Heterotopic Ossification as a Secondary Cause of Wounds in the Combat-Related Amputee

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Introduction
Heterotopic Ossification (HO) is the formation of lamellar bone in non-bone tissue. In the combat-related amputee population, the prevalence of HO is 64%, well over the reported civilian rate of 4% to 25%. Risk factors for HO formation include blast mechanism of injury, lateral, anterior, and posterior thorax wounds, soft tissue injury, associated extremity and amputee amputations. The blast wave causes damage to the periosteum and subcutaneous connective tissue, allowing bone formation. Unlike in the civilian population, HO in the combat-related amputee is prone to development of wounds related to HO formation and growth, particularly in areas beneath afflicted patients. Following initial revision and definitive closure, HO excision surgery with amputation revision is required in up to 41% of patients. As many as 41% of patients require a technically difficult surgery to excise the HO and revise their amputation at 6 months postinjury. Wound maintenance prior to surgery or at best tenuous wound closure is the goal prior to the definitive excision surgery. However, with excellent wound care and good socket fit, most patients are able to avoid further surgery due to the definitive management of HO in the combat-related amputee population. Other measures that are taken to reduce the incidence of HO include the use of celecoxib as a prophylaxis. Current research is aimed at identifying biomarker and HO therapy-based prognostication and gene therapy for the treatment of HO. The primary reference for this presentation is the article "Heterotopic Ossification in Wartime" by Forsberg, JA; Potter, BK.  Heterotopic ossification in wartime extremity. J Orthop Traumatol. 2012;13(4):264-274. The importance of the care of Wounded Warriors is mirrored by the care of the returning combat-related amputee. Acknowledgements: We wish to thank the military medical centers of the United States Army, Navy, Air Force, and Marine Corps for their tireless efforts and dedication to the care of Wounded Warriors. We also wish to thank the Wounded Warrior Project and all of our Wounded Warriors and employee of the United States government and agency employees as part of that person's official duties. As many as 41% of patients require a technically difficult surgery to excise the HO and revise their amputation at 6 months postinjury. Wound maintenance prior to surgery or at best tenuous wound closure is the goal prior to the definitive excision surgery. However, with excellent wound care and good socket fit, most patients are able to avoid further surgery due to the definitive management of HO in the combat-related amputee population. Other measures that are taken to reduce the incidence of HO include the use of celecoxib as a prophylaxis. Current research is aimed at identifying biomarker and HO therapy-based prognostication and gene therapy for the treatment of HO. The primary reference for this presentation is the article "Heterotopic Ossification in Wartime" by Forsberg, JA; Potter, BK.  Heterotopic ossification in wartime extremity. J Orthop Traumatol. 2012;13(4):264-274. The importance of the care of Wounded Warriors is mirrored by the care of the returning combat-related amputee. Acknowledgements: We wish to thank the military medical centers of the United States Army, Navy, Air Force, and Marine Corps for their tireless efforts and dedication to the care of Wounded Warriors. We also wish to thank the Wounded Warrior Project and all of our Wounded Warriors. References: 1. Davis TA, et al.  Extensive bone formation in severely injured extremity combat wounded: a heterogeneous cohort. J Orthop Traumatol. 2016;17(2):50. 2. Dart J, et al.  Association of HLA haplotype with heterotopic ossification in high-energy penetrating war injuries. J Orthop Traumatol. 2012;13(1):1-7. 3. Forsberg, JA; Potter, BK.  Heterotopic ossification in wartime extremity. J Orthop Traumatol. 2012;13(4):264-274. The importance of the care of Wounded Warriors is mirrored by the care of the returning combat-related amputee. Acknowledgements: We wish to thank the military medical centers of the United States Army, Navy, Air Force, and Marine Corps for their tireless efforts and dedication to the care of Wounded Warriors. We also wish to thank the Wounded Warrior Project and all of our Wounded Warriors.

Wound Characteristics Associated with HO:

- Superficial, Pale, Chronic Granulomatous Tissue
- Critical colonization
- Focal areas need to be packed
- Responds well to sharp debridement
- Wound dressings used commonly:
  - Hydrofibers (+/- silver)
  - Foam
  - Monomer
  - Hydrogel
  - Hydroductive dressings
- Adjunct modalities very helpful
  - UV-C lamp
  - MIST ultrason

Case 2: A 23 year old Airman with bilateral TFA. His wounds were treated for several months prior to eventual closure. He had severe HO and underwent amputation revision and HO resection due to inactivity in amputological pain. Ten days postoperatively, he developed an infection in the left leg and several debridements in his anterior and posteriorly. He had moulage wound care pre and postoperative. After HO resection and revision, he was finally able to progress with amputological rehabilitation and use his prosthesis for ambulation without pain and ulceration.

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Mild HO

- Wound after Excision
- HO as a result of HO
- Adjunct modalities very helpful
- • Responds well to sharp debridement
- • Focal areas need to be packed
- • Adjunct modalities very helpful

Moderate HO

- Wound after Excision
- HO as a result of HO
- Adjunct modalities very helpful
- • Responds well to sharp debridement
- • Focal areas need to be packed
- • Adjunct modalities very helpful

Severe HO

- Wound after Excision
- HO as a result of HO
- Adjunct modalities very helpful
- • Responds well to sharp debridement
- • Focal areas need to be packed
- • Adjunct modalities very helpful

Conclusions
HO development and maturation in residual limbs presents unique challenges for wound care and rehabilitation providers. Large areas of exposed osseous tissue can predispose to HO formation and growth, particularly in areas beneath afflicted patients. The subsequent wound was packed with an absorptive dressing and was closed within a few weeks. He did not require major operative resection of his HO.

References: