The Safety of Brachial Artery Puncture for Arterial Blood Sampling*

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**Objective:** This study was designed to determine the incidence of complications in a sample of 6,185 brachial artery punctures for arterial blood gas analysis.

**Methods:** The study sample was comprised of adult patients who had arterial blood gas analysis ordered in the course of their clinical evaluations in a multispecialty clinic and hospital affiliated with a university school of medicine. Subjects were entered prospectively at the time the procedure was done.

**Results:** The overall incidence of all complications was 2.0%. Immediate limb pain or paresthesias occurred in 1.1%, while the onset of symptoms was delayed up to 24 h in 0.9%. Hematoma formation occurred in only 0.06%. None of the complications was considered to be of major impact, in that none was associated with limb ischemia or other subjective abnormalities. Only one subject required analgesic medication to control pain that ultimately subsided spontaneously without deficit.

**Conclusion:** We believe that brachial artery puncture, when properly performed, is a safe and reliable alternative route for obtaining arterial blood for gas analysis.

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**Key words:** arterial puncture; blood gas analysis; complications

Obtaining arterial blood for blood gas analysis has become a routine procedure in most hospitals and many outpatient clinics. Thirty years ago, arterial punctures were primarily performed by physicians because of the potential for serious complications. Today, with improved training and equipment, it is commonly performed by nurses, laboratory technicians, and respiratory therapists, without physician assistance.

Arterial blood samples from the upper extremities are usually performed using the radial artery, even though radial artery punctures are often technically more difficult to perform and may cause the patient more discomfort.¹ The radial artery is preferred because of the common belief that brachial artery punctures are significantly more dangerous for the patient.

In our pulmonary laboratory, brachial artery puncture has been the preferred method for obtaining arterial blood for blood gas analysis for >30 years. This route was preferred because of our clinical impression that it was safe, caused less discomfort, and was technically easier for the technician.

We found surprisingly little information about the incidence of complications for brachial or radial artery sampling in the medical literature. Most published reports were anecdotal, detailing complications without reference to the rate of occurrence. This prompted us to report the incidence of complications in 6,185 consecutive brachial artery punctures performed for blood gas analysis in our laboratory between 1992 and 1996.

**Materials and Methods**

We prospectively recorded the following information on all patients having arterial blood gases drawn: (1) the arm from which blood was obtained; (2) the number of sticks required to obtain the sample; and (3) the presence or absence of any complication at the time of the procedure. Each time a complication was noted, the medical record was reviewed 48 h and 2 months later to ascertain the seriousness, duration, and outcome of the complication.

A registered or certified pulmonary function technician performed all brachial artery punctures. Our technicians are trained by the more experienced technicians in the department to do both brachial and radial artery punctures and follow established standard protocols.² An important part of their training involves learning to assess the patient’s condition, confirm that the patient is receiving the ordered fraction of inspired oxygen, assure appropriate sample handling, and note what respiratory treatments are in progress at that time. Their training has also
included identifying contraindications, hazards, complications, and limitations associated with the procedure, as well as the proper method for applying pressure to the artery after needle withdrawal. Technicians may not perform arterial punctures without supervision until their trainer is satisfied they are competent to perform the procedure.

In all subjects, the arterial pulsation was identified and the antecubital fossa was cleaned with an alcohol pledget. No local anesthesia was used. The brachial artery was entered percutaneously using a 20-gauge needle with attached syringe. If the patient experienced pain or if blood could not be obtained, the needle would then be withdrawn and the procedure was moved to the opposite arm. After the sample was obtained, manual pressure was applied to the artery for a minimum of 3 min, but often as long as 10 min if the patient was receiving anticoagulation therapy. After the application of pressure, the site was carefully inspected for any sign of swelling or discoloration. If either was noted, additional pressure was applied and the attending physician was notified so he or she could inspect the site later. If the patient had had a recent brachial artery puncture, the opposite arm was preferentially used. Brachial artery punctures were never performed through an existing hematoma, antecubital scar, or open wound. None of these patients had arterial cannulations or intra-arterial injections.

Results

During the period of January 1992 through January 1996, a total of 6,185 brachial arterial punctures were performed. The subjects were all adults. The age range was 18 to 94 years. Sixty-three percent of brachial artery sticks were performed on patients in their sixth and seventh decades of life, 19% in their fourth and fifth decades, 14% in their eighth and ninth decades, and 4% in patients <30 years of age. Forty-nine percent were female and 51% were male. Seventy-five percent of the arterial sticks were performed on outpatients in the medical clinic, 21% were performed on patients in general hospital wards, and 4% were performed on patients hospitalized in the ICU. Only 155 (2.5%) required more than one stick to obtain the arterial blood sample.

One hundred twenty-seven (2.0%) complications were recorded. These occurred in a random fashion, with none arising in patients who required multiple sticks. The complications were of two types. The most common complication recorded was that of extremity pain or paresthesias, which was noted in 123 instances (group 1). Only four punctures resulted in hematoma formation (group 2).

A little more than half of group 1 patients (66 subjects) complained of pain at the time of the arterial stick. Of these, one fourth (16 subjects) complained of temporary diffuse pain in the extremity, one half (33 subjects) complained of localized discomfort at the needle site, and one fourth (17 subjects) experienced a shock-like pain, suggesting that the median nerve had been touched by the needle. Only one patient had discomfort that lasted >48 h. A neurologist saw her 10 days after the procedure. At that time, there was pain without objective ischemic or neuropathic change. The symptoms resolved spontaneously, without treatment, sometime prior to a second visit at 2 months.

Fifty-seven patients noted no discomfort at the time of the procedure, but developed hand pain or acroparesthesia in the fingers within 24 h following the procedure. Only one had persistent symptoms. She noted the onset of pain and paresthesias in her thumb 4 days after the procedure. She was evaluated by a neurologist, who found no objective abnormality. The pain subsided within 4 months with the use of oral ibuprofen.

Only four patients had identifiable antecubital hematomas after the procedure. None of these patients were receiving anticoagulants at the time of the arterial stick. Two of these were clinic patients and two were hospitalized in general medical wards. None were in the ICU. None of the hematomas resulted in subsequent ischemia or other serious complication and all resolved spontaneously.

The incidence of the complications as a percent of the entire group is listed in Table 1.

Discussion

This prospective study involving 6,185 brachial artery punctures for arterial blood gas analysis documents that this is an acceptably safe procedure with a low incidence of complications when performed by properly trained personnel. We considered all of our complications to be minor, since none had any lasting or serious consequence for the patient. In our opinion, brachial artery punctures are technically easier to perform and generally associated with less discomfort than radial artery punctures. Our results were similar to a 1973 report by Felkner, who found 2,500 arterial sticks without serious complication. Unfortunately, Felkner did not categorize complications by puncture site. Petty et al reported in 1966 on the simplicity and safety in 475 arterial punctures with only minor hematoma formation.

The medical literature has been almost totally

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silent on this subject over the past 15 years. We found no reports that documented the incidence of complications. Most reports involved anecdotal accounts of cases that resulted in complications that, when taken collectively, give the impression that brachial artery punctures are fraught with frequent and serious complications.

McCreary et al.9 reported one case of limb ischemia noted 6 h after a brachial artery stick. The patient was being treated for an abdominal catastrophe and was in postoperative shock.9 The ischemia was complicated by the fact that IV fluid had infiltrated into the hand. There was no mention of what medication(s) might have been in the IV fluid. Treatment consisted of IV heparin and a stellate ganglion block. Eighteen hours later, the extremity gradually improved. Subsequent surgical exploration of the arm showed edema of the tissues without other abnormalities. They concluded that the cause of this patient’s limb ischemia was unclear.

In 1976, Neviser et al.7 reported the complications of brachial and femoral artery punctures in 13 patients who were receiving heparin therapy. The complication rate was not reported even though complications were categorized by puncture site. Two patients had hematomas after brachial artery sticks. They reported large hematomas that were associated with the development of median neuropathies. They also reported the development of infected hematomas after repeated arterial punctures performed through the existing antecubital hematoma. This report underscores the importance of proper attention to the arterial puncture site during and immediately after the procedure and the importance of not repeating the procedure in an extremity after a complication had already arisen. Both of the reported cases required incision and drainage of the affected arm and, in one case, required skin grafting. They reported two median nerve neuropathies, one with incomplete recovery of motor function 1 year later, and the second recovering after decompression and neurolysis. They also described seven patients presenting with ischemic change secondary to bruising and tenseness of the flexor compartment of the forearm. At surgical decompression, they noted ecchymoses and swelling that extended from the antecubital fossa into the carpel canal.

An extensive 1967 study by Mortensen9 of 3,193 arterial needle punctures, cannulations, and cutdowns reported on 66 major complications and 321 minor complications. The study included all arterial punctures for any reason, including arteriography and cardiopulmonary bypass. One thousand four hundred sixty-six percutaneous artery punctures had a major complication rate of 1.3% and minor complication rate of 10%. The remainder of the arterial punctures involved arterial catheterization by the Seldinger technique (719) and cutdown arteriotomy with repair (1,006). The Seldinger technique, which is no longer in use, was associated with an increased rate of complications (4.4% and 14.3% respectively). Of the percutaneous needle punctures, there were only 34 brachial artery punctures listed, but they reported an 8.9% rate of major and a 33% rate of minor complications. Overall, they listed the factors predisposing to complications as follows: (1) an age of <10 years; (2) the presence of arteriosclerotic vascular disease or hypertension; and (3) concurrent anticoagulation. These authors made a plea for objective studies of complication rates, since anecdotal recollection is frequently faulty.

The most recent report that we found was a 1989 case report by Berger.9 This involved a patient who had developed a median neuropathy following brachial artery puncture.9 This report lacked specific information about the resulting median neuropathy. He reported immediate pain of neuropathic type when the nerve was struck by the needle. The pain resisted all treatment modalities for >1 year and apparently resulted in permanent sequelae. Unfortunately, the article specifies that there was “pain at the site of the injection,” but fails to indicate what, if anything, was injected.

Ward and Green10 reported on 588 patients who underwent 1,360 arterial punctures of various kinds. They reported only one potential complication of a brachial artery puncture. The complication occurred in a patient with a cannulated brachial artery who had had a right middle lobectomy, but who also had developed postoperative GI bleeding and shock. The extremity where the arterial puncture occurred became pulseless. After hydration and reestablishment of BP, the pulse returned. Again, there was no mention of the number of procedures by puncture site. They concluded that complications increased when radiographic dyes or drugs were injected into the arteries, there was significant arteriosclerotic disease, or there was long-term catheterization of the artery.

We believe that our results show that brachial artery puncture for arterial blood gas analysis is an acceptably safe procedure in adults when performed by trained experienced personnel following established guidelines. We believe that the immediate withdrawal of the needle at the first perception of neuropathic pain is important, and that further arterial punctures should not be done in that extremity. It is also important to apply adequate pressure over the puncture site for at least 3 min to prevent hematoma formation. The puncture site should be inspected carefully for signs of hematoma formation.
after pressure is discontinued so that pressure can be
reinstituted if bleeding is suspected.

We would certainly agree that anticoagulation
would increase the potential risk of hematoma
formation and would require pressure to be ap¬
plied for a much longer time than usual. Although
we did not record the number of arterial punc¬
tures done on patients who were receiving anticoagulant therapy, none of the patients who
developed hematomas had been receiving antico¬
agulants. Most of our patients were in the age
group in which atherosclerosis and hypertension
are common. If these conditions contribute to the
risk of complications, as others have suggested, the
influence must be very small. None of our patients
had received intra-arterial injections. It is conceiv¬
able that this could increase the complication rate,
depending on the nature of the material injected.
The literature would suggest that complications
may be more severe in patients who are in
cardiovascular shock at the time arterial blood is
obtained.

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