

Hot Air Sauna Burns and Coma Resulted from Fentanyl Patch Overdose

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Summary

A 48-year-old man with attention deficit disorder, obesity, sleep apnea and a previous history of addiction to amphetamine was admitted with 4% burn injury in the Emergency Department (ER) after he was found unresponsive in a hot air sauna. On his arrival on ER the patient was drowsy and confused (Reaction Level Scale-RLS 3), but responds to strong stimulation. He was intubated and required intensive care treatment. Opioid toxicity was suspected and the examination revealed a 100 µg/h Fentanyl patch on his right shoulder. The exposure to heat is known to increase the rate and extent of opioid delivery in patients with transdermal fentanyl patches. The unconsciousness caused by fentanyl overdose, the immobility and the prolonged exposure to hot air resulted in full-thickness burns. The heat exposure associated with hot air sauna resulted in an extremely complex injury with full-thickness skin damage and deep tissue destruction. The burn injuries required several surgical interventions with debridement, allogenic skin graft, dermal substitute and local flaps. This case report highlights the risk of overdose associated with fentanyl patches, but also the challenges associated with burn treatment in patients exposed to hot air sauna.

Background

According to the new recommendations of opioids prescription, there is no place for the use of transdermal fentanyl in the patients with chronic non-malignant pain [1]. In practice it is occasionally still used by some pain management specialists due to the advantages of delivering a steady dose and improving patient compliance. However, intoxications with large fatal outcomes have been widely reported in the literature. Wearing a fentanyl patch under heat sources such as heating pads, electric blankets, saunas, heated waterbeds, hot baths or sun bathe may increase the amount of fentanyl that reaches the blood and can cause life-threatening breathing problems and death. Burn injuries associated with hot air sauna are rare [2] but associated with complex injury with deeper tissue destruction [3].

Case Report

Written informed consent was obtained by the patient for publication of this case. We present the case of a 48-years-old Caucasian male patient who suffered severe burns by falling unconsciousness in a hot sauna. In past history amphetamine abuse, Attention Deficit Disorder (ADD) treated with dexamphetamine, depression, obesity, sleep apnea. About 7 years ago received initially weak opioids for treating of right hip pain related with arthrosis. The opioids doses escalated and after gastrointestinal bleeding due to duodenal ulcers in 2016 he received fentanyl patches. Unfortunately, he failed to reduce his consumption and after a duodenal switch operation in 2016 he continued to use for his hip pain relatively high doses fentanyl patches 100µg/h. One year later, the patient was found unresponsive in hot air sauna with a fentanyl patch applied on his skin. It was unclear how long time passed until

the patient was found unconsent Upon arrival in the emergency department the patient displayed signs of opioid overdose (pin-point pupils, hypoventilation, respiratory frequency 8/min, saturation 86%, hypoxia PaO₂=7.4 pKa). The patient was drowsy and confused (RLS 3), but responds to strong stimulation. Laboratory test showed an impaired renal function with creatinine 174 mmol/L, GFR=40 mL/ml/1,73, rhabdomyolysis with myoglobin 3000 ug/L and metabolic acidosis (BE=-6.3, Lactate=6.2 mmol/L). Urine drug test was positive at admittance for opioids and amphetamine. RLS 3/8). His core temperature was 39.2 °C due to accidental hyperthermia. The patient was intubated in emergency department and underwent CT which couldn't revealed other injuries. Clinical examination revealed burns covering 4% of Total Body Surface Area (TBSA) with a mixed depth accordingly. Superficial dermal burns on the neck (0.75% TBSA) back (3,0% TBSA) and trunk (0,25% TBSA). Deep dermal burns were seen on the skull 025% TBSA. The patient was moved to the burn unit for demarcation of the burns and was treated with dressing changes every other day. As anticipated with hot air sauna burns, his burns developed into full thickness skin burns and after six days the burns were clearly demarcated. Necrotic areas were excised down to the fascia on the neck, back, skull, and abdomen. All burns were grafted with split thickness autologous skin grafts. The skin grafts on the scalp, the neck and back became infected with staphylococcus aureus and a majority of the grafts were lost. The patient was put on antibiotics and underwent dressing changes daily. Nineteen days after the injury further revision of the burn wounds was performed on the scalp, back and neck. In addition, parts of the trapezius muscles were removed due to necrosis and covered with split thickness skin grafts. On the scalp the tabula externa was removed and covered with dermal

substitute (Nevelia®). The patient was discharged after 30 days and planned for a third operation to cover the dermal substitute on the scalp with split thickness skin graft. However, the dermal substitute was accidentally removed and the patient received a double rotation flap to cover the defect. In regular follow ups during 18 months the patient showed good skin quality and was not in need of any additional treatment. The patient complained during hospitalization of severe pain to the sites of injury and Acute Pain Services were contacted. He received opioids, for his nociceptive pain and antiepileptic, anti-depressive medication for his neuropathic pain. On discharge he was prescribed opioids and adjuvants and followed by Transitional Pain Services. His regimen failed to improve his persistent pain and three years after burn injury he received opioid substitution with buprenorphine 16 mg/day.

Discussions

Despite widespread use, fentanyl patches are not without risks. Several cases in literature highlighted fentanyl overdoses complicated with coma, respiratory depression and burns after exposure to sun [4], warming blanket [5] or hot bath. This is the first case indicated the potentially serious effects of transdermal fentanyl from hot air sauna. The exposure of the skin to the hot air induces increased drug release from the dosage form, increased drug permeation into and across the skin, increased skin perfusion with elevated systemic absorption of fentanyl into systemic circulation [6]. The temperature in the sauna room is usually 80–90 °C (176–194 °F) but often exceeds 100 °C (212 °F) [2]. The absorption of fentanyl in warm baths increases with 180%, and is considered that in hot air sauna the concentrations exceed this percent. (references) Although we did not measure fentanyl plasma concentrations, we believe that this mechanism was responsible for the observed symptoms of opioid overdose in this patient, together with his associated conditions (obesity and sleep apnea). Adding water to the hot stones of the oven produces steam, which replaces the air in the sauna [7].

Thus, unconsciousness after hot air may be because of decreased oxygen content in the air related with this mechanism of producing steam. However, this is not likely in the case, as much higher temperature is required to decrease oxygen. While the time until the patient was found unconscious in sauna was not known, the period recorded in other studies was 30 minutes to 1 hour [3].

In comparison with the general population, higher rates of substance abuse, misuse were seen in the patients with burn injury [8,9,10,11]. Substance abuse in burn injury patients was reported to be an aggravating condition in patients' recovery. This was true for our patient who required started from the burn injury, continuously monitoring of his opioid's intake with multiple follow-ups from Pain Clinic and then Addiction Center.

Typically, the burned hot air sauna areas are localized on the parts of the body that are directly exposed to hot air, in this case with unconsciousness and immobility caused by fentanyl overdose [3]. Although hot air sauna burns are small injuries with %TBSA estimated to vary between 3 and 32% [12,13], the patients have higher mortality when compared with similar sized flame burns [12]. Similar with electrical injuries, these are severe burns, that cause damage of the subcutaneous tissue and even deeper tissue destruction to the affected area that leads to rhabdomyolysis [12]. The patient displayed a small

burn injury on arrival, but he developed rhabdomyolysis and had severe deep tissue destruction that required prolonged medical and surgical treatment. The burns encountered in this patient, especially in the neck and skull, extended far beyond the visible cutaneous areas to subcutaneous fat and muscles. Previous studies found similar pattern of hot air sauna burn injuries [13,14]. The same authors recommended as surgical treatment of choice, pedicled flaps harvested from contralateral side of the body as the blood flow is unaffected, and not free flap which may failed due to deficient blood supply [13,14].

Because opiates have profound immunomodulatory effects, it is likely that treatment with long term opioids is associated with increased infection rates [15,16]. It is possible that long term opioid treatment in this case has acted synergistically with immunosuppression from burn injury and contributed to the development of postburn infectious complications that demanding several surgical interventions and long time to recover this patient.

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