate, and such detailed follow-up is rare [8].

Virtually any microorganism is capable of infecting a synthetic graft, including some rare and unusual pathogens [9, 10]. Early graft infections are usually caused by virulent hospital-acquired pathogens such as *S.aureus*, *P.aeruginosa*, members of the family *Enterobacteriaceae*. Late infections are due to graft colonization by "low-virulence" organisms such as *Staphylococcus epidermidis* or other coagulase-negative staphylococci or, infrequently, *Candida* species [4]. *S.aureus* has a predominant role in both types of infection [11, 12].

Our findings were in accordance with data cited above: in our study, Gram-positive bacteria were predominant (55.55%) of all the pathogens that were isolated. However, our results suggest that Gram-negative bacteria have a significant share as etiological agents in case of late vascular graft infection. This conclusion is in contrast with a commonly accepted statement that these pathogens are causative agents predominantly in early infections [5].

Recently, Zetrenne et al. [13] reported that Gram-negative organisms were cultured in abundance (45%) from isolates, which is in support of our results. Our data is in accordance with conclusions of Reilly, that, when an infected graft is aortic in location, the rate of recovery of coagulase-negative staphylococci and S.aureus declines and the rate of recovery of Gram-negative organisms increases. When an aortic graft infection is associated with an aorto-enteric fistula, the bacteriology of the infecting organism shifts even more notably to Gram-negative organisms [8]

This "shift" of microbial profile of late vascular graft infections is probably attributable to the fact that, in guidelines for prophylaxis and empiric therapy of this kind of infections, the drugs of choice are antibacterial agents against Gram-positive bacteria. This "shift" was prognosticated by Brun-Buisson about ten years ago [14].

Current literature suggests that polymicrobial infections have became significant in many cases [5]. In our group of patients there were ten cases of polymicrobial infections. We tried to find a correlation between the etiology of infection and patient's outcome. We observed poor outcome in cases of polymicrobial infections, caused by association between two types of Gram-negative bacteria.

In our study, the mortality rate was 35.71% (5 cases). In 4 of them, the infection was caused by association between Gram-negative bacteria and/or Candida. Only in 3 of the cases the same microorganisms were cultured simultaneously from the prosthesis and from blood cultures, which is in accordance with results reported by Bishart and Minuhin, i.e. in late infections of abdominal prosthetic vascular grafts the yield from blood cultures is lower [15].

P. aeruginosa is not among common causative agents of late vascular graft infection [13]. In our study, this pathogen was isolated only in one case, in association with *Proteus mirabilis*. Intraoperatively, we found total destruction of vascular tissue and the silver cover of prosthesis. These microorganisms elaborate the enzymes elastase and alkaline protease, which break down

elastin, collagen, fibronectin and fibrin [12].

Conclusion

The incidence of late intracavitary vascular graft infections in our study correlated with data reported by other authors. The average period, during which infections developed, was about 3 years. Among the causative agents, Gram-positive microorganisms had a predominant role but infections caused by Gram-negative bacteria, especially when they were in association, had a worse outcome.

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