Hand Gangrene Following Unsuccessful Cannulation of the Internal Jugular Vein: a Case Report and Literature Review

Paul S. Roettges · Peter M. Murray · David Hill

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Abstract Hand gangrene following vascular cannula placement is uncommon and is usually the result of thrombotic occlusion of an artery. We describe a case of hand gangrene resulting in wrist disarticulation, following multiple unsuccessful attempts at internal jugular vein cannulation in a critically ill patient.

Keywords Venous · Ischemia · Thrombosis · Amputation · Cannulation

Introduction

Cannulation injury leading to vascular compromise of the hand is a known potential complication following peripheral arterial cannulation, and it frequently leads to tissue loss or amputation [19]. Arterial flow compromise from luminal thrombosis might be seen in as many as 25% of hands following radial artery cannulation [5]. Hand gangrene is a rare complication following successful indwelling venous

cannulation in the arm [17]. We report a case of a critical intensive care unit (ICU) patient who developed hand gangrene, resulting in amputation, following multiple unsuccessful attempts at cannulating the internal jugular vein with a 9-Fr hemodialysis catheter.

Case Report

A 78-year-old female with lymphoma, Parkinson's disease, and Lewy body dementia presented to the emergency room with acute mental status changes. Physical examination revealed atrial fibrillation, hyperkalemia, subacute renal failure, left-side pleural effusion, anemia secondary to an acute gastrointestinal bleed, severe acidosis, and acute urosepsis. No vascular abnormalities were noted of the right or left hand upon presentation. The patient was admitted to the medical intensive care unit, where multiple unsuccessful attempts were made at placing a 9-Fr hemodialysis catheter in the right internal jugular vein. Eventually, the left internal jugular vein was cannulated without complications, using ultrasound guidance.

Four hours following the attempts at right internal jugular cannulation, the patient's right hand was noted to be cooler than the left hand. Several hours later, the right hand became blue. The radial pulse was palpable, and the rest of the arm reportedly warm. Initial management of the right hand consisted of elevation and warm compresses.

At 2 days postadmission, the patient's right hand appeared worse and the radial pulse was absent. Hand surgery consultation was obtained. Inspection at this time demonstrated an obvious purplish discoloration of the right hand to the level of the metacarpal phalangeal joints, and multiple areas of petechia coursed proximally over the dorsum of the hand. The palmar aspect of the hand had

Sources of Support None.

P. S. Roettges
Neuroscience Research, Mayo Clinic,
4500 San Pablo Road,
Jacksonville, FL 32224, USA

P. M. Murray (✉)
Department of Orthopedic Surgery, Mayo Clinic,
4500 San Pablo Road,
Jacksonville, FL 32224, USA
e-mail: murray.peter@mayo.edu

D. Hill
Department of Family Medicine, Mayo Clinic,
4500 San Pablo Road,
Jacksonville, FL 32224, USA

obvious areas of full-thickness skin necrosis. No radial or ulnar pulses were palpable, and the digits were cold to touch (Fig. 1a, b). No signal could be demonstrated in the digits of the right hand with pulse oximetry. Examination of the contralateral left arm and hand was unremarkable. Duplex ultrasound exam showed thrombosis of the entire right basilic vein (Fig. 2). The 10 days following admission, the patient developed right hand gangrene (Fig. 3a, b), and at 20 days postadmission, a right wrist disarticulation was performed (Fig. 4). The delay in surgical treatment occurred due to failure of the family to provide consent for the procedure. The patient's postoperative course for the wrist disarticulation wound was uneventful; however, the patient expired on postoperative day 22 due to respiratory failure.

Discussion

Venous gangrene is an uncommon result of venous occlusive disease in a limb. The mechanism is believed to

Figure 2 Ultrasound demonstrating segmental of right basilic vein.

be a result of massive venous outflow obstruction, resulting in a compromise of arterial inflow from the 16- to 17-time increase in intravascular pressure [4]. In the lower limb, this condition is known as *phlegmasia cerulea dolens* and is

Figure 1 a, b Appearance of right hand approximately 24 h following admission to the ICU.

Figure 3 a, b Appearance of the hand at time of hand amputation.

Figure 4 Intraoperative photograph of wrist disarticulation.

characterized by cyanosis, swelling, and pain; it may occur spontaneously in patients with low cardiac output or hypercoagulable states [4]. Deep venous thrombosis (DVT) is uncommon in the upper limb, comprising from 2–10% of all DVTs [3, 6]. Symptoms may include pain, swelling, and paresthesias. Diagnosis can be reliably made with sonography [3, 4]. Gangrene of the hand associated with acute venous occlusive disease of the upper limb is rare, with only 16 cases reported [17]. Factors such as life-threatening illness, diminished tissue perfusion, hypercoagulability, malignancy, and indwelling venous cannulation are believed to play a role [3, 17]. In the review by Smith et al., 16 cases were identified in the literature, with seven of the cases having had peripheral intravenous (IV) placement in the ipsilateral limb [1, 6, 7, 9, 10, 15–17]. One of those cases occurred following successful placement of an ipsilateral subclavian catheter [17]. In our review of these cases, we found that one patient labeled with venous occlusive disease actually had arterial occlusive disease, which would bring the number of previously reported cases of venous gangrene of the hand to 15 [15].

Digital ischemia following arterial cannulation is more common and results from thrombotic occlusion, most commonly seen in the radial artery [13]. Catheter-related occlusion following radial artery cannulation may develop in 25% of patients, but recanalization may occur [12]. Occlusion is also related to the length of time the catheter remains in place [2]. Other factors leading to occlusion include diabetes mellitus, peripheral vascular disease, vasospastic disease, hypercoagulable state, and systemic hypotension [13].

Our current case report identifies a previously unreported mechanism for venous gangrene of the hand: multiple unsuccessful attempts at cannulation of the internal jugular vein. Venous gangrene of the hand or upper limb has been noted in critically ill patients at presentation to the hospital,

or it has occurred following successful placement of an indwelling venous catheter in seriously ill patients [17]. Although the patient in our report was critically ill and suffered from multiple medical problems, our case was unique because of the unsuccessful indwelling catheter placement; therefore, the cannula was not a nidus for the development of clot or emboli. Instead, multiple passes of a large bore catheter were made in the internal jugular vein. Our patient developed extensive venous occlusion of the right basilic vein that led to venous outflow obstruction of the arm and venous gangrene of the right hand.

Hand ischemia treatment following venous occlusive conditions in the upper limb is controversial and only limited experiences are available. The limb should be elevated immediately while further treatment options are considered. If feasible, lysis of clots or thrombectomy should be initially considered. An axillary block with indwelling catheter placement is a consideration to improve vasodilatation and arterial inflow to the hand [12]. Surgical peripheral sympathectomy could be considered if the axillary block was clinically successful in the patient [8]. Johnson et al. and Wheatley and Marx reported the successful use of a 75,000-IU bolus of intra-arterial urokinase in patients with acute or subacute arterial occlusions, but no mention is made of the use of urokinase in acute venous occlusion of the upper limb leading to hand ischemia [11, 20]. More recent literature on extensive limb venous occlusion has reported that higher doses of urokinase (200,000 IU over 4 h followed by continuous infusion of 100,000 IU/h) have been successful after initial infusion of catheter-directed intravenous recombinant tissue plasminogen activator and in conjunction with balloon venoplasty [14]. In the acute deep venous thrombosis state and prior to the development of venous gangrene, low molecular weight heparin IV infusion, with target international normalized ratio of 2.5, is also considered an option [3]. Calcium channel blockers, such as nifedipine in low dosages (30 mg by mouth twice daily), have been shown to be successful in the initial stages of arterial occlusive disorders of the upper limb, but their efficacy in venous obstructive disorders is unknown [12]. Other treatment considerations include hyperbaric baric oxygen treatments, intra-arterial papaverine injections, and corticosteroids, but no prospective data exist to support their use. Unfortunately, in our patient, attempts at salvage were not possible, and wrist disarticulation was necessary.

Upper extremity venous occlusion leading to hand gangrene is a rare clinical entity. A previously unreported phenomenon occurred in our patient, whereby multiple unsuccessful internal jugular vein cannulation attempts likely led to known acute upper limb basilic vein occlusion, ultimately resulting in gangrene of the hand. The patient suffered from multiple medical problems including acute

urosepsis, which has been shown to be associated with *phlegmasia cerulea dolens*, as well as acute venous gangrene of the upper limb [4, 17]. Unfortunately, many patients with multiple medical conditions and upper extremity venous occlusion require amputation of the affected limb and their mortality rate approaches 25% [4, 18]. In patients that require central or peripheral venous cannulation, we recommend against multiple cannulation attempts at the same site and encourage the use of ultrasound-guided central venous catheter placement when feasible.

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