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Case Report

Reticular Telangiectatic Erythema in Association to Implanted Medical Device

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Abstract

Infections associated with implantable devices pose significant risks, as bacteria and other microorganisms can attach to the device surfaces, leading to complications ranging from mild inflammation to severe, potentially fatal infections. This review explores the development of reticular telangiectatic erythema (RTE) in patients with various implanted medical devices, including subcutaneous neurostimulators, shoulder prostheses, and hip prostheses. RTE manifests as red, net-like patches on the skin covering the device and is often associated with low-grade infections caused predominantly by Staphylococcus epidermidis, known for its biofilm-forming capability. The review presents three cases of RTE following device implantation, all resolving after antimicrobial treatment and device removal, despite negative patch tests for contact allergies. These cases highlight the importance of recognizing low-grade infections in patients with implanted devices and underscore the need for precise diagnostic and therapeutic strategies. The findings suggest that infections involving S. epidermidis play a critical role in the development of RTE. This review stresses the importance of preventive measures such as meticulous implantation techniques and prophylactic antibiotics and advocates for further research with larger sample sizes to better understand the role of microorganisms in RTE. It also calls for the development of improved diagnostic and treatment strategies. Future research directions include creating new materials resistant to biofilm formation, developing advanced antimicrobial agents, and enhancing diagnostic techniques to detect infections earlier.

Keywords: *Implantable device-related infection; Reticular telangiectatic erythema; Staphylococcus epidermidis, Biofilm; Antimicrobial treatment*

Introduction

Implantable device-related infection is a serious complication that can occur when bacteria or other microorganisms enter the body and attach to the surface of the implanted device. This can cause a range of symptoms, from mild inflammation to severe infections that can be life-threatening. Reticular telangiectatic erythema (RTE) is a skin condition that has been linked to the use of implanted medical devices such as pacemakers, defibrillators, and neurostimulators (Beggs et al., 2018). It is a rare but potentially serious complication that can result in significant discomfort and cosmetic disfigurement. RTE is characterized by the appearance of red, reticular (net-like), and telangiectatic (dilated blood vessels) patches on the skin overlying the implanted device.

This case report describes the conditions of three patients who developed RTE followed by the implantation of subcutaneous neurostimulator, shoulder prosthesis, and hip prosthesis. The presence of a low-level infection caused by S. epidermidis, known for producing biofilm, may be the root cause of the observed RTE despite the absence of any visible technical faults in the implanted devices (Büttner et al., 2015).

Nevertheless, the use of antimicrobial treatments, such as antibiotic therapy and device removal, resulted in the complete resolution of the RTE in every case. Similar cases of RTE have been reported in research that was published in the year 2011.There have been reports of post-implantation erythema following the insertion of an elbow prosthesis, a knee prosthesis, and a spinal cord stimulator. These implants have not been previously identified as causes of this condition (Aneja et al., 2011).

I. Background On Implanted Device Associated Infection

A. History

The most common issue with implants is infections (Beggs et al., 2018). RTE was initially reported in 1981 by Gensch and Schmitt in a patient with a pacemaker implant (Gensch and Schmitt, 1981). Since then, 19 patients with similar skin lesions have been documented in the MEDLINE database under various names (Kint and Vermander, 1983). These include RTE, erythema, circumscribed RTE, persistent telangiectatic erythema, circumscribed erythema, annular erythema, telangiectatic pacemaker erythema, telangiectatic erythematous cutaneous reaction and erythema with telangiectasia (Pitarch et al., 2006). The clinical presentations of all the case reports of RTE shows a similarity.

The discussed study displays the case of three patients reported with a Reticular telangiectatic erythema (RTE) and it was suspected to be caused by the post-surgical infection. The first person reported to have a RTE underwent a surgery for the replacement of the battery of the medical device subcutaneous neurostimulator. The results of a skin biopsy revealed the presence of lymphocytes infiltrating the area around blood vessels in the top layer of skin. To confirm whether a contact allergy to any of the implanted materials such as metals was the cause, patch tests were conducted, but they did not show any allergic reaction. After that, revision surgery was done, and the analysis of four bacterial swabs indicated the presence of *S. epidermidis*. The second case of RTE was a 66-year-old female who had a shoulder prosthesis surgery. The infection formed within a few days after the implant and the patch tests showed negative results. Nonetheless, after a period of 8 months, the results of a blood test indicated an increased level of C-reactive protein (CRP) and there was no elevation in the number of white blood cells. An ultrasound scan showed the presence of a fluid collection with several compartments, requiring the removal of the prosthesis. Subsequently, two tests revealed the growth of *S. epidermidis* (Wuyts et al., 2019). Another case concerned of a man who had to have a second surgery to fix a hip replacement. As a result of the surgery, a round and tender area developed gradually around the cut on his body. However, scintigraphy of leucocyte and bone gave a negative result. The culture tests done with the samples collected through hip aspiration couldn't give a positive result. After one month, a mass that was fluctuating in nature appeared. Following this, two cultures were obtained from the mass, which consisted of multi-sensitive *S. epidermidis* and *Staphylococcus capitis* bacteria. *S. epidermidis* and *S. capitis* are types of bacteria that are usually found on human skin.

B. Epidemiology

Indwelling medical devices are responsible for more than half of the nearly two million healthcare-associated infections (VanEpps and Younger, 2016). Implantable device related infections are becoming an increasingly important public health problem. According to various studies, the incidence of these infections varies widely depending on the type of device, the patient population, and other factors. In general, however, implantable device- related infections are more common in patients with compromised immune systems, such as those with diabetes or cancer, and in patients who undergo certain medical procedures, such as dialysis or surgery.

The implant devices can become infected through a variety of routes, including contamination during the implantation procedure, the spread of bacteria or other microorganisms from other parts of the body, or the migration of bacteria from a distant site through the bloodstream. The aetiological agent which caused the infection was found to be *S. epidermidis* and *Staphylococcus capitis.*

The risk of infection is higher in people who have weakened immune systems, such as those with diabetes, cancer, or HIV. Additionally, the risk is also higher in people who have undergone multiple surgeries or who have had implants for an extended period. In addition to patient-related factors, the risk of implantable device-related infection is also influenced by various device-related factors, such as the type of material used, the design of the device, and the duration of implantation. For example, some materials, such as certain metals or polymers, may be more prone to infection than others, and devices that are designed with more complex features may be more difficult to sterilize effectively.

C. Testing

If a healthcare provider suspects a bacterial infection of Reticular Telangiectatic Erythema (RTE), they may collect a bacterial culture swab to identify the type of bacteria present. In the discussed cases, the patch tests for detecting any allergic reactions as well as the culture shows a negative result for the patients except the third case. Since, after a month, two cultures from a fluctuating mass were culture positive for the multi-sensitive Staphylococcus capitis and S. epidermidis bacteria (Wuyts et al., 2019). However, it is unclear from the given information what caused the mass to develop or what implications the bacterial presence might bring. Further testing and evaluation would be needed to determine the significance of these findings. The analytical techniques which involved CT-SPECT and MRI scan were able to find the low-grade infections. Fusion imaging with SPECT/CT can enhance both specificity and sensitivity by reducing uncertain interpretations compared to planar scintigraphy or SPECT alone (Koppula et al., 2021).

In the discussed cases, an elevated level of C-reactive protein (CRP) helped to recognize the infection. However, C-reactive protein (CRP), and procalcitonin (PCT) are conventional laboratory methods which are not enough to diagnose the surgical implant associated infections (Corvec et al., 2012). There are several emerging methods for detecting implant- associated infections. Some of these include:

- Biomarker assays that detect specific proteins or genetic material associated with infection (Alvand et al., 2017).
- Mass spectrometry-based techniques that can identify bacterial species directly from clinical samples (Ho and Reddy, 2010).
- Optical imaging methods that use fluorescent probes to detect bacteria or inflammatory cells around the implant (Mills et al., 2016).
- Nanoparticle-based approaches that target bacterial cells specifically and enable rapid detection of infection (Lee et al., 2019).
- Next-generation sequencing technologies that can identify the genetic makeup of bacterial species within the implant and surrounding tissues (Phillips et al., 2022).

D. Treatment

Topical treatments such as moisturizers, barrier creams, and topical steroids may also be recommended to reduce redness and inflammation. In some cases, laser therapy may be used to reduce the appearance of telangiectasia. The article mentions that an antimicrobial strategy, including antibiotic therapy and removal of the infected devices, led to complete disappearance of the RTE in all cases. The antibiotic treatments for the three patients consisted of Linezolid 600 mg, Clindamycin IV 600 mg, IV Flucloxacillin 6 × 2 g and Rifampicin 2 × 450 mg as oral medication (Wuyts et al., 2019). The antimicrobial treatment couldn't be started unless and until the infection and the organism to cause the infection is finalized and it took almost weeks and months for this process.

II. Prevention And Management

Prevention and management of implantable device-related infections require a multidisciplinary approach, involving clinicians, engineers, and microbiologists. Measures such as appropriate patient selection, careful implantation techniques, and the use of prophylactic antibiotics can help reduce the risk of infection. In cases where infection does occur, prompt diagnosis and treatment are critical to prevent further complications, such as sepsis or device failure. The implantable device associated infections (IDAI) are costly and pose a significant economic burden on healthcare systems. However, when considering all types of IDAIs, a "DR strategy" (delayed re-implant strategy) has been found to be associated with reduced length of stay (LOS) for patients without incurring additional costs (Ahmed et al., 2019).

Preventing implantable device-related infections requires a combination of proper device selection, proper surgical techniques, and careful post-operative care. Some measures that can be taken to reduce the risk of infection include:

- Appropriate preoperative screening for infection
- Thorough cleaning of the skin and surgical site prior to surgery

- Use of antibiotics before and after surgery
- Proper handling and sterilization of devices and surgical equipment
- Proper surgical technique to minimize tissue damage and reduce the risk of contamination
- Careful post-operative care, including wound care and monitoring for signs of infection

If an infection does occur, prompt and appropriate treatment is critical. This may involve surgical removal of the infected device, antibiotic therapy, and other treatments to manage symptoms and prevent the spread of infection.

Conclusion

In conclusion, the devices showed no apparent technical defects, and patch tests to exclude contact allergies were negative in all cases. An antimicrobial strategy including antibiotic therapy and removal of the infected devices led to complete disappearance of the RTE in all cases. The subsequent replacement of the devices with new ones led to no recurrence of the condition. Overall, the paper provides interesting clinical observations and raises important questions about the potential role of low-grade infections in the development of RTE, but further research is needed to confirm these findings and explore their implications. The authors suggest that while the role of S. epidermidis in RTE is poorly defined, this microorganism may play an important role in the pathogenesis of some cases of otherwise unexplained RTE. However, since this is a case report with a small number of patients, the findings may not be generalizable to a larger population. Additionally, the lack of a control group makes it difficult to draw definitive conclusions about the role of S. epidermidis in RTE. Further research with larger sample sizes and control groups is needed to confirm these findings.

Future Treatment and Progression

- In terms of future treatments, research is ongoing to develop better strategies to prevent and treat infections related to implanted devices. Some potential areas of focus include:
- Developing new materials with improved resistance to biofilm formation and infection. This could involve modifying the surface of the device to make it more resistant to bacterial adhesion or designing materials that release antimicrobial agents.
- Developing new antimicrobial agents that are more effective against biofilms. Biofilms are notoriously difficult to treat with antibiotics, so researchers are exploring alternative approaches such as using bacteriophages or antimicrobial peptides.
- Improving diagnostic techniques to detect low-grade infections earlier. Currently, it can be difficult to detect biofilm-related infections using standard laboratory methods, so developing new techniques such as molecular diagnostics or imaging could help identify infections earlier and improve treatment outcomes.

Conflict of Interest

The author declare no conflict of interest.

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