

## Expert's comment concerning Grand Rounds case entitled “Pure distraction injury of T1–2 with quad fever” by Jun-Yeong Seo et al. (Eur Spine J [2017]: doi:10.1007/s00586-017-5232-2)

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This is a well-written case report and literature review describing a T1–T2 distraction and spinal cord injury (SCI) in a 52-year-old male [1]. The paper highlights many of the challenging aspects of diagnostics and treating postoperative fever in a patient with a cervical level of neurologic impairment. The authors focus on quad fever, which represents a rare condition of prolonged body temperature elevation above 40 °C in tetraplegic patients once all potential sources of fever and infection have been ruled out.

Fever occurs frequently among patients with SCI and often constitutes an early sign of underlying morbidity. McKinley et al. [2] reported an incidence of fever of 60.4% during acute care and 50% during rehabilitation. Several

medical conditions secondary to SCI, as well as preexisting risk factors, predispose patients to both infectious and non-infectious etiologies for fever. Respiratory infections and urinary tract infections represent the most frequent causes. Other common infectious etiologies following SCI include decubitus ulcers, wound infection, and osteomyelitis. Non-infectious etiologies include thromboembolism, heterotopic ossification, thermoregulatory dysfunction, and medication-related fevers. In practice, the exact cause of fever is sometimes difficult to establish, since concomitant infections, rapidly resolving viral infections, or transient thermoregulatory dysfunction might occur at the same time.

Thermoregulation and fever are primarily mediated through the hypothalamus and its effector mechanisms. In patients with complete SCI above T6, neuronal pathways to and from the hypothalamus are interrupted, and the sympathetic dysfunction lead to an inability to self-regulate internal body temperature (poikilothermia) [3]. Patients with cervical or upper thoracic levels of neurologic impairment present an increased risk for either hyperthermia or hypothermia. The exact pathophysiology of quad fever remains unclear, but it could be attributed to the autonomic dysfunction. Goyal et al. [4] described high spiking and persistent fever with no obvious evidence of infection in one patient with SCI. The outcome in this patient was relatively benign. On the other hand, Ulger et al. [5] described a fatal course of quad fever in five younger patients with cervical SCI who had no significant previous comorbidities. Therefore, clinicians should be aware of quad fever, as one potentially life-threatening non-infectious cause of temperature dysregulation.

In the current case report, an immediate work-up of infectious, as well as non-infections, metabolic, and drug-related causes are well described. The treatment of this

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unexplained fever included antipyretics, intravenous cold fluids and ice packs. Empirical antibiotics were administered as no infectious agent was identified within the first 3 weeks [1]. Additionally, volemic expansion and vasoconstrictors (noradrenaline, dopamine) are usually recommended in patients with SCI, ideally aiming for a mean arterial blood pressure of 85 mmHg and a systolic blood pressure of 120 mmHg [6]. In this case, neurogenic shock and high fever led to severe drops in blood pressure, which made hemodynamic management particularly difficult and might have led to a lethal outcome as described by Ulger et al. [5].

In the present case, SCI was associated to thoracic trauma including a hemothorax and multiple rib fractures. This condition might be qualified as a polytrauma. In polytrauma patients, the prevalence of non-infectious systemic inflammatory response syndrome is high, which might have played an additional role in this patient. Lindner et al. [7] reviewed the systemic inflammatory response syndrome of 256 validated polytrauma patients in an intensive care unit. Among their patients, 33.2% developed a secondary sepsis. This frequent complication occurred in the presented case, since urine cultures evidenced *Candida tropicalis* 3 weeks after trauma. Furthermore, *Enterococcus* and *Streptococcus* were identified in the blood cultures later on, leading to a secondary septic decompensation, although no infectious cause of fever was previously evidenced. It should be kept in mind that course of an apparently non-infected polytrauma patient has a high chance of developing a secondary sepsis. Therefore, clinical investigations tracking a germ need to be repeated.

In polytrauma patients, timing of spinal stabilization is a critical issue and a damage control strategy might be considered in certain situations. All lesions and the hemodynamic situation need to be taken into account. Whenever possible, the spine should be stabilized within 48 h. Early management of the spinal trauma improves respiratory function, and reduces mechanical ventilation time, secondary pulmonary complications and mortality [6, 8, 9]. Furthermore, thoracic trauma needs to be considered carefully. In the present case, no secondary pulmonary infection occurred although the patient presented a significant thoracic injury, and regular chest x-rays were performed. Operative management of rib fractures might additionally be considered in flail chest injuries that are often encountered in combination with thoracic spinal injuries. A positive effect of surgical rib fracture fixation has been observed for pneumonia rate, duration of mechanical ventilation, duration of intensive care units stay

[10, 11]. In the case of cervical SCI with an initial level of paralysis at C8, the benefit of such techniques might be limited since accessory respiratory muscles are paralyzed. Prolonged positive-pressure ventilation is usually indicated in these patients.

In conclusion, this is an informative case, which evidences the rare but potentially life-threatening condition of quad fever in a tetraplegic patient. The steps of clinical and diagnostic work-up as well as therapeutic measures are well presented and might be helpful for the practice of spinal surgeons and intensive care specialists in trauma centers.

#### Compliance with ethical standards

**Conflict of interest** None of the authors has any potential conflict of interest.

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