# Relevance of bacterial cultures of abdominal aortic aneurysm contents

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***Background.*** *To establish further insight into the relevance of intraoperative bacterial cultures of abdominal aortic aneurysm contents a study was performed of the rate of occurrence of prosthetic graft infection after aneurysm repair.*
***Methods.*** *Bacterial cultures were obtained from 216 patients, who were followed up for more than 3.5 years after operation and studied retrospectively in a single center analysis.*
***Results.*** *Thrombus cultures yielded bacteria in 55 of 216 (25.5%) cases, including 11 of 44 (25%) cases with ruptured aneurysms. Prosthetic infections (4 of 216; 1.9%) occurred more frequently ($p < 0.02$) in patients with positive thrombus cultures (3 of 55; 5.5%) than in patients with negative cultures (1 of 161; 0.6%). In two patients the species isolated from the thrombus was also cultured from the vascular prosthesis, although in one graft infection other organisms were also isolated.*
***Conclusions.*** *The presence of bacteria in the intraluminal thrombus does not appear to be an important factor in the development of graft infection after primary elective and urgent abdominal aortic aneurysm repair. Therefore routine intraoperative cultures are unnecessary unless clinical signs of infective aortitis are present. (SURGERY 1996;119:129-32.)*

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THE PATHOGENESIS OF VASCULAR GRAFT INFECTION is not completely clarified. Sources of bacterial contamination of a vascular prosthesis can be either exogenous, as in catheter-related sepsis, or endogenous, as in ischemic bowel necrosis. The role of other potential infectious mechanisms, including translocation of intestinal bacteria during the perioperative period, has yet to be established.[1] Controversy exists over the significance of microbiologic monitoring of the abdominal aortic aneurysm wall and its contents in the prevention and management of prosthetic graft infection. The intraoperative presence of bacteria in the arterial wall has been shown in various studies.[2-10] Positive arterial wall cultures were recorded in 12% to 45% of vascular reconstructions.[2-5] Cultures of abdominal aortic aneurysm contents yielded bacteria in 8% to 18%.[5-10] Several authors have suggested a relationship between the presence of bacteria in the aneurysmal contents and subsequent prosthetic infections, whereas others have claimed the opposite. To establish further insight into the relevance of intraoperative bacterial cultures of abdominal aortic aneurysm contents we performed a retrospective single center study of the occurrence of prosthetic graft infection after aneurysm repair.

## PATIENTS AND METHODS

**Demography.** During the period 1987 to 1991 bacterial cultures of intraluminal thrombus from abdominal aortic aneurysms were obtained from 216 (79%) of 275 patients operated on in the St. Radboud University Hospital, Nijmegen, the Netherlands. The 187 (87%) male and 29 (13%) female patients had a median age of 68 years (range, 44 to 87 years). Elective surgery was performed in 172 (80%) cases, and 44 (20%) patients were operated on for ruptured aneurysms. Skin cleansing was performed with povidone-iodine before an incision was made. Adherent plastic drapes and bowel bags were not routinely used. A midline transperitoneal approach was used in 201 (93%) cases, and a paramedian retroperitoneal thoracolaparotomy was used in the remaining 15 (7%) cases. Straight prosthetic grafts were inserted in 149 (69%) and bifurcated grafts in 67 (31%) cases. In 40 (19%) cases at least one groin incision was made during the vascular reconstruction. The mean (±SEM) operating time was 164 (±4) minutes. A follow-up with special emphasis on the occurrence of prosthetic infections was available for all patients and lasted a mean duration of 43.5 (±0.3) months.

**Prophylactic antibiotics.** Prophylactic antibiotics

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**Table I.** Patient characteristics related to outcome of thrombus culture

| | *Culture (+)* | *Culture (-)* | *Total* | *p (+) vs (-)* |
|---|---|---|---|---|
| No. of patients | 55 | 161 | 216 | — |
| Male/Female | 46/9 | 141/20 | 187/29 | 0.61* |
| Age (yr) | 66.5 ± 1.0 | 68.2 ± 0.6 | 67.8 ± 0.5 | 0.16† |
| Diabetes mellitus | 2 (4%) | 8 (5%) | 10 (5%) | 0.97* |
| Aneurysm size (cm) | 8.2 ± 0.5 | 7.5 ± 0.2 | 7.6 ± 0.2 | 0.17† |
| Operation time (min) | 167 ± 9 | 163 ± 5 | 164 ± 4 | 0.71† |
| Blood loss (L) | 2.8 ± 0.2 | 3.1 ± 0.2 | 3.1 ± 0.2 | 0.39† |
| Inguinal incision | 9 (16%) | 31 (19%) | 40 (19%) | 0.78* |

Mean values given are ±SEM.
*Chi-squared.
†t test.

**Table II.** Bacteria cultured from aortic aneurysm contents of 55 patients*

| | *No. of isolates* | |
|---|---|---|
| Aerobic bacteria | | |
| *Staphylococcus* species | | 34 |
| *S. epidermidus* | 26 | |
| *S. saprophyticus* | 4 | |
| *S.* coagulase negative | 3 | |
| *S. aureus* | 1 | |
| *Corynebacterium* species | | 6 |
| *Streptococcus viridans* | | 2 |
| *Listeria monocytogenes* | | 1 |
| *Streptococcus hemolyticus*, group B | | 1 |
| Anaerobic bacteria | | |
| *Propionibacterium acnes* | | 10 |
| Gram-positive rods, not further identified | | 4 |
| *Peptostreptococcus* | | 1 |
| TOTAL | | 59 |

*In four patients two different species were cultured.

were administered in 213 of 216 (99%) patients. Cefazolin (Kefzol) was used in 137 (63%) patients, cephalothin (Keflin) in 69 (32%) cases, and other broad-spectrum antibiotics in 7 (3%) patients. The antibiotic prophylaxis was initiated 30 minutes before the skin incision was made. In 143 (66%) cases prophylaxis was given for 24 hours, in 40 (19%) cases it was given for 48 hours, and in 30 (14%) cases it was given for a period lasting longer than 48 hours, to a maximum of 5 days. No topical antibiotics were applied during operation.

**Microbiologic investigation.** Samples from intraluminal thrombus were obtained immediately after opening of the aneurysm and were transported with minimal delay to the clinical microbiology laboratory for processing. The specimens were cut to pieces and inoculated onto 5% sheep blood agar, then cross-inoculated with a streak of *Staphylococcus aureus* onto Schaedler agar and in a Brewer modified thioglycollate broth. The media were incubated at 35° C for a minimum of 8 days. Blood agar was incubated under 5% to 10% $CO_2$ and Schaedler agar under anaerobic conditions (5% $H_2$, 10% $CO_2$, 85% $N_2$). Thereafter the thioglycollate was subcultured on both blood agar and Schaedler agar, which were incubated for another 48 hours under $CO_2$ and anaerobic conditions, respectively.

**Statistical analysis.** Statistical analysis was performed by means of chi-squared tests for assessment of independence of categorical variables and unpaired *t* tests for comparison of the distribution of continuous variables, when appropriate.

## RESULTS

The 30-day mortality was 6.5% in elective cases and 47.5% after ruptured aneurysm repair. No early deaths were attributed to infectious complications. Cultures of the aneurysm contents yielded bacteria in 55 of 216 (25.5%) cases, including 11 of 44 (25%) cases with ruptured aneurysms ($p = 0.7$, chi-squared). There were no differences in male to female ratio, age, prevalence of diabetes mellitus, aneurysm size, operation time, blood loss, or the use of inguinal incisions between the groups of patients with negative and positive thrombus cultures (Table I). The bacteria isolated are listed in Table II. In four patients two different isolates were cultured from the thrombus.

Prosthetic infections were diagnosed in 4 of 216 patients, representing an infection rate of 1.9%. In the cases in which thrombus cultures were not performed the infection rate was 1 in 59 (1.7%; $p = 0.8$, chi-squared). The aneurysm contents yielded bacterial growth in three of four patients with prosthetic infections. Prosthetic infections occurred more frequently ($p = 0.02$, chi-squared) in patients with positive aneurysm content cultures (3 of 55; 5.5%) than in patients with negative cultures (1 of 161; 0.6%). The bacteria isolated from aneurysm contents and the infected vascular prostheses are listed in Table III. In two patients (B and D) the species isolated from the thrombus was also cultured from the vascular prosthesis, although in

**Table III.** Bacterial isolates from aortic aneurysm contents and vascular prosthesis in four patients with graft infections

| *Patient* | *Thrombus* | *Complication* | *Prosthesis* | *Outcome* |
|---|---|---|---|---|
| A | No growth | Groin abscess | *Escherichia coli* | 40 days* |
| B | *Staphylococcus epidermidis* | Aortoduodenal fistula | *Streptococcus* species<br>*Enterococci*<br>*Enterobacter cloacae*<br>*Staphylococcus epidermidis* | 12 mo* |
| C | *Staphylococcus epidermidis* | Colon perforation | *Serratia marcescens*<br>*Enterococcus faecalis*<br>*Citrobacter freundii* | 54 days* |
| D | β-hemolytic *Streptococcus* group B | Retroperitoneal infection with spondylodiscitis | β-hemolytic *Streptococcus* group B | Alive 6 yr |

*Time of death after operation.

one graft infection other organisms were isolated as well.

Patient D was initially admitted elsewhere for evaluation of epigastric and back pain with fever and an elevated erythrocyte sedimentation rate. After development of a vena cava inferior syndrome he was transferred to our hospital. An inflammatory aneurysm of the abdominal aorta was diagnosed with extensive destruction of multiple lumbar vertebral bodies and an aortocaval fistula. The ensuing aneurysm repair was uncomplicated. Cultures from the wall of the aneurysm and from the thrombus yielded β-hemolytic *Streptococci* group B. Other than the routine 48 hours of prophylaxis with cefazolin no antibiotics were administered and the patient had an uneventful recovery. The patient was readmitted after 60 days because of intractable back pain. Investigation with computed tomography (CT) showed a spondylodiscitis at the level of LII-LIII and a retroperitoneal mass extending to the vascular prosthesis. Group B β-hemolytic *Streptococci* were cultured from several CT-guided biopsies. High-dose intravenous penicillin was administered for 6 weeks, followed by orally administered amoxycillin (Clamoxyl) for 2 months. Six years after operation the patient was alive and well, without signs of infection. In retrospect, an infective aortitis was primarily misdiagnosed and antibiotic treatment was indicated earlier in the course of the disease.

In patient B *Staphylococcus epidermidis* was cultured from the aneurysm contents. An aortoduodenal fistula with a prosthetic infection was diagnosed 12 months after operation, from which four different organisms were isolated, including *Staphylococcus epidermidis*. The patient died of multiple organ failure after subsequent graft removal. A causative relation between the positive thrombus culture and the prosthetic infection cannot be ruled out in this case, because infective factors may play a role in the formation of aortoduodenal fistulas.[11-14]

## DISCUSSION

Prosthetic graft infections after aortic reconstructive surgery are reported to occur in 1% to 3% of all cases. This serious complication carries a mortality rate of 25% to 75% and results in a high rate of limb loss among survivors. Both Ernst et al.[6] and Buckels et al.[8] have found that positive bacterial cultures of the aneurysm contents, irrespective of the isolated pathogens, were associated with an increased prosthetic infection rate. This is in accordance with the findings in our study, in which the incidence of positive thrombus cultures was 25.5%. The prosthetic infection rate in patients with positive cultures was 5.5%, compared with 0.6% in those with negative cultures. However, apart from isolated cases of infective aortitis, in none of these reports was a relationship established between the organisms cultured from the thrombus and those involved in the subsequent graft infection.

Several other studies[4, 5, 7, 9, 10, 15-18] were unable to show an increased graft infection rate in patients with positive cultures from the aneurysm contents. Consequently, different clinical regimens have been proposed for patients with positive thrombus cultures, varying from watchful waiting to prolonged treatment with antibiotics.

Analyses of cost-effectiveness of these approaches are lacking. Complete antibiotic coverage would involve prophylaxis in all patients for at least 8 days until final culture results are available, followed by a prolonged (e.g., 5 weeks) course of specific antibiotic treatment in cases with positive thrombus cultures. In our series this would have meant 216 × 8 antibiotic daily dose equivalents (DDEs) and an additional 55 × 35 DDEs for cases with positive cultures. An arbitrary 50% reduction of the prosthetic infection rate (from four to two cases) in the group of patients with positive cultures would thus involve 3653 antibiotic DDEs. In contrast, our current protocol consists of a single preoperative dose prophy-

laxis (cefazolin 1 gm), which would only have amounted to 72 (⅓ × 216) DDEs in the above series.

Ruptured abdominal aortic aneurysms are reported to harbor bacteria more frequently than do asymptomatic aneurysms.[6, 8] Like others,[5, 9, 10] however, we were unable to confirm this finding. Durham et al.[3] studied the effect of multiple vascular operations on bacterial presence in the arterial wall and its relation to subsequent graft infections. Positive arterial cultures had no predictive value for graft infection among patients undergoing primary major vascular surgery, but the incidence of graft infection was significantly increased after secondary surgery in cases with positive cultures.

Contamination of the specimens during operation, transport, or processing in the laboratory invariably leads to an unknown proportion of false-positive bacterial cultures that are associated with all clinical studies.[5, 15, 17] In the absence of a reliable method to compensate for this phenomenon we have, in accordance with others, made no attempts to correct for an overestimation of the number of positive thrombus cultures.[5-10, 15-18]

The present study and the accumulated evidence from the literature do not support the idea that the presence of bacteria in the intraluminal thrombus is an important factor in the development of prosthetic infection after primary elective and urgent abdominal aortic aneurysm repair. Complete antibiotic coverage is considered most impractical. Therefore routine intraoperative cultures are unnecessary unless clinical signs of infective aortitis are evident.

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