Case Report

Thermal injury from forced-air warmer device precipitated by massive extravasation from peripheral venous cannula

ABSTRACT

Extravasation injury (EVI) is an iatrogenic complication of venous cannulation. Usually innocuous but occasionally it engenders sequelae. Its severity is determined by various physicochemical properties of infusate. A 50-year-old patient developed leg EVI from crystalloids infused through a pressurized digital infuser (PDI), likely from cannula tip displacement during positioning for craniotomy. We ignored checking gravity-aided free-fluids flow before switching on PDI. Following surgery, the patient had an edematous leg with bullae and epidermal peelings from severe extravasation and burns, respectively. Doppler revealed patent leg arteries. Therefore, EVI was conservatively managed, with complete recovery. Apparently, increased local tissue pressure from extravasation produced conditions of peripheral circulation sufficiency predisposing the leg to thermal injury from the forced-air warmer. On inspecting PDI postoperatively, its upper-pressure alarm limit was 300 mmHg, which prevented it from sounding alarm during extravasation.

Key words: Bullae, epidermis peeling, extravasation injury, forced air warmer, pressurized digital infuser

Introduction

Peripheral venous cannulation is a prerequisite for administering general anesthesia (GA). Occasionally, extravasation from the cannula into the surrounding tissue may happen. Extravasation incidence under anesthesia remains elusive, although in hospitalized patients, the reported incidence is 10% to 30%.[1] Its severity depends upon many physicochemical characteristics of infusate like pH, osmolality, cytotoxicity and vasoactivity, and infusion pressure. The clinical course of EVI is generally innocuous,[2] although serious complications may result rarely.[3]

Inadvertent hypothermia under GA adversely impacts patient outcomes. A fluid warmer integrated into a digital pressure infuser (DPI) effectively counteracts hypothermia by infusing warm fluids at an adjustable rate and pressure. Concomitantly using forced air warmer device (FAWD) bolsters DPI to combat hypothermia. Manufacturers advice against the use of FAWD in peripheral ischemic conditions (PICs) to prevent burns. Nevertheless, even without ischemic pathology, massive extravasation by increasing local tissue pressure may cause vascular compression, thereby, creating conditions similar to PIC. Therefore, the affected extremity might become vulnerable to a thermal injury (TI) from FAWD.

We present a patient who suffered TI from the FAWD, apparently from PIC prompted by large extravasation.

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Parmod K. Bithal, Ravees Jan, Mohammed M. Kalou, Mohammad S. Bafaquh[1]

Departments of Anesthesiology and Perioperative Medicine and [1]Neurosurgery, King Fahad Medical City, Riyadh, Kingdom of Saudi Arabia

Address for correspondence: Dr. Parmod K. Bithal, 5/28, IInd Floor, Sarvapriya Vihar, New Delhi - 110016, India.
E-mail: bithal.parmod@gmail.com

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Case Report

A 50-year-old, 75 kg American Society of Anesthesiologists II, nonsmoker male, was scheduled to undergo brain tumor resection. An 18-G cannula inserted in the left hand was used for inducing GA. Another 16-G cannula was inserted in the right leg immediately above the ankle, after confirming free backflow of blood. Invasive BP monitoring (radial artery), besides routine monitoring, was instituted. Legs were wrapped in an intermittent pneumatic compression device (IPCD). Patient was positioned for craniotomy. The 16-G cannula was connected to a DPI set at 41°C, without verifying gravity-aided free-fluids flow to preclude cannula displacement from patient movement during positioning. The 18-G cannula acted as a carrier for continuous delivery of fentanyl and rocuronium along with fluids infusion. Whole body warming blanket was connected to the hose of FAWD set at 43°C. The surgical procedure of 6 h was uneventful, without any hemodynamic perturbations. He received 4.2 L crystalloids (2.5 L through DPI and 1.7 L from the carrier). No mannitol or vesicant agent was infused. Blood loss and urine outputs were 400 mL and 2.5 L, respectively. Following surgery, the patient undraping revealed bullae just above the right ankle. IPCD and cannula were removed immediately. The calf muscles were edematous, tense, with multiple bullae, and peeled off epidermis from TI at multiple sites [Figure 1]. Even gentle leg palpation would peel off epidermis. A pulse oximeter was applied to the right big toe, which showed an absent pulse with difficulty to palpate dorsalis pedis artery. Capillary refill time in toes exceeded 4 s (grade 4 extravasation).[4]

The leg was elevated by placing pillows underneath. Suspecting compartment syndrome, vascular, plastic, and general surgeons were summoned urgently. Doppler detected satisfactory signals from all the right leg arteries. Therefore, the consensus was conservative management. Approximately 15 min later, the pulse reappeared with 100% SpO_2. Following the application of antibiotic ointment, the leg was crepe bandaged. After extubation, he was transferred to the neurointensive care unit. On inspecting the DPI, its upper-pressure alarm limit was 300 mmHg. The patient's leg healed completely and he was discharged after 7 days.

Discussion

Iatrogenic EVI from venous cannula is common.[5] Nevertheless, only major extravasation event produces a catastrophe.[3] Extravasation results from many factors.[6] By far, its most frequent cause is accidental dislodgement of improperly secured cannula, especially with patient movement during positioning. The full effect of the major EVI may not manifest immediately but over days, even with cytotoxic drug infusion. Early local symptoms even from vesicant extravasation resemble those of irritant extravasation: local pain, erythema, burning, pruritus, or swelling.[7]

Figure 1: Leg showing bullae and epidermis peeling from thermal injury

Since hypothermia is a common complication of anesthesia, to counteract it an active warming strategy, like using FAWD, is recommended.[8] Although extremely uncommon, FAWD has produced burns under anesthesia from misuse of this system called "hosing," that is, using the device hose without blanket attachment and focussing the hot air onto one body area.[9] Besides hosing, poor peripheral tissue perfusion is recognized as another potential risk factor for TI with FAWD. Hence, the manufacturers warn against its use in such conditions from any pathology.

Our patient had extravasation most probably from a displaced cannula tip when we moved him for positioning. We cannot surmise the volume extravasated because the cannula was hidden under the drapes. In a displaced cannula, gravity-aided fluid flow into the vein either ceases completely or becomes extremely slow-catching, thereby, attention of anesthesiologist. Since we were using DPI, flow rate remained unaltered because its upper-pressure alarm limit was extremely high, at 300 mmHg, which we noticed subsequent due to the mishap. Therefore, DPI never sounded alarm. Hypovolemia from such massive extravasation in conjunction with surgical bleeding and fluid losses would also have raised red flag from hemodynamic disturbances. However, both insignificant blood loss and simultaneous fluids administration through the carrier line averted hemodynamic instability. We believe that such huge extravasation by increasing local tissue pressure compromised

peripheral arterial circulation producing conditions similar to PIC, thereby, causing TI from FAWD. The mainstay of EVI treatment is prevention, beginning with identification of the potentially risky situations.[10]

In conclusion, when using DPI, we must check gravity-aided free-fluid flow to exclude cannula displacement after patient positioning, especially when cannula is concealed from view. Importantly, set the upper-pressure alarm limit of DPI to a low threshold. When in suspicion, go under the drapes for a look. Furthermore, if the cannula is under the IPCD, the latter should be periodically unwrapped and limb inspected.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the journal. The patient understands that his name and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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