**INTRODUCTION**

Enhanced clinical suspicion and early detection of invasive fungal infection (IFI) has played an increasingly pertinent role in clinical management of patients admitted for traumatic injury. Due to severely impaired wound healing, IFI patients are more likely to require revision to a more proximal amputation, hemipelvectomies or hip disarticulations, a higher number of operative procedures, and longer intervals preceding initial wound closure. Prior investigations have shown mortality rates as high as 38% for patients with trauma-related IFI.

The majority of IFI cases arise in immunocompromised patients. Many clinical interventions and physiologic phenomena in the setting of traumatic injury induce immunosuppressant states. Notably, large-volume blood transfusion induces a transient immunosuppressive state, facilitating opportunistic fungal and bacterial infections.

We present a previously immunocompetent 62-year-old man whose care was complicated by infection with *Humicola* species, a rare cause of IFI. Only 16 cases of *Humicola* infection have been reported, with none of these cases having originated in immunocompetent patients. We present this case to report a rare invasive fungal infection in a previously immunocompetent patient. We also discuss how IFI impacts surgical management of patients with traumatic injuries.

**CASE REPORT**

A 62-year-old man with no pertinent medical history presented after sustaining extensive polytrauma when he was hit by a car while riding his motorcycle. He developed hemorrhagic shock secondary to traumatic liver laceration, treated with massive blood transfusion. He also sustained multiple severe orthopedic injuries, and guillotine below-knee amputation (BKA) of right lower extremity was performed (Fig. 1). Two weeks later, he was transferred to our facility for multidisciplinary surgical consultation given the complexity of his injuries.

Soon after arrival, the patient underwent additional debridement of the guillotine BKA. Wound cultures from both stump and right traumatic knee wounds grew a rare, unidentifiable fungus, necessitating initiation of empiric
intravenous amphotericin B. The stump culture addition-
ally grew *Candida parapsilosis*. One week later, the BKA was
partially closed with a posterior advancement flap. A small
area was left open laterally and dressed with negative pres-
sure wound therapy (NPWT) to promote wound drainage
and bacterial clearance in the setting of persistent posi-
tive wound cultures without gross infection or purulence.
NPWT dressing changes were scheduled every other day,
at which time his wounds were assessed for granulation
tissue and IFI clearance.

Due to concerns of skin graft failure and IFI exacerba-
tion, NPWT was applied for longer intervals between revi-
sion surgeries and closure compared with management of
traumatic wounds not affected by IFI. Additionally, con-
servative advancement of amputation level for definitive
clearance of IFI was considered. There were several mul-
tidisciplinary discussions among the infectious disease,
orthopedic and plastic surgery services pertaining to the
persistence of IFI at the knee wound. The mainstay of
these discussions was the efficacy of surgical debridements
and antifungal therapy versus surgical advancement to an
above-knee amputation to definitively clear the infection.
Based on discussions with the patient and his stable clini-
cal status, our primary goal was salvage of BKA to better
support ambulation with a prosthesis in the future.

Six weeks after positive fungal cultures from our patient’s
initial revision surgery, the fungus was identified as *humicola*
species by DNA sequencing at an external laboratory. A few
days later, the wound sites exhibited healthy granulation
tissue (Fig. 2). Wound cultures confirmed resolution of
the fungal infection at the knee wound, and split-thickness
skin grafting was deemed an appropriate reconstruction
due to absent exposed bone or tendon. Split-thickness skin
grafting was performed at the knee wound, and the stump
wound underwent definitive closure. The patient has fol-
lowed up for outpatient wound care and antifungal therapy
and is being fitted for a prosthesis (Fig. 3).

**DISCUSSION**

High index of clinical suspicion is essential to promptly
diagnose trauma-related IFI and prevent significant mor-
bidity and mortality. Treatment of IFI is often delayed due
to low clinical suspicion afforded to previously immuno-
cOMPETENT patients followed by protracted confirmational
laboratory testing. According to the Trauma Infectious
Disease Outcomes Study Investigative Team, the diagnostic criteria for trauma-related IFI include (1) presence of traumatic wound(s), (2) recurrent necrosis following serial surgical debridements, and (3) laboratory evidence of fungal infection. In our case, a rare fungus necessitated DNA sequencing at an external laboratory over the course of 6 weeks. We suggest initiating aggressive IFI treatment with ongoing wound necrosis after two surgical debridements. Three pillars of IFI management include (1) prompt and aggressive surgical debridement, (2) limiting immunosuppressant therapies, and (3) empiric dual antifungal therapy (amphotericin B and broad-spectrum triazole). Aggressive surgical debridement is defined as debridement beyond the area of gangrenous demarcation every 24–48 hours until there is no further evidence of necrosis. Angioinvasive potential is an important indicator for aggressive surgical debridement, as these mycoses often extend beyond visible infectious wound demarcations. Debridement is also an essential adjunct to systemic antifungal therapy to improve wound penetration in the setting of local border ischemia. Wound closure should be delayed until the wound is clean and granulation tissue is evident.

Healthy and immunocompetent patients who undergo traumatic injury are at risk for trauma-related IFI. Trauma leads to cortisol-dependent immunosuppression, and patients can also experience transfusion-related immunomodulation. In a case-control study investigating IFI arising from combat casualties in Afghanistan, 97.2% of cases had been treated with massive blood transfusion. This consequence is dose-dependent, with a 5% increased risk of infection for each unit transfused.

To date, little is known about the effectiveness of antifungal medications in treating trauma-related IFI. Plasma drug concentration is the primary indicator for monitoring treatment efficacy. In a case series describing two patients with trauma-related IFI, Akers et al found amphotericin B to be undetectable in wound effluent collected by NPWT despite high concurrent plasma concentrations. Thus, it is imperative that surgical and infectious disease teams collaborate to develop comprehensive, multidisciplinary treatment plans.

**CONCLUSIONS**

Clinical management of trauma-related IFI has adopted increasingly aggressive approaches with respect to its substantial morbidity and mortality rates. We present this case in hope of instilling a high index of clinical suspicion and to discuss surgical management of trauma-related IFI.

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