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Case Report Open Access

Accidental Intra-Arterial Injection of Alcoholic Chlorhexidine- Complications and their Management

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Chlorhexidine (CHX), a cationic diacetate or digluconate salt with bactericidal surface-active ammonium compounds, is a disinfectant used every day in health care. Its antimicrobial effects persist because it binds strongly to proteins in the skin and mucosa, making it an effective antiseptic ingredient for hand washing, skin preparation for surgery and placement of intravascular access [1]. It is effective against gram-positive and negative bacteria and has antifungal activity. At low concentration, it also has a bacteriostatic action and is active against certain spores and viruses. The adjunction of alcohol to CHX improves bacteriostatic action and allows reducing CHX concentration. Accidental intravascular administration of disinfectants occurs potentially more frequently than reported. Toxic effects of intravascular alcoholic CHX administration and its anti-toxic treatment are not well described in available literature.

We report here a case of accidental intravascular administration of CHX after approval of his son for publication; the patient died before submission. An 80-years old man was scheduled for a femoro-popliteal bypass surgery. The medical history of the patient included: arterial hypertension, hypercholesterolemia, non insulin-dependent type 2 diabetes, chronic obstructive bronchitis, chronic renal insufficiency, cardiac insufficiency (NYHA Stage II), Parkinson's disease and a Methicillin Resistant *Staphylococcus aureus* (MRSA) infection.

A left arterial radial catheter was inserted before general anesthesia induction. Unintentionally 1.5 ml of transparent alcoholic CHX was injected through this arterial catheter. The patient immediately complained of a burning sensation in the hand. An attempt was performed to draw back the injected solution, but the pain remained unchanged. The arterial line was flushed with saline solution followed by 2 ml lidocaine 1%, furthermore 50 µg nitroglycerin was injected intravenously (IV). Five minutes later, we suspected a vasospasm in the territory of the radial artery, with the thumb and index becoming livid. Sensibility and mobility were conserved at all time. Intraarterial (ia) administration of the α-blocker phentolamine (boli of 1 mg, total 5 mg) diminished the livedo. We then proceeded with the planned surgery. During the operation another arterial catheter was inserted in the above brachial artery and the first catheter was removed as it could contribute to local ischemia. We administrated twice 0.5 mg nimodipine (calcium antagonist) through the brachial catheter, followed by a continuous arterial perfusion of nimodipine (0.2 mg/h in the first hour followed by 0.5 mg/h). Additionally to the 5,000 units of heparin IV necessary for the bypass surgery, 2,000 units more were injected through the arterial line. Six hours after the ia alcoholic CHX injection, the first angiography showed a thrombotic occlusion and a vasospasm in the radial arterial territory (mid arm until the 2 first fingers). Percutaneous dilatation followed by fibrinolysis with 4 mg alteplase was immediately effective with a reperfusion. Oral calcium antagonist and full therapeutic anticoagulation with iv heparin were started. Because of recurrent vasospasm, two other arteriographies with percutaneous dilatation and local administration of calcium antagonists and thrombolysis were performed during the following 4 days. The last angiography showed a persistent occlusion of the arteria digitalis propria of the thumb. Clinically, a slight improvement with pain reduction and thumb recolorization were observed.

One month later the patient presented a necrosis of the thumb. Debridement and arthrodesis of the proximal and distal phalanges of the thumb were unavoidable. The scar was covered by skin and bone graft, followed by pressure chamber therapy (5 times a week for 1 month) with good outcome. A good thumb-perfusion was assessed by a last angiography. The patient died three month later because of a respiratory distress due to his chronic obstructive bronchitis complicated by repeated bronchoaspirations, a consequence of his advanced Parkinson's disease.

Injection of a large volume of 1% CHX solution (15 mg/kg) into the jugular vein in rats provokes immediate dyspnea followed by death as showed in an animal study. The lethal mechanisms were a sudden blockage of oxygen supply to the lungs, a dysfunction in respiratory and heart muscles, as well as severe lung damage. Arterial administration has fewer toxic effects in rats: necrotic-like symptoms developed at the injection site together with severe hematuria. The elimination half-lives ($t_{1/2}$) in these animal experiments were 2.05 hours for venous and 2.29 hours for arterial injections, therefore, there was enough time for major necrosis [2].

Human case reports of accidental injection of CHX are scarce. One case describes an accidental intravenous injection of 4 ml CHX 20% (80 mg, 13 mg/kg) instead of a muscle relaxant during general anesthesia, which caused a toxic shock followed by ARDS, successfully treated by plasma exchange and extracorporeal membrane oxygenation [3]. Accidental oral ingestion caused caustic burns of the oral cavity [4]. Unintentional injection of CHX into the biliary duct during cholecystectomy was responsible of sclerotic toxic cholangitis; five years after the injection the patient still presented signs of biliary stenosis and successive biliary prostheses were necessary [5].

Alcohol, which is the largest component of alcoholic CHX, is used clinically to induce sclerosis [6]. Ethanol causes blood sludging, protein coagulation and damage of the vascular intima, resulting in definitive distal vascular occlusion after intravascular injection. Hemolysis of red blood cells and secondary increase of calcium due to cellular release can further lead to arterial vasospasm [7]. Accidental intra-arterial puncture or ethanol leaks into vessels during hepatocellular carcinoma

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treatment induced massive hepatic necrosis with partial gastric, splenic and pancreatic infarctions. Ethanol was thought to be responsible of endothelial cell injury or local chemical thrombosis, with further extension to distal major vessels, yielding a large zone of ischemia [8].

No standardized management is established for unintentional ia injection of CHX and alcohol. The recommended therapy is mostly symptomatic: reverse arterial spasm, maintain and/or reestablish blood flow to the distal portions of the extremity, treat the complications of vascular injury and ischemia, relief pain and support rehabilitation. A treatment algorithm for unintentional ia drug injections has been developed [9,10]. The first step of this recommendation suggests keeping the arterial line in order to: deliver medical treatment to the site of injury and assure vessel and catheter patency (continuous infusion of isotonic solution), do immediate diagnostic measurements such as arteriography, blood gas analysis and invasive arterial pressure measurements. The second step is to obtain an immediate vascular-specialized advice. An angiography should be performed in any patient with clinical signs of ischemia, through the catheter. Initiation of anticoagulation with heparin, as thrombosis is a key pathogenic mechanism after ia injections, is the third step. The forth step aims to relieve pain: either through a regional nerve block, a stellate ganglion block or a sympathectomy; however there is no evidence of outcome improvement related to these pain-relieving treatments. As a fifth step antibiotics may be indicated, especially for drug addicted patients with high risk of Clostridia infections in ischemic muscle. Finally in the sixth's step, arterial vasodilatation with local injection of vasodilators (reserpine, tolazine, nicardipine), thrombolytic drugs (alteplase) or local anesthetics (lidocaine) could be indicated. Hyperbaric oxygen therapy and corticosteroids are further measures, which have been proposed.

In our case the incident was attributed to safety failures of a daily preformed medical procedure: the use of a non-colored CHX solution instead of a mandatory CHX-colored solution, not available at the time of the arterial puncture and no specific identifiable goblet for disinfectant. Clinicians should be aware of potential severe complications related to CHX injection, and decision makers should improve working conditions because simple safety measures can avoid this type of incident.

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