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A case report of necrotizing fasciitis with a sole causative agent: *Actinotignum schaalii*

Mateusz Michalczak [1], Jakub Michalczak [1], Aldona Olechowska-Jarząb [2,3], Justyna Rymarowicz [1]

[1] 2nd Department of General Surgery, Jagiellonian University Medical College, Macieja Jakubowskiego 2, 30-688 Kraków, Poland
[2] Department of Microbiology, Jagiellonian University Medical College, Macieja Jakubowskiego 2, 30-688 Kraków, Poland
[3] Department of Pharmaceutical Microbiology, Jagiellonian University Medical College, Macieja Jakubowskiego 2, 30-688 Kraków, Poland

ORCID of the author(s)

MM: https://orcid.org/0009-0000-9133-4935
JM: https://orcid.org/0009-0001-0096-4593
AOJ: https://orcid.org/0009-0007-8149-7424
JR: https://orcid.org/0000-0002-6713-5255

Abstract

Actinotignum schaalii (*A. schaalii*) is a Gram-positive, anaerobic bacterium. While primarily associated with urinary tract infections in elderly and immunocompromised individuals, it has also been implicated in soft tissue infections such as necrotizing fasciitis. However, its role as a primary pathogen in necrotizing fasciitis outside the genitourinary region remains underreported. We present a case of necrotizing fasciitis of the axilla caused by *A. schaalii* in an elderly diabetic female. This case is unique in that it highlights the bacterium's role as the sole causative agent in a severe soft tissue infection, diverging from its typical polymicrobial involvement. This case emphasizes the pathogenic potential of *A. schaalii* in severe soft tissue infections and highlights the importance of advanced microbiological techniques for its accurate identification.

Keywords: necrotizing fasciitis, *Actinotignum schaalii*, soft tissue infections, anaerobic bacteria, infectious disease diagnostics, clinical case report, advanced diagnostic techniques, rare pathogens, MALDI-TOF, diabetes and infections

Introduction

Actinotignum schaali (*A. schaalii*) is a Gram-positive, anaerobic bacterium related to members of the genus *Actinomyces*. It is part of the microbiota primarily found in the genitourinary tract and on the skin. *A. schaalii* is associated with various human infections, particularly urinary tract infections in elderly and immunocompromised individuals. It has also been implicated in conditions such as bacteremia and soft tissue infections, and, less commonly, in osteomyelitis, and abscess formation [1]. Soft tissue infections caused by the *A. schaalii* bacteria are rare but are progressing rapidly [2-4]. The bacterium's involvement in severe polymicrobial infections, including necrotizing fasciitis, underscores its pathogenic potential. *A. schaalii* is frequently underreported, as it is slow-growing and difficult to phenotypically identify with typical microbiology laboratory techniques [5]. The slow growth and resemblance to the microbiota on the skin and mucous membranes contribute to its occasional misidentification [6].

We present a case of necrotizing fasciitis caused by *A. schaalii* in an elderly diabetic female patient. This case is significant because, although *A. schaalii* is most commonly associated with urinary tract infections (UTIs), it is rarely reported as a cause of skin infections [7]. While there are documented instances of Fournier's gangrene involving this pathogen in combination with other microorganisms [8], there is no evidence in the literature of *A. schaalii* acting as the sole causative agent of necrotizing fasciitis in different regions of the body. This makes our findings unprecedented.

Corresponding Author
Justyna Rymarowicz
2nd Department of General Surgery, Jagiellonian University Medical College, Macieja Jakubowskiego 2, 30-688 Kraków, Poland
E-mail: justyna.rymarowicz88@gmail.com

Informed Consent
The authors stated that the written consent was obtained from the patient presented with images in the study.

Conflict of Interest
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Case presentation

A 68-year-old female with a medical history of type 2 diabetes, obesity, and hypertension presented to the emergency department. Her diabetes was managed with gliclazide (60 mg daily), and hypertension was treated with ramipril 5 mg and indapamide 1.5 mg. She reported a two-day history of redness and painful swelling around her right armpit extending to the back and around the right breast.

On admission, her vital signs were as follows: respiratory rate, 15 breaths/min; SpO2, 95%; blood pressure, 139/77 mmHg; heart rate, 98 beats/min; and body temperature, 39°C. Physical examination revealed swelling of the right axillary fossa extending to the upper outer quadrant of the right breast, with visible pus-filled blisters and crepitus over the axilla extending to the scapula and the right thoracic wall. The remainder of the physical examination was unremarkable.

Initial laboratory diagnostic results revealed elevated levels of inflammatory markers, including white blood cell count and C-reactive protein, as detailed in Figure 1 and 2. Other laboratory values, such as a full blood count (FBC), urea and electrolytes (U&E), and clotting and arterial blood gas (ABG) tests, were initially within normal ranges.

Figure 1: Trend of white blood cell counts [normal: 4.50 - 11.00 x10^3], measured throughout the hospitalization, highlighting the correlation with the patient's treatment interventions and clinical progression.

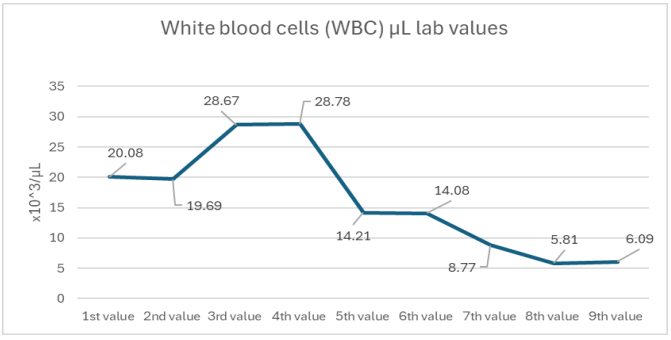
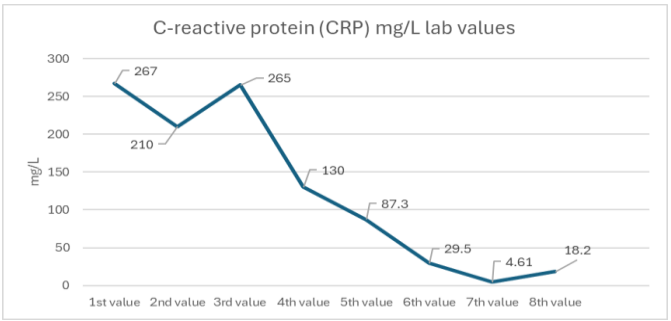


Figure 2: Trend of C-reactive protein (CRP) [normal: <5.00 mg/L] measured throughout the hospitalization, highlighting the correlation with the patient's treatment interventions and clinical progression.



A computerized tomography scan was performed and an extensive abscess-like collection with free gas in the area of the right armpit was seen, measuring approximately 9x12x10cm; extending from the axilla to the level of the 7-8th ribs, infiltrating to the anterior border of the pectoralis major muscle and posteriorly to the scapula. Visible gas penetration was observed spreading along the muscular fascia to the neck and the lower edge of the scapula, with further extension distally along the right upper extremity (Figure 3: panels A, B, C).

The patient was admitted to the Department of General Surgery. Empirical intravenous antibiotic therapy was immediately initiated with clindamycin 600 mg TDS and Cefotaxime 1 g BD, and an initial incision and drainage procedure was performed. This was followed by a series of extensive surgical debridements of infected subcutaneous tissue and fascia, with the concomitant application of negative pressure wound therapy (Figure 4: panels A, B, C). Surgical debridement was repeated until the wound was clear and covered with granulation tissue. Additionally, hyperbaric oxygen therapy was initiated on the sixth day of hospitalization.

The purulent fluid was immediately sent for microbiological culture. Initial microbiology results, obtained after three days, showed positive aerobic bacterial growth; however, the type of bacteria could not be determined. After 48 hours of incubation at 35°C on Columbia Agar with 5% sheep blood, small colony growth was observed. Following isolation, species identification was performed using mass spectrometry, which identified the pathogen as *A. schaalii*. Antimicrobial susceptibility testing of the strain was conducted on Mueller-Hinton agar enriched with horse blood and NAD. The diffusion method using gradient concentration strips (E-test) was employed to determine the minimum inhibitory concentration (MIC) values for selected antibiotics.

The final sensitivity results from the culture were available on the sixth postoperative day, showing *A. schaalii* as the sole pathogenic microorganism. The antibiotic sensitivity results presented minimum inhibitory concentrations of 0.0016 for both benzylpenicillin and ampicillin, 0.032 for Cefotaxime, 1.5 for ciprofloxacin, and 0.002 for trimethoprim/sulfamethoxazole. Due to the lack of breakpoint values available for this bacterium in EUCAST, the susceptibility could not be determined.

During hospitalization, the patient remained in good general condition. She was alert, oriented, and able to actively participate in her care. Vital signs remained stable throughout, and no significant complications were observed.

Written and signed informed consent was obtained from the patient for the publication of this case report. All identifying information has been anonymized to protect the patient's privacy.

Discussion

This is one of the few reported cases of *A. schaalii* causing necrotizing fasciitis. As stated by Könönen et al. [2], Actinomyces species have been detected at body sites where microbes are generally not found. Infections associated with *A. schaalii* typically involve the urinary tract and include cystitis, pyelonephritis, and urosepsis. However, other types of infections, especially those caused by *A. schaalii*, are increasingly being reported, including less frequent manifestations such as bacteremia, abscess formation, cellulitis, spondylodiscitis, bladder necrosis, epididymitis, and endocarditis [9].

A. schaalii belongs to the group of Gram-positive rods, many of which are considered harmless. This scenario has changed with the introduction of molecular testing, in particular, the use of 16S rRNA gene sequencing. This tool made it possible to identify bacteria more easily (tentatively to the species level). As a result, Gram-positive bacteria have being increasingly recognized as a cause of infection, including complicated skin and soft tissue infections (CSSI) [10]. Necrotizing infections and bacterial growth are rampant, and the species of bacteria can be rapidly identified [11].

Figure 3: A) Coronal view of Computed Tomography B) Sagittal view of Computed Tomography C) Axial view of Computed Tomography

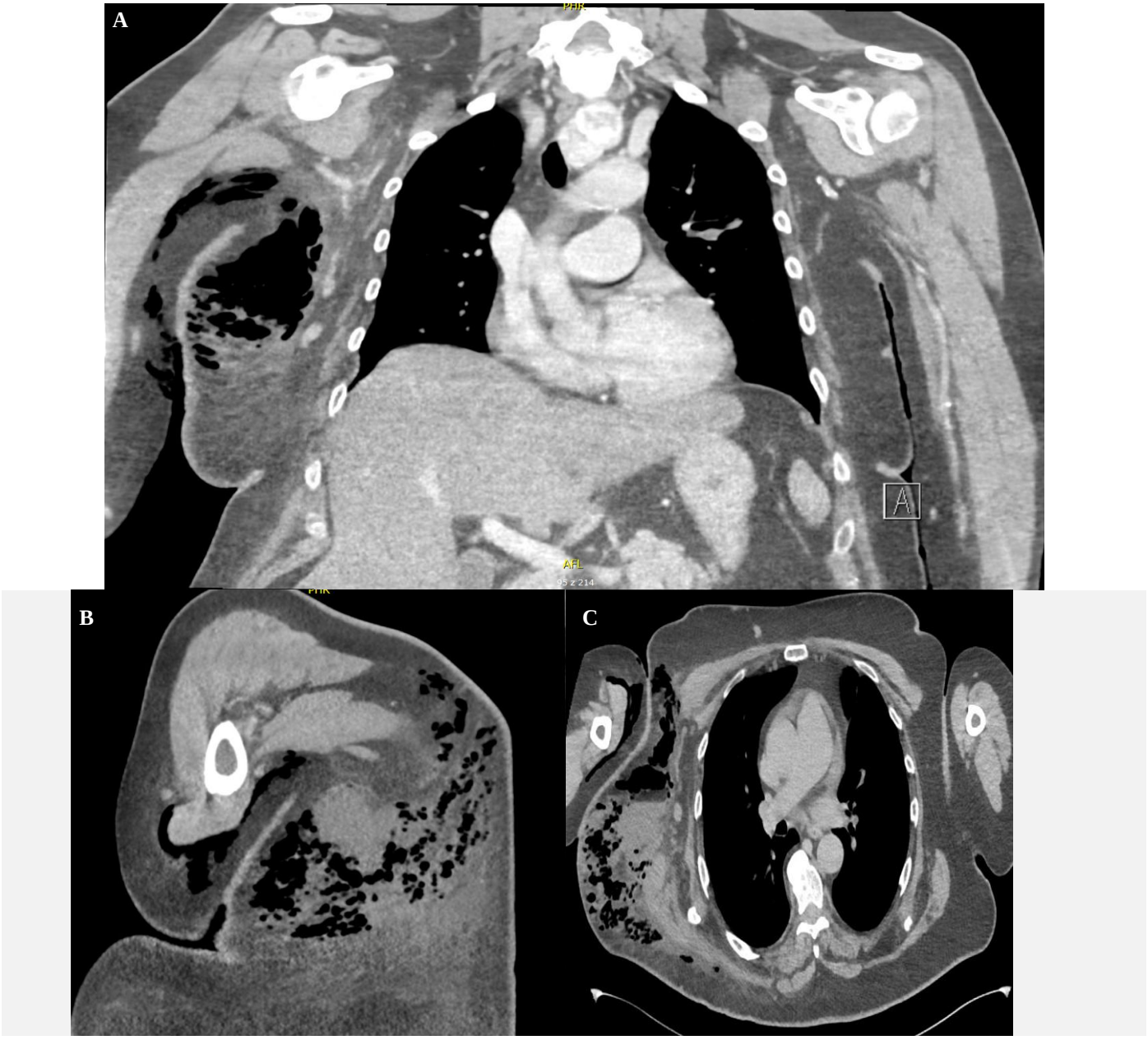
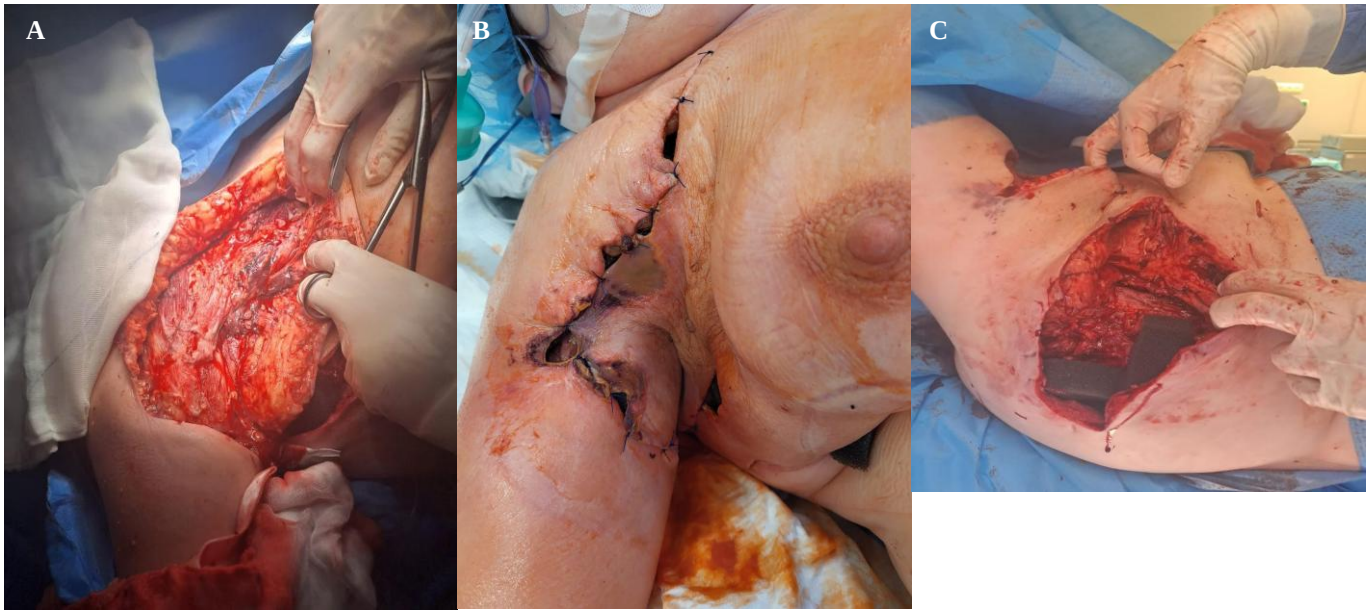


Figure 4: A) Clinical image depicting an intraoperative view of necrotizing fasciitis caused by *Actinotignum schaalii*, illustrating extensive soft tissue destruction. B) Clinical image of a surgical wound following debridement of necrotizing fasciitis in the right axillary region. C) Clinical images depicting an intraoperative view of necrotizing fasciitis caused by *A. schaalii*, illustrating extensive soft tissue destruction.



The clinical manifestations seen in our patient, which include an extensive abscess with gas formation, extensive inflammatory infiltration, and necrotizing fasciitis, are consistent with the aggressive nature of *A. schaalii*. One of the main challenges in managing infections caused by *A. schaalii* is the difficulty in detecting it in microbiological cultures. As mentioned above, identifying this pathogen typically requires advanced molecular techniques, such as 16S rRNA gene sequencing, real-time PCR, or spectrometry-based methods, which may not always be accessible [12]. The challenges in identifying *A. schaalii* underscore the importance of considering this organism in the differential diagnosis of soft tissue infections, particularly when the clinical presentation is severe and rapidly progressing, and when initial microbiological cultures do not yet yield a clear pathogen. For identification in our laboratory, mass spectrometry was used on the MALDI Biotyper Sirius System. Proteomic methods using mass spectrometry are based on analyzing the protein profile spectrum.

A. schaalii is considered a commensal bacterium of the urogenital system [13]. However, this species can cause UTI in elderly patients with urological disorders or with urinary catheters [14]. There are limited reports of *A. schaalii* being a part of polymicrobial pathogens in invasive infections, such as bacteremia or urosepsis, and skin infections [15]. The use of molecular genomic methods and proteomic diagnostics based on matrix-assisted laser desorption/ionization mass spectrometry (MALDI-TOF MS) has significantly improved detectability. The role of *A. schaalii* in infections is still underestimated due to the limited availability of diagnostic possibilities and tools.

Regarding other diseases caused by *A. schaalii*, identification using MALDI-TOF MS as the primary species identification method, combined with an increasing number of older persons with urinary tract morbidity, suggests that Actinotignum infections will likely be more frequently encountered [16]. In previous studies, it was shown that patients affected by UTIs are typically older males with underlying urinary tract conditions [17,18]. Due to the limited research evidence, it is challenging to confirm an age and gender correlation with *A. schaalii* infection in patients with complicated skin and soft tissue infections. However, elderly age, immune deficiency, and underlying diseases with symptoms may reflect the virulence of *A. schaalii* and the severity of the illness in elderly patients.

The management of *A. schaalii* infections is complex due to the lack of clear guidance on antibiotic sensitivity. In this case, the sensitivity testing did not provide a conclusive recommendation for the most effective antibiotic. *A. schaalii* based on results presented by Pedersen et al. [16] on antimicrobial susceptibility testing, β-lactams and vancomycin seem like feasible treatment options but resistance patterns can vary, and the presence of mixed infections with other bacteria can further complicate treatment decisions. Although there are no clear guidelines for the duration of antimicrobial therapy for *A. schaalii*-associated infections, it has been suggested that the duration should be at least two weeks [9].

In this patient, the prolongation of broad-spectrum antibiotics was necessary until the pathogen was identified and its antibiotic sensitivity profile could be assessed. In treatment, beta-lactam antibiotics are used and are effective. Commonly used antibiotics include penicillin, third-generation cephalosporins, carbapenems, and glycopeptides, with vancomycin being frequently employed.

The applicable interpretation guidelines, according to which drug susceptibility is assessed in Europe, including Poland, are the EUCAST guidelines. However, for the guidelines on the species *A. schaalii*, there are no specified interpretation ranges. Therefore, an antibiotic can be used in therapy based on positive literature data regarding its efficacy. The use of surgical debridement, combined with hyperbaric oxygen therapy, was a critical component of treatment to control the infection and promote healing in the affected tissues.

This case report highlights several important clinical implications. Primarily, it strengthens the need for awareness of *A. schaalii* as a potential pathogen in complicated skin and soft tissue infections, especially in patients with risk factors such as diabetes, immunosuppression, and obesity. It also exhibits the importance of early and aggressive intervention in cases of suspected necrotizing fasciitis, regardless of the initial pathogen in microbiological findings. Lastly, it points to the need for further research into the optimal management and identification of *A. schaalii* infections, including the development of more specific diagnostic tools and straightforward guidelines for antibiotic therapy.

Conclusion

The case of a 68-year-old female with necrotizing fasciitis caused by *A. schaalii* shows the complexity of diagnosing, identifying, managing, and treating infections caused by rare pathogens. It also underscores the pivotal role of advanced diagnostic techniques in detecting these pathogens and guiding to the appropriate and necessary treatment. Recently, such infections have become more frequently recognized due to improved diagnostic methods. Still, clinicians must remain observant in considering a broad range of potential pathogens, especially in patients presenting with atypical symptoms and significant underlying health conditions. Further research is needed to validate and confirm the clinical significance of these bacteria and establish the most effective treatment strategies.

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