ACCIDENTAL INTRAARTERIAL INJECTION IN DRUG ABUSE*

By WILLIAM K. LLOYD, M.D., JOHN M. PORTER, M.D., THOMAS D. LINDELL, M.D., JOSEF RÖSCH, M.D., *and* CHARLES T. DOTTER, M.D.
PORTLAND, OREGON

RECENTLY, 2 patients were treated at the University of Oregon Medical School for severe tissue necrosis resulting from the accidental intraarterial delivery of self-injected drugs.

What was once an infrequent complication of anesthesia[5,11,13] has become a common penalty of drug abuse.[1,8,12]

REPORT OF CASES

CASE 1. A 37 year old male narcotic addict came to the emergency room approximately 4 hours after having injected an oral preparation of sodium secobarbital (Seconal) into his right radial artery. Immediately following the injection, which consisted of the contents of four 100 mg. capsules dissolved in $2\frac{1}{2}$ ml. of water, the patient had experienced severe pain in the distal forearm and hand. Examination showed cyanosis, coldness, and anesthesia to pinprick of the palm and fingers. The dorsal surface of the hand was spared. There was marked restriction of motion, although pain may have been the limiting factor. The radial and ulnar pulses were strong.

Emergency treatment included morphine sulfate, intravenous dextran 40, and 50 mg. of Lidocaine injected into the radial artery. The pain continued until a right axillary nerve block was instituted. Oral papaverine (100 mg. every 6 hours) and heparin (10,000 units, intramuscular, every 4 hours) were begun, but were discontinued after 7 hours. The axillary block was maintained for the next 5 days. Although at the end of this time the pain had subsided, the hand

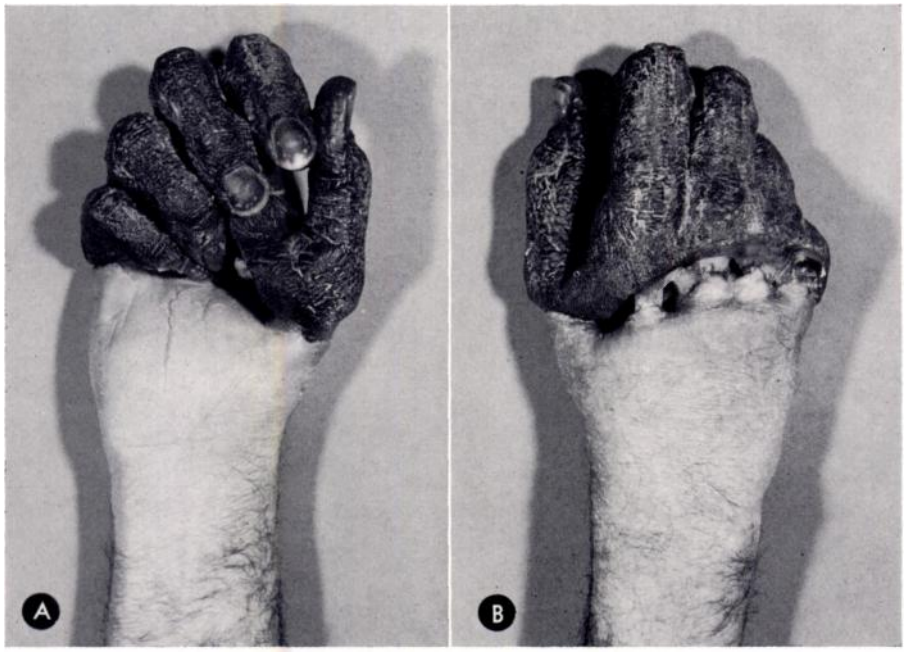

FIG. 1. Case 1. (*A*) Anterior and (*B*) posterior views of the distal right forearm and hand showing mummified digits and open exposure of distal metacarpals.

* From the Departments of Diagnostic Radiology and Surgery, Guttman Institute for Vascular Research, University of Oregon Medical School, Portland, Oregon.

Aided in part by USPHS Grants GM 01682, HL05828 and HL03275; Clinical Research Center MOI RR00334, and the Hoechst Pharmaceutical Company.

FIG. 2. Case 1. Arteriogram of the distal right forearm and hand. (*A*) Arterial phase and (*B*) venous phase. Demonstrated is a complete cut-off of all vasculature distal to the mid-metacarpal level.

and distal forearm had become red, swollen and blistered. Because of this and low-grade fever, antibiotics were started. Thirteen days after the accidental injection, a clear line of black demarcation had formed at the level of the metacarpal-phalangeal joint. Roentgenograms showed no evidence of osteomyelitis. At the end of 1 year, the hand appeared mummified and showed no evidence of either viability or infection (Fig. 1, *A* and *B*). Arteriography revealed complete occlusion of the distal right radial artery and occlusion of all digital arteries at their origins (Fig. 2, *A* and *B*).

CASE II. A 32 year old white male accidentally injected into his right radial artery two 50 mg. pentazocine (Talwin) tablets dissolved in tap water. An immediate "burning" sensation in the hand resulted, and over the next 3 days progressive pain, swelling and numbness developed. On the third day, the patient consulted a physician who incised and drained the injection site and evacuated several blood clots from around the radial artery. The patient returned home and was treated with proteolytic enzymes (Papase) and meperidine hydrochloride (Demerol). During the next few days, the hand was intermittently white, pink, and blue-black. Nine days after the accidental injection, the patient was admitted to another hospital because of persistent pain and impending gangrene of the radial side of the wrist and hand.

A stellate block was performed and intravenous dextran 40 and antibiotics were begun. He was referred to the University of Oregon Medical School, where arteriography demonstrated patency of the ulnar and radial arteries and the deep and superficial palmar arcades. There was complete blockage of the digital arteries to the thumb and severely impaired blood flow to the index and middle fingers. Small, irregularly narrowed arteries extended to the fourth and fifth metacarpal phalangeal joints, but no farther. Reserpine, 2.5 mg., was injected through an in-

Fig. 3. Case 11. (*A*) Arteriogram of the hand prior to reserpine administration. Demonstrated are complete occlusion of digital arteries to the thumb and severely impaired flow to the remaining digits. (*B*) Arteriogram following reserpine administration reveals slightly increased flow to the third, fourth and fifth digits.

dwelling brachial arterial catheter and 24 hours later follow-up arteriography demonstrated increased patency of arteries to the third, fourth and fifth fingers (Fig. 3, *A* and *B*). Despite the intraarterial administration of streptokinase (Streptase, Hoechst), 105,000 units over the course of 19 hours,[6] a third arteriogram revealed no further improvement. The gangrenous thumb and index finger were eventually amputated at the mid-metacarpal level. Microscopic examination of the amputated digits showed extensive gangrene with loss of overlying surface epithelium. Marked endothelial proliferation and luminal narrowing were present in the digital arteries and arterioles. Particulate matter was demonstrated in the lumen of digital small arteries.

DISCUSSION

Van der Post[13] in 1942 described the loss of 3 fingers following accidental intraarterial injection of thiopental. In 1948, Cohen[5] reported 12 similar cases. Prominent clinical features included burning hand pain, shock, vasomotor spasm, cyanosis, mottled bluish-green discoloration, vesiculation, neurologic symptoms and gangrene. It was observed that extremities which became gangrenous were never edematous. It is now clear[8,10,12] that similar complications may follow the improper intraarterial injection of a wide variety of drugs, especially those intended for oral administration.

The mechanisms of injury in such cases have been the subject of controversy. Burn[3] demonstrated a vasoconstrictor action of thiopentone believed due to norepinephrine released from the arterial wall and stated that the effects of thiopentone could be diminished by sympathectomy or prior reserpine administration. Kinmonth and Shepher[9] demonstrated in rabbits that

the vasospasm following intraarterial thiopentone injection was brief and that after a short period of compensatory vasodilatation, normal caliber returned. Later, sometimes as long as 3 or 4 days later, edema, inflammation and vessel occlusion developed; due, they concluded, to direct vascular damage rather than spasm. Since tissue preservation would be favored by maintaining blood flow pending maximal healing, they recommended sympathectomy and heparin. Brown *et al.*[2] showed that barbiturates in the blood in high concentration can form crystals and lead to hemolysis and platelet aggregation. While parenteral solutions of many drugs can be safely given intraarterially, the inert materials and binders contained in tablets of the same drug can cause severe vessel and tissue damage.

Generalized necrotizing angiitis secondary to drug abuse has been described in several recent reports.[4,7] The vascular changes in such cases are widespread and distinctive; representing, we believe, a mechanism of injury different from that which occurred in our 2 patients.

Whatever the mechanism of injury or the roles played by various factors, thrombosis of small or major vessels occurs in all cases where there is permanent tissue damage. Primary treatment should therefore be directed to maintaining blood flow by preventing or limiting thrombosis; thus, even in drug abuse, angiography can play an important role in diagnosis and management.

SUMMARY

Two cases of accidental intraarterial drug injection with resulting tissue loss are reported and the mechanisms of injury discussed.

Although variability in the amount of arterial and tissue damage from case to case and the relatively small number of cases make evaluation of any treatment program difficult, we believe that the use of heparin, intraarterial vasodilating agents and local or systemic fibrinolytic drugs can play important therapeutic roles.

Charles T. Dotter, M.D.
Department of Radiology
University of Oregon Medical School
3181 S.W. Sam Jackson Park Road
Portland, Oregon 97201

REFERENCES

1. Albo, D., Jr., Cheung, L., Ruth, L., Snyder, C., and Reemtsma, K. Effect of intraarterial injections of barbiturates. *Am. J. Surg.*, 1970, *120*, 676–678.
2. Brown, S. S., Lyons, S. M., and Dundee, J. W. Intra-arterial barbiturates. *Brit. J. Anaesth.*, 1968, *40*, 13–19.
3. Burn, J. H. Why thiopentone injected into artery may cause gangrene. *Brit. M. J.*, 1960, *2*, 414–416.
4. Citron, B. P. Necrotizing angiitis associated with drug abuse. *New England J. Med.*, 1970, *283*, 1004–1011.
5. Cohen, S. M. Accidental intraarterial injection of drugs. *Lancet*, 1948, *2*, 361–371.
6. Dotter, C. T., Rösch, J., Seaman, A. J., Dennis, D., and Massey, W. H. Streptokinase treatment of thromboembolic disease. *Radiology*, 1972, *102*, 283–290.
7. Halpern, M., and Citron, B. P. Necrotizing angiitis associated with drug abuse. Am. J. Roentgenol., Rad. Therapy & Nuclear Med., 1971, *111*, 663–671.
8. Harrison, A. M., Joo, Y. D., Isreal, J. R. Intraarterial administration of oral pentazocine. Letter to Editor. *J.A.M.A.*, 1970, *213*, 914.
9. Kinmonth, J. B., and Shepher, R. C. Accidental injection of thiopentone into arteries: studies of pathology and treatment. *Brit. M. J.*, 1959, *2*, 914–918.
10. Klatte, E. C., Brooks, A. L., and Rhamy, R. K. Toxicity of intra-arterial barbiturates and tranquilizing drugs. *Radiology*, 1969, *92*, 700–704.
11. Ogilvie, T. A., Penfold, J. B., and Clendon, D. R. Gangrene following intraarterial injection of myanesin. *Lancet*, 1948, *1*, 947–949.
12. Pearlman, H. S., Wollowick, B. S., and Alvarez, E. B. Intra-arterial injection of proposyphene into brachial artery. *J.A.M.A.*, 1970, *214*, 2055–2057.
13. Van der Post, C. W. Report of case of mistaken injection of pentothol sodium into aberrant ulnar artery. *South African M. J.*, 1942, *16*, 182.