The need for multiple vascular access or preemptive central venous catheterization in patients requiring planned interhospital helicopter transport: a flight doctor's suggestion

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Hemorrhagic shock can develop due to severe bleeding, such as after major trauma, postpartum or gastrointestinal bleeding. At least two peripheral intravenous routes with large-bore catheters are recommended to reverse hemorrhagic shock, and such functional intravenous routes are essential for the proper management of other concurrent diseases as well. Conditions during helicopter transportation are different from those seen in-hospital, and the primary concerns are to maintain aseptic conditions, protect patient's privacy, and prevent infection risk, especially during pandemics, such as the ongoing COVID-19. Herein, I describe two recent experiences of improper management during helicopter transport due to intravenous line malfunction. Subsequently, based on my experience, I suggest the use of multiple intravenous routes or preemptive central catheterization in patients requiring helicopter transportation.

Key Words: Intravenous administration, Central venous catheterization, Aircraft, Air ambulances

Introduction

Hemorrhagic shock can develop secondary to severe bleeding, such as after major trauma, postpartum or gastrointestinal bleeding, and at least two peripheral intravenous (IV) routes with large-bore catheters (>18 gauge) are recommended for correcting hemorrhagic shock (1,2). Typically, critically ill patients can be transported by air ambulance equipped with medical devices, including cen-

tral or peripheral IV catheters. However, in-flight conditions are different from those encountered in-hospital, and the primary concerns are to maintain aseptic conditions, patient's privacy, and infection risk, especially during pandemics, such as the ongoing coronavirus disease-2019 (COVID 19). Herein, I describe my recent experience from two cases of improper in-flight patient management due to IV malfunction, and subsequently suggest placement of multiple intravenous routes or preemptive central cathete-

Fig. 1. (A) Patient image, Case 1. (B) A peripheral intravenous line that had been established at the local hospital was removed while the patient was waiting for the helicopter (red arrow). Another IV line (new one) had to be removed again (yellow arrow) in-flight.

rization to interhospital transfer cases before a patient is transported by helicopter.

Case presentation

Case 1

A 52-year-old male suffered traumatic subarachnoid and subdural hemorrhage after falling from a height of 3 m. Vital signs were initially stable, but the primary physician decided to transfer the patient to a level I trauma center due to the possibility of worsening mental status, and thus requested helicopter transportation. At the rendezvous point, the patient's consciousness was evaluated as E3V2M6 on the Glasgow Coma Scale, and thus was not intubated. His COVID-19 status was unknown. The patient had no IV access throughout his transportation to the hospital because it had been removed due to patient irritability (Fig. 1). Another IV line was established on his left hand but was removed after take-off because of patient irritability as well. Therefore, another attempt was made to establish IV access but was not successful due to multiple reasons, including limited cabin room, uncooperative patient, fogging of goggles, etc. The flight nurse tried to remove the goggle but it was left in place due to safety concerns. The patient's mental status progressed to a stupor (E2V2M5), and repeated evaluations indicated increased amount of intracranial hemorrhage. Consequently, the patient was operated accordingly.

Fig. 2. Patient image, Case 2. Two peripheral intravenous lines were established on his left arm. The line (red arrow) in his shoulder malfunctioned in the field, whereas the other (yellow arrow) one became nonfunctional afterward. Intravenous access attempts were not easy to make due as splints had been applied to all extremities.

Case 2

A 20-year-old male fell from the 10th floor, resulting in traumatic epidural hemorrhage, right pneumothorax with lung laceration, liver laceration, fractures of the pelvic bone and L2, and multiple extremity fractures. The patient was intubated at the primary hospital. Two peripheral IV lines were placed on his left arm, and two packs of red blood cells were provided at the rendezvous point (Fig. 2). Splints were applied in all extremities. However, the IV line on his shoulder was not functional at the rendezvous point, and the functional line on his hand failed due to

clogging soon after take-off. Multiple attempts to establish IV access failed. Transfusion could not be performed, and the patient progressed to grade III hemorrhagic shock. As peripheral line access could not be re-established at our emergency department, two central catheters were inserted under ultrasonography guidance. Massive transfusion was initiated after catheterization, followed by embolization and surgery.

Discussion

Central catheterization is not typically used as the first treatment option for hemorrhagic shock resuscitation because of its lower flow rate compared with that of peripheral catheters, except for multilumen access catheters (3-5).

Critically ill patients or patients with time-sensitive conditions—major trauma, acute coronary syndrome, and acute stroke—are typically transported by helicopters equipped with various devices and medications. However, in-flight conditions are bound to have certain disadvantages—limited space, severe vibration, and difficulty in maintaining aseptic conditions and patient privacy during procedures. Moreover, as the right side of the patient is in contact with the cabin wall, procedures, such as thoracostomy or central catheterization on that side, are practically not possible (Figs. 1 and 2). Furthermore, it is far from easy to maintain aseptic conditions when performing invasive procedures in an ambulance (Fig. 3) or the flight cabin as strong winds from the rotor wings make the field too dusty. Therefore, it is recommended that all necessary procedures should be performed before the take-off (6,7). In my personal experience, it is better to perform invasive procedures in

Fig. 3. Central catheterization in the ambulance before bringing the patient on-board the helicopter.

the primary hospital while waiting for the helicopter to transport the patient because aseptic conditions can be successfully maintained and the time required to get the patient on-board can be reduced.

The current COVID-19 pandemic situation further complicates helicopter transfer of critical patients as there is no time to obtain results of a positive/negative COVID-19 test. However, the procedures in the limited cabin space can increase infection risk, such as when turning on the heater in winter to facilitate inner circulation of the heated air. For these reasons, helicopter transport of patients with infectious diseases is prohibited according to the operations manual. Other issues faced by in-flight medical personnel include facial shields or goggles that do not fit well with the headgear, and thus result in significant discomfort, fogging of goggles and consequent reduction in visibility that may require removal of protection devices during the procedure (Fig. 4). If the patient has an infectious disease such as COVID-19, medical crews and pilots also become exposed to infections, which can then delay or suspend additional dispatch if the helicopter needs to be quarantined.

As described, failure of establishing IV lines occurs frequently during helicopter transportation, especially during patient transfer from the ambulance into the helicopter cabin. This in turn prevents caretakers from providing necessary management and care to patients, such as sedative agents for intubation or transfusion. As it is not possible to anticipate the removal of preexisting IV lines, I suggest establishing multiple IV access ports or pre-emptive central catheterization at the primary care hospital,

Fig. 4. Helicopter medical crews wear facial shields or goggles along with their mask. However, facial shield or goggles can easily fog up and block the visual field. Moreover, the facial shield may not fit well with the respective headgear.

whenever possible, in patients requiring planned helicopter transport. Furthermore, this suggestion should be limited to interhospital transfer, not transfer from the scene. To the best of my knowledge, a similar recommendation has not been made before. I believe that some experts do not agree with routine central catheterization; however, if the patients described here had been provided access via a central catheter or multiple IV routes, proper and efficient care could have been provided. More importantly, such measures can help prevent spread of infections to the medical crews or the pilots.

Conflict of interest

No potential conflict of interest relevant to this article was reported.

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