 DOI 10.1099/jmmcr.0.000051

Case Report

Post-operative wound and vascular graft infection caused by *Haemophilus parainfluenzae*

Sophia Tsiplakou,[1] Grigorios Voulalas,[2] Elena Kiliari,[1] Georgios Kastrisios[2] and Chrysostomos Maltezos[2]

[1]Microbiology Laboratory, KAT Hospital, Athens, Greece

[2]Vascular Surgery Clinic, KAT Hospital, Athens, Greece

Correspondence
Sophia Tsiplakou
stsiplakou@gmail.com

Introduction: We present a rare case of wound and vascular graft infection caused by *Haemophilus parainfluenzae* after reconstruction of the femoral artery bifurcation.

Case presentation: *H. parainfluenzae* was isolated from pus samples taken from a patient who had undergone angioplasty of the superficial femoral artery and anastomosis with a synthetic graft. The pathogen was isolated from samples taken from both the wound and the graft. Management involved wide surgical debridement and irrigation, preservation of the prosthetic graft and transposition of muscle flaps in conjunction with the administration of culture-based antimicrobials.

Conclusion: *H. parainfluenzae* surgical wound and vascular graft infections are uncommon, and quick diagnosis and preservation of the graft is of great importance in treatment.

Received 2 December 2014
Accepted 8 April 2015

Keywords: *Haemophilus parainfluenzae*; surgical wound infection; vascular graft.

Introduction

Haemophilus parainfluenzae is an unusual pathogen in human infections. *H. parainfluenzae* has been reported as the causative agent of systemic infections such as endocarditis (Darras-Joly *et al.*, 1997; Winn *et al.*, 2005) and less commonly of bacteraemia, pneumonia, empyema, epiglottitis, meningitis, arthritis, cerebral abscess, urethritis and genital infections (Oill *et al.*, 1979; Chu & Sexton, 2008; Winn *et al.*, 2005). Surgical site and vascular graft infections due to *H. parainfluenzae* are extremely rare and the recovery of the pathogen is difficult, as it is slow-growing and fastidious. In the present report, we describe a wound and subsequent vascular graft infection by *H. parainfluenzae*.

Case report

A 68-year-old female patient was admitted to the Vascular Surgery Department with severe intermittent claudication of the left lower extremity. On physical examination, the femoral artery of the left limb was solely palpable, whilst the contralateral limb was palpable up to the posterior tibial and dorsalis pedis arteries. The ankle brachial index of the left lower extremity was 0.4. The patient's personal history included hypothyroidism; she was a former smoker, had a body mass index of 30 and had been operated on for osteoarthritis of the ipsilateral knee and hip joint. Angiography studies revealed a near-occlusive stenosis of the proximal superficial femoral artery along with stenosis of the common femoral artery. Taking into consideration the angiographic and clinical examination, endarterectomy of the common femoral artery in combination with angioplasty of the superficial femoral artery was undertaken. During the operative procedure, diffuse and extended atherosclerosis of the common femoral artery and its bifurcation was noted. Anastomosis was performed between the distal external iliac artery and the first third of the superficial femoral artery end to end, using an interposition graft (polytetrafluoroethylene of 7 mm diameter), along with a re-implantation of the profound femoral artery, which was anastomosed end to side using a Carrel patch. The immediate post-operative period was uneventful, and the patient regained palpable peripheral pulses. On post-operative day 5, she developed inflammation of the groin wound with purulent exudates. Laboratory investigation revealed a white blood cell count of $6.84 \times 10^3\ \mu l^{-1}$ (67 % granulocytes, 20 % lymphocytes and 9 % monocytes), a haemoglobin level of $11\ g\ dl^{-1}$ and a platelet count of $298 \times 10^3\ \mu l^{-1}$. The C-reactive protein level was $30.4\ mg\ dl^{-1}$ (normal value $<0.5\ mg\ dl^{-1}$). The remaining biochemical laboratory tests were within normal ranges.

The patient was on ciprofloxacin (400 mg twice daily, intravenously) at the time of culture collection. A culture from the wound was obtained, and amikacin (500 mg three times daily) and rifampicin (600 mg twice daily) were empirically administered intravenously. A routine culture was performed and the swab was plated onto

horse blood agar (Oxoid) incubated at 37 °C both in air and anaerobically, chocolate agar (Oxoid) incubated at 37 °C in air supplemented with 5 % CO_2 and MacConkey agar (Oxoid) incubated at 37 °C in air. The swab was also inoculated in brain–heart infusion broth (Oxoid) and incubated at 37 °C in air. The first culture yielded only *Staphylococcus epidermidis*, which was considered part of the flora of the area. As there was no improvement in the clinical picture, a second culture of the purulent exudate was obtained, which confirmed the presence of *S. epidermidis*, which was methicillin resistant. In addition, this organism showed resistance to fucidic acid, macrolides, quinolones and rifampicin. Along with *S. epidermidis*, *Escherichia coli* was also isolated, which was resistant to ampicillin, piperacillin, tetracycline, quinolones and aminoglycosides. Although these bacteria are members of the skin flora, intravenous linezolid (600 mg twice daily) in combination with ceftriaxone (2 g once daily) were administered according to the susceptibility results of the pathogens (linezolid MIC for *S. epidermidis* of 1 μg ml^{-1} and ceftriaxone MIC for *E. coli* of 1 μg ml^{-1}), in order to prevent any contamination of the graft itself, and all previously administered antimicrobials were discontinued. The infection was classified as grade III according to Szylagyi's classification (Szilagyi *et al.*, 1972). On post-operative day 8, a wide surgical debridement of the wound with multiple irrigations and transposition of the sartorius muscle, and a femoral rotation of the muscle flaps were performed. Pus was aspirated using a syringe from three different sites of the perigraft area. In addition, cultures were obtained using swabs from the adjacent tissues. It should be noted that the graft was not embedded and the purulent exudates surrounded it. Macroscopically, the purulent exudate had a chocolate-like colour and was malodourous. The intraoperative pus samples were sent to the microbiology department and routine culture was performed as described above. Gram staining of the pus revealed 4+ polymorphonuclear leukocytes and Gram-negative coccobacilli. After 24 h of incubation, all intraoperative sample cultures showed bacterial growth on blood agar and chocolate agar plates. On Gram staining, the isolate was found to be a Gram-negative coccobacillus with some filamentous cells. Identification was performed using X (haemin) and V (NAD) factor-containing disks, using a Rapid ID NH system (Thermo Scientific) and API NH system (bioMérieux). By the growth around the V (NAD-NADP) factor-containing disk and the profiles 4327 and 7720, respectively, the isolate was identified as *H. parainfluenzae*. Interestingly, *S. epidermidis* and *E. coli* were not isolated from the intraoperative pus samples. We believe that a deep-seated infection due to *H. parainfluenzae* was revealed, as the patient was on broad-spectrum antimicrobials for only 2 days in which time *S. epidermidis* and *E. coli* could not have been eradicated.

Antibiotic susceptibility testing for *H. parainfluenzae* was performed using the disk-diffusion method according to Clinical and Laboratory Standards Institute guidelines (CLSI, 2014). The isolate was susceptible to ampicillin, aztreonam, cefotaxime, ceftriaxone, cefuroxime and tetracycline but resistant to trimethoprime/sulfamethoxazole, levofloxacin and ciprofloxacin. The micro-organism tested negative for β-lactamase production.

Our patient responded well to the conservative and operative treatments (linezolid and ceftriaxone administration and wide debridement with transposition of muscle flaps). She experienced resolution of febrile episodes and a decrease in her inflammatory markers several days after the second operation. She was discharged 5 weeks after the initial operation and was prescribed linezolid *per os* for 6 weeks, after consultation with an infectious diseases specialist. She returned 6 days later with complete healing of the trauma, in good condition and free of any symptoms, and the cutaneous sutures were cut.

Discussion

Infections of synthetic grafts are serious complications that the vascular surgeon faces in common practice and constitute a major concern, as the infection is difficult to eradicate. The reported frequency of prosthetic vascular graft infections ranges between 2 and 6 % (Bunt, 1983), and some studies have demonstrated higher reinfection rates of any new prosthetic graft implanted (10–15 %) (Cardozo *et al.*, 2002; Gibbons *et al.*, 2000). The clinical picture can vary from latent infection to bacteraemia (Back, 2010), and the risk of limb and life loss frequently obliges the vascular surgeon to perform excision of the infected synthetic graft and extra-anatomical bypasses or *in situ* replacement using autologous vein, antibiotic-impregnated prostheses or cryopreserved arterial allografts in order to revascularize the extremity. Meanwhile, the morbidity is high (Bandyk & Back, 2005) and the whole infectious condition threatens the individual. The most common pathogens that have been isolated and described are *Staphylococcus aureus*, *S. epidermidis*, *Klebsiella* spp., *Pseudomonas* spp., *Enterobacter* spp., *Serratia* spp., *Proteus* spp., *E. coli* and fungi (Back, 2010). There is no evidence as to the optimal duration of antibiotic therapy. This may vary from 11 days to more than a year, although a minimum of 6 weeks of intravenous therapy followed by up to 6 months of oral therapy is commonly recommended (FitzGerald *et al.*, 2005). Despite being contrary to conventional concepts, partial or complete graft preservation combined with aggressive drainage and groin wound debridement is an acceptable option for treatment of infection in selected cases (Calligaro *et al.*, 2003).

In our case, *H. parainfluenzae* was isolated from the surgical wound, and the presence of this unusual bacterium created a sense of anxiety, because it is hard to determine whether the pathogen is of high or low virulence and also the experience of treating such pathogens from surgical traumas is limited.

Haemophilus spp. are considered to be part of the normal flora of the upper respiratory tract and urogenital tract. *H. parainfluenzae* is a commensal organism of the oropharynx and is present in over 20 % of faecal samples. *H. parainfluenzae* has been reported as the pathogen causing a variety of infections such as endocarditis, pneumonia, meningitis, epiglottitis, arthritis, cerebral abscess, urethritis and genital infections (Winn *et al.*, 2005). It is a Gram-negative bacillus, a fastidious organism that grows optimally on chocolate agar at 35 °C in 5 % CO_2 (Killian, 2003). Most *Haemophilus* spp. are susceptible to third-generation cephalosporins, trimethoprime-sulfamethoxazole, fluoroquinolones and aztreonam. Increased production of β-lactamase by these organisms has been observed. Oral agents used for infections where *H. parainfluenzae* is suspected or confirmed include penicillins, tetracyclines, quinolones, macrolides, cephalosporins and sulfonamides (Chu & Sexton, 2008; Steinberg & Burd, 2010).

Surgical site infections due to *H. parainfluenzae* have been described as being related to procedures near the upper respiratory tract, where *H. parainfluenzae* may be present as part of the normal flora (Auten *et al.*, 1991; Lee *et al.*, 2012). Infection involving a vascular prosthesis is difficult to eradicate. If not recognized or treated promptly, implant failure will occur as a result of sepsis, haemorrhage or thrombosis, with end-organ ischaemia. Graft infection occurs much less frequently than wound infection, with the incidence of early graft infection in the range of 1 % of procedures. Early diagnosis and treatment is mandatory using either graft preservation or excision procedures with revascularization in combination with culture-based antibiotics for at least 6 weeks (Hasse *et al.*, 2013).

In conclusion, in order to rapidly detect and identify unusual pathogens such as *H. parainfluenzae* from wound infections intraoperative samples should be obtained, proper culture techniques should be applied, and the microbiology laboratory should be alert for the correct diagnosis and successful management of such serious infections.

References

Auten, G. M., Levy, C. S. & Smith, M. A. (1991). *Haemophilus parainfluenzae* as a rare cause of epidural abscess: case report and review. *Rev Infect Dis* **13**, 609–612.

Back, M. R. (2010). Local complications: graft infection. In *Rutherford's Vascular Surgery*, pp. 643–661. Edited by J. L. Cronenwett & K. W. Johnston. 7th edn., Philadelphia, PA: Saunders.

Bandyk, D. F. & Back, M. R. (2005). Infection in prosthetic vascular grafts. In *Rutherford's Vascular Surgery*, pp. 875–894. Edited by R. B. Rutherford. 6th edn., Philadelphia, PA: Saunders.

Bunt, T. J. (1983). Synthetic vascular graft infections. I. Graft infections. *Surgery* **93**, 733–746.

Calligaro, K. D., Veith, F. J., Yuan, J. G., Gargiulo, N. J. & Dougherty, M. J. (2003). Intra-abdominal aortic graft infection: complete or partial graft preservation in patients at very high risk. *J Vasc Surg* **38**, 1199–1204.

Cardozo, M. A., Frankini, A. D. & Bonamigo, T. P. (2002). Use of superficial femoral vein in the treatment of infected aortoiliofemoral prosthetic grafts. *Cardiovasc Surg* **10**, 304–310.

Chu, V. H. & Sexton, D. J. (2008). HACEK. In *Clinical Infectious Disease*, pp. 965–968. Edited by D. Schlossberg. New York: Cambridge University Press.

CLSI (2014). *Performance Standards for Antimicrobial Susceptibility Testing*, 24th Informational Supplement M100–S24. Wayne, PA: Clinical and Laboratory Standards Institute.

Darras-Joly, C., Lortholary, O., Mainardi, J. L., Etienne, J., Guillevin, L. & Acar, J. (1997). *Haemophilus* endocarditis: report of 42 cases in adults and review. *Clin Infect Dis* **24**, 1087–1094.

FitzGerald, S. F., Kelly, C. & Humphreys, H. (2005). Diagnosis and treatment of prosthetic aortic graft infections: confusion and inconsistency in the absence of evidence or consensus. *J Antimicrob Chemother* **56**, 996–999.

Gibbons, C. P., Ferguson, C. J., Edwards, K., Roberts, D. E. & Osman, H. (2000). Use of superficial femoropopliteal vein for suprainguinal arterial reconstruction in the presence of infection. *Br J Surg* **87**, 771–776.

Hasse, B., Husmann, L., Zinkernagel, A., Weber, R., Lachat, M. & Mayer, D. (2013). Vascular graft infections. *Swiss Med Wkly* **143**, w13754.

Killian, M. (2003). *Haemophilus.* In *Manual of Clinical Microbiology*, pp. 623–635. Edited by P. R. Murray, E. J. Baron, J. H. Jorgensen, M. A. Pfaller & R. H. Yolken. 8th edn., Washington, DC: AMS Press.

Lee, L. N., Susarla, S. M., Henstrom, D. K., Hohman, M. H., Durand, M. L., Cheney, M. L. & Hadlock, T. A. (2012). Surgical site infections after gracilis free flap reconstruction for facial paralysis. *Otolaryngol Head Neck Surg* **147**, 245–248.

Oill, P. A., Chow, A. W. & Guze, L. B. (1979). Adult bacteremic *Haemophilus parainfluenzae* infections. Seven reports of cases and a review of the literature. *Arch Intern Med* **139**, 985–988.

Steinberg, J. P. & Burd, E. M. (2010). Other Gram-negative and Gram-variable bacilli. In *Principles and Practice of Infectious Diseases*, pp. 3015–3017. Edited by G. L. Mandell, J. E. Bennett & R. Dolin. 7th edn., Philadelphia, PA: Elsevier.

Szilagyi, D. E., Smith, R. F., Elliott, J. P. & Vrandecic, M. P. (1972). Infection in arterial reconstruction with synthetic grafts. *Ann Surg* **176**, 321–323.

Winn, W. C., Allen, S. D., Janda, W. M., Koneman, E. W., Procop, G. W., Schreckenberger, P. C. & Woods, G. (2005). *Koneman's Color Atlas and Textbook of Diagnostic Microbiology*, 6th edn., Philadelphia, PA: Lippincott Williams & Wilkins.