Media Blasting: An Unwanted Source of Dermabrasion and Tattooing

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Objective:

Upon completion of the lecture, attendees should be better prepared to:

- Describe the various types of blasting media, anticipated degrees of dermal and soft-tissue trauma, and potential associated risks of systemic complications and risk for traumatic tattooing
- Describe the various modalities for management of traumatic tattooing, and the pros and cons of each approach for a specific traumatic tattooing case scenario
- Recognize the adverse effects of persistent exposure to various blasting media that can affect peri-operative management

Abstract:

Introduction: Industrial accidents are a major source of morbidity and mortality. According to the 2017 ABA National Burn Repository, from 2008 to 2017, 7.0% of all cases in the database were in an industrial setting, and 12.5% of all cases in the database are work-related accidents. While the majority of industrial setting and work-related burn accidents are related to flame and contact, in addition to electrical exposure, abrasive blasting is a potent under-reported source of friction burn injury. Abrasive blasting is a common industrial process for cleaning and preparation of surfaces characterized by acceleration of blasting media in an air or liquid substrate to high velocities - typical operating pressures are 80 to 110 pounds-per-square-inch (PSI; 551 kPa - 758 kPa). Particle size and composition are variable dependent on application - biologics (e.g. walnut), aluminum oxide, silica, silicon carbide, steel grit, and steel shot are all used, with mean particle sizes from less than 0.05 mm to approximately 2 mm. At close range, given relatively consistent particle velocities, kinetic energy at impact increases proportionally to particle mass, with associated increased tissue penetration and media injection. High pressure injection injuries to the upper extremity resulting in neurovascular injury with functional loss, injection of foreign materials, and even amputation have been reported in the literature. In addition, prolonged work-place exposure to aerosolized particulates may lead to restrictive lung diseases and systemic toxicities. While industry awareness and governmental standards for safety equipment theoretically limit direct and aerosolized particulate exposure, accidents may occur. We report an abrasive blasting accident resulting in friction burns and traumatic tattooing to the face, neck, chest, and bilateral upper extremities along with associated ocular, neck and posterior pharynx injection injuries, and a systematic review of the available evidence for management options and peri-operative considerations.

CASE REPORT:

A 48 year-old Caucasian male with a past medical history significant for hyperlipidemia and esophageal stricture was transferred to a regional burn center following an industrial accident using a media blaster. Per reports the patient was operating a media blaster with steel grit to strip lead paint from a bridge when the hose became disconnected and subsequently sprayed his face, neck, chest, and bilateral upper extremities with particulate under high pressure. At the time of the accident the patient was wearing proper personal protective equipment including safety goggles, which became dislodged from the force of the propelled material. On exam he was found to have 11.42% TBSA superficial-second and deep-second degree friction burns to the face, neck, chest and bilateral upper extremities. There was significant injection of metal particulate throughout these burns and metallic foreign bodies were appreciated in the bilateral eyelid, conjunctiva, and corneas. Maxillofacial computed tomography revealed innumerable metallic foreign bodies scattered along the superficial soft tissue of the face, neck, bilateral nasal passages, oral cavity, posterior oropharynx, and adjacent to the carotid bifurcation. Given facial and oropharyngeal edema and media injection, he required intubation and ventilation in the intensive-care unit, and fibroscopic evaluation, and was extubated post-injury day 7. Surgical subspecialists from otolaryngology, vascular surgery, and ophthalmology assisted in management. Ophthalmologic intervention included bilateral globe exploration and metallic foreign body removal of the eyelid, conjunctiva, and corneas. Selective dermabrasion and mechanical debridement of the face, neck, ears, chest, and bilateral upper extremities measuring approximately 2715 cm2 was performed. Wound care occurred daily with dressing varying by location: edema gloves for hands and digits; bacitracin/polymixin B ointment, bismuth-impregnated petrolatum gauze, with cotton gauze and elastomer wrap to the extremities, burn gauze to torso; and petrolatum ointment to the face and ears three times daily. He was discharged to home on post-burn day 13 with visiting nurse services for assistance in managing wound care. Although none of these burns required grafting there continues to be significant tattooing and ultimately he may require future dermabrasion.

SYSTEMATIC REVIEW METHODS: To assess the outcomes of various methodologies of management of traumatic tattooing, in particular related to what is occasionally referred to in the literature as explosive traumatic tattooing (i.e. non-abrasive material transfer), we performed a systematic review in May 2018 using multiple databases of Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE Ovid, MEDLINE In-Process & Other Non-Indexed Citations, EMBASE Ovid, and PubMed. We included studies regardless of publication status. We included all studies regardless of language as able. There were no limits to types of participants or types of intervention. Intervention types were classified as radiation (e.g. laser), surgical, or dermabrasion, taking note of the degree of involvement in body surface area, as could be interpreted from available data. Primary outcome was defined as success rate in terms of cosmetically or functionally sufficient outcome.

Results: We identified 77 references through a systematic search and no additional records were identified through other sources. Based on our criteria, 16 potentially

relevant titles were identified and the full-text of these articles were reviewed. In total, 15 studies were included in the review, representing a total of 94 patients. 60% were case reviews. There was a tendency of surgical and dermabrasion approaches prevalent earliest reports in the 1970s, switching to radiation-based therapies in the 1990s to 2000s, with a trend towards dermabrasion techniques in the late 2000s to 2010s. Overall, 91% of patients were managed by radiation therapies, mostly by Q-switched Nd:YAG, but also by Q-switched ruby, erbium:YAG, and CO2. Surgical approaches generally entailed microsurgical excision techniques using provider-formed or commercially available sharp implements. Likewise, dermabrasion techniques included a varied methodology for management. The vast majority of traumatic tattoos reported involved the face. As can be expected given the majority being case reviews, the success rate overall was deemed high. The heterogeneity of the reports was high, and the level of evidence low, being expert opinion if not case studies.

Conclusions: The use of abrasive blasting devices is relatively safe when individuals have received proper operating instructions and are wearing appropriate personal protective equipment. Silicosis, amputations, exposure to loud noises, and functional loss of extremities are all potential occupational injuries sustained while operating abrasive blasting equipment is reported in the literature. There is a distinction in injuries typically occur from abrasive (motor vehicle accidents and road rash) or explosive (gunpowder, fireworks) etiologies resulting in impregnation of foreign, pigmented particles in the dermis and blue or black pigmentation of the skin. Traumatic tattooing associated with abrasive blasting equipment such as sandblasters has not been well reported, and generally falls into the latter category. Management of complex friction burn injuries with traumatic tattooing such as the one documented in this case report involves a multidisciplinary team approach. Patients with burn injuries who have sustained concomitant traumatic injuries should initially undergo resuscitation and stabilization of all life threatening injuries. Following resuscitation and stabilization, it is imperative that a patient undergo immediate treatment of traumatic tattoo injuries to minimize the risk of permanent discoloration and tattooing. Many agree debridement should occur within 24 hours of injury prior to re-keratinization, as was done with our patient. Once the re-keratinization process has begun it becomes much more challenging to manage these injuries. There are several different strategies reported in the literature for managing these injuries as reflected in over 50 years of clinical management, if not more. Each management strategy comes with a unique constellation of risks and benefits. The effectiveness of each modality ultimately depends on the type and size of the injected particulate, and it is easy to envision a spectrum of management along the spectrum of particle distribution, with laser therapy and dermabrasion effective for smaller particles, surgical excision effective for large particles, the likely cut-off around 0.25 to 0.5 mm. However, given cost economics, increasing distribution will favor enmasse methods of management. Further study is needed into the tissue responses to traumatic tattooing at differing levels of penetration with differing materials, and the clinical aspects comparing aesthetic and functional outcomes with different

	management paradigms. Regardless of final management, it is clear and agreed upon in the available literature that early management of traumatic tattooing should always consist of mechanical debridement and copious irrigation to remove gross particulate matter. Delay in therapy, beyond 24 hours, results in increased risk of scarring and residual pigmentation that lead to aesthetic complications and patient dissatisfaction. **References and Resources:** Iverson PC. Surgical removal of traumatic tattoos of the face. Plastic and Reconstructive Surgery, 1947, 2(5):427-32.
Disclosure:	Philip D. Hewes – No Relevant Financial Relationships to Disclose Nicole C. Toscano – No Relevant Financial Relationships to Disclose Diana Stephens – No Relevant Financial Relationships to Disclose Derek E. Bell – No Relevant Financial Relationships to Disclose