

ference. The value of R2 should be about a third that of R1. Total parts cost for the 1 × 3 × 2-inch aluminum chassis, 4PDT toggle switch, resistors, pin plugs, and jacks is about \$15.00.

Either adapter is useful for monitoring patients who have coronary-artery disease, in whom it is important to record V<sub>5</sub> and limb-lead ECGs.<sup>2,3</sup> The adapter shown in figure 1 requires only four patient electrodes and will enable the anesthesiologist to display alternately on Tektronix and similar monitors either V<sub>5</sub> or lead II, by use of a single toggle switch. The adapter shown in figure 2 employs the conventional five-electrode arrangement, including a separate electrode

for circuit common. This device may minimize 60-Hz interference that might be excessive when the simpler adapter is used with certain monitors in some patient environments.

### References

1. Kaplan JA (editor): *Cardiac Anesthesia*. New York, Grune and Stratton, 1979, pp 119-120
2. Kaplan JA, Dunbar RW, Hatcher CR: Diagnostic value of the V<sub>5</sub> precordial electrocardiographic lead: A case report. *Anesth Analg (Cleve)* 57:364-367, 1978
3. Kister JR, Miller ED Jr, Epstein RM: More than V<sub>5</sub> needed (correspondence). *ANESTHESIOLOGY* 47:75, 1977

Anesthesiology  
52:80-81, 1980

## Pseudoaneurysm, a Late Complication of Radial-Artery Catheterization

S. WOLF, M.D.\* AND D. T. MANGANO, PH.D., M.D.†

The most common complications of radial arterial catheterization are thrombus, embolus and hematoma formation,<sup>1-4</sup> usually detected prior to or shortly after decannulation. We report the uncommon occurrence of pseudoaneurysm formation 18 days after decannulation in a patient who had an otherwise uncomplicated hospital course.

### REPORT OF A CASE

A 68-year-old man was admitted to the hospital with a six-week history of nausea, vomiting, and weight loss. Gastrointestinal roentgenograms revealed a mass in the right upper quadrant. His medical history included sixty pack-years of cigarette smoking, with chronic bronchitis, and claudication, for which a right lumbar sympathectomy had been performed two years prior to admission. Physical examination disclosed no abnormality except an increased anteroposterior chest diameter and mild inspiratory wheezes. Allen's test for adequacy of ulnar collateral vessel filling was normal at 3 sec.<sup>5</sup> Results of routine laboratory tests and coagulation studies and electrocardiogram were within normal limits. Roentgenograms of the chest and pulmonary function tests were consistent with mild chronic obstructive pulmonary disease. An exploratory laparotomy with general anesthesia was scheduled.

Prior to induction of anesthesia a #20 Long-Dwel<sup>®</sup> catheter was placed percutaneously in the left radial artery on the first attempt, without difficulty. The vessel was not transfixed during this procedure. Physiologic saline solution with 2 units of heparin/ml was infused continuously through the catheter at a rate of 3 ml/hour by an Intralflow<sup>®</sup> system. The left arm was extended at the

shoulder and flexed at the elbow without tension on the brachial plexus. It remained under direct observation throughout the operation. There was no evidence of compromised perfusion. Anesthesia and operation were without incident. A Whipple procedure was performed for adenocarcinoma of the pancreatic duct. Postoperatively, the patient was observed in the intensive care unit, where his condition remained hemodynamically stable, with good peripheral perfusion.

Twenty-four hours after operation the arterial catheter was removed, and manual pressure applied for 5 min. Perfusion remained normal and unchanged, with full pulses, normal Allen's tests, and no hematoma formation. There were no arterial punctures made after decannulation. There was no evidence of complication until the eighteenth postoperative day, when the patient was noticed to have a 1.5 × 1.5-cm painless pulsatile mass over the site of cannulation. No thrill was detected. Peripheral perfusion remained good. Over the following week the mass was unchanged, and the patient was discharged on the twenty-third postoperative day. However, on the thirtieth postoperative day the patient was readmitted because the mass had enlarged to 3 × 3 cm. A thrill and bruit were noticed; peripheral perfusion was unimpaired.

Surgical exploration revealed a pseudoaneurysm 3 × 3.5 cm in dimensions at the site of arterial puncture in the left radial artery (fig. 1). The left radial artery was ligated proximally without compromising perfusion of the hand.

### DISCUSSION

The most common complications associated with radial arterial catheterization are transient thrombosis (incidences as high as 88 per cent),<sup>6,7</sup> occlusion after cannulation (to 60 per cent),<sup>8</sup> and hematoma formation (to 40 per cent).<sup>7</sup> These complications generally occur early in the cannulation-decannulation course. Late complications, such as pseudoaneurysm, have been suggested as possibilities,<sup>4</sup> but have not been documented. Data are available, however, for axillary and femoral arterial pseudoaneurysms associated

\* Resident, Department of Anesthesia, University of California, San Francisco.

† Assistant Professor of Anesthesia, University of California, San Francisco, and Veterans Administration Medical Center, San Francisco.

Received from the University of California Medical Center, San Francisco, California 94143. Accepted for publication June 17, 1979.

‡ Becton, Dickinson and Company, Rutherford, N. J.

§ Sorenson Research, Salt Lake City, Utah.



FIG. 1. Radial-artery pseudoaneurysm occurring at the site of radial arterial puncture. The ligature (arrow) lies around the proximal portion of the artery. The diameter of the pseudoaneurysm is 3 cm.

with the Seldinger technique for percutaneous angiography.<sup>9,10</sup> Erickson and Jorulf<sup>10</sup> reported ten pseudoaneurysms occurring one to five weeks following decannulation. These pseudoaneurysms appeared to have occurred at the sites of arterial punctures.

Our patient had a radial arterial pseudoaneurysm 18 days following decannulation despite a normal preoperative Allen's test, nontraumatic insertion and removal of a small arterial catheter, no immediate hematoma formation, and an uncomplicated hospital course. Since the complications from a pseudoaneurysm could include rupture, dissection, occlusion, or embolus, we suggest that physicians be alert to the possibility of such late complications, especially in patients with hypertension and severe occlusive vascular disease. Patients should be instructed to inspect the sites of cannulation and report any swelling.

#### REFERENCES

1. Bedford RF, Wollman H: Complications of percutaneous radial artery cannulation: An objective prospective study in man. *ANESTHESIOLOGY* 38:228-236, 1973
2. Gardner RM, Schwartz R, Wong HC, et al: Percutaneous indwelling radial artery catheters for monitoring cardiovascular function. Prospective study of the risk of thrombosis and infection. *N Engl J Med* 290:1227-1231, 1974
3. Mathews JI, Gibbons RB: Embolization complicating radial artery puncture. *Ann Intern Med* 75:87-88, 1971
4. Samaan HA: The hazards of radial artery pressure monitoring. *J Cardiovasc Surg* 12:342-347, 1971
5. Allen EV: Thromboangiitis obliterans: Methods of diagnosis of chronic occlusive arterial lesions distal to the wrist with illustrative cases. *Am J Med Sci* 178:237-244, 1929
6. Mortensen JD: Clinical sequelae from arterial needle puncture, cannulation and incision. *Circulation* 35:1118-1123, 1967
7. Brown AE, Sweeney DB, Lumley J: Percutaneous artery cannulation. *Anesthesia* 24:532-536, 1969
8. Kim JM, Arakawa K, Bliss J: Arterial cannulation: Factors in the development of occlusion. *Anesth Analg (Cleve)* 54:836-841, 1975
9. Molnar W, Paul DJ: Complications of axillary arteriotomies. *Radiology* 104:269-276, 1972
10. Eriksson I, Jorulf H: Surgical complications associated with arterial catheterization. *Scand J Thor Cardiovasc Surg* 4:69-75, 1970