were periodically reviewed during document development and updated as needed. SCAI policy requires that writing group members with a current, relevant financial interest are recused from participating in related discussions or voting on recommendations. The work of the writing committee was supported exclusively by SCAI, a nonprofit medical specialty society, without commercial support. Writing group members contributed to this effort on a volunteer basis and did not receive payment from SCAI.

Literature searches were performed by group members designated to lead each section and initial section drafts were authored primarily by the section leads in collaboration with other members of the writing group. Recommendations were discussed by the full writing group until a majority of group members agreed on the text and qualifying remarks. All recommendations are supported by a short summary of the evidence or specific rationale.

The draft manuscript was peer reviewed in September 2021, and the document was revised to address pertinent comments. The writing group unanimously approved the final version of the document. The SCAI Publications Committee and Executive Committee endorsed the document as official society guidance in March 2022.

SCAI statements are primarily intended to help clinicians make decisions about treatment alternatives. Clinicians also must consider the clinical presentation, setting, and preferences of individual patients to make judgements about the optimal approach.

Introduction and background

Large-bore endovascular devices for the treatment of a variety of cardiac and aortic pathologies have become commonplace in modern cardiovascular disease management. The common femoral artery is the most frequent access site for percutaneous placement of large-bore arterial sheaths and devices.[2] However, transfemoral access may be limited in 13-20% of patients due to prior surgical interventions or severe aortoiliac and/or iliofemoral atherosclerotic disease, tortuosity, or calcification. In these circumstances, axillary artery access is often a viable and beneficial alternative.[2,3]

Axillary arterial access is traditionally performed through open surgical exposure, which allows for direct puncture, primary arterial repair, or placement of a sidearm conduit. However, percutaneous axillary arterial access has become increasingly common and evolved from lessons learned from percutaneous access and closure of large-bore femoral arteriotomies.[4,5] Advantages of percutaneous access include avoidance of a surgical incision, general anesthesia, and conduit graft infection.

The transaxillary approach facilitates long-term indwelling mechanical circulatory support (MCS) devices of varying dimensions, such as intra-aortic balloon pumps (IABP) and percutaneous left ventricular assist devices (pVAD). Such devices are frequently used in cardiogenic shock, high-risk percutaneous coronary interventions, and ventricular tachycardia ablation therapy, but also serve as a bridge to durable left ventricular assist device placement or heart transplantation after several days or weeks.[6] In these circumstances, the prolonged presence of a large-bore femoral arterial sheath limits mobility, promotes deconditioning, and carries an increased risk of infection.[4] Transaxillary access for prolonged-use MCS devices potentially avoids such complications.

Transaxillary access has also been shown to be a useful alternative access for transcatheter aortic valve replacement (TAVR) and as an adjunct during complex endovascular aortic repair (EVAR) of aneurysmal disease involving visceral and renal branches.[7,8]

While the need for transaxillary access is expected to increase, the published evidence base is limited. The goals of this SCAI expert consensus statement are to: 1) review the anatomic considerations and risks for percutaneous axillary artery access, 2) suggest best practices for access techniques, hemostasis/closure strategies, and complication management, and 3) recommend options for training and privileging.

Anatomic considerations

Understanding the relevant anatomy of both the axillary artery and subclavian artery is paramount when considering axillary artery access. The axillary arteries arise from the subclavian arteries that arise from the brachiocephalic artery on the right and directly from the aortic arch on the left (Figure 1).[9] Variant arch anatomy may occasionally occur, with the more common including the bovine arch (common origin of the brachiocephalic and left common carotid arteries), arteria lusoria (right subclavian artery arises from the proximal descending thoracic aorta distal to the left subclavian artery origin) and left vertebral artery arising directly from the aortic arch.

The subclavian artery is mostly intrathoracic in location and supplies significant branches including the vertebral artery, the internal mammary artery, the thyrocervical trunk, costocervical trunk, and dorsal scapular artery. The subclavian artery is intimately related to the brachial plexus, and given its course and anatomy, injury to the subclavian artery may result in intrathoracic bleeding or compressive neck hematoma.[10]

Beyond the lateral border of the first rib, the subclavian artery continues as the axillary artery, which is now extrathoracic (Figure 1). This distinction is important as the extrathoracic location limits the risks of puncture-related pneumothorax and hemothorax. The axillary artery is divided into 3 segments defined by the pectoralis minor muscle. The first segment is medial to the pectoralis minor and has a single branch, the superior thoracic artery. The second segment lies directly posterior to the pectoralis minor and has 2 branches, the thoraco-acromial and lateral thoracic arteries. Lateral to pectoralis minor, the third segment is the origin of 3 branches, the subscapular, posterior humeral circumflex, and anterior humeral circumflex arteries. The third segment ends at the head of the humerus and continues as the brachial artery.

The axillary artery typically measures 6-7 mm in diameter, with a range of 5-8 mm.[9] This corresponds to a relative French size of 15 to 24. The axillary artery is infrequently affected with atherosclerotic disease (2%) compared with the femoral artery, with unclear pathophysiology.[9]

The neurovascular relationship between the course of the axillary artery and the surrounding nerves favors the second segment for percutaneous puncture and closure. The phrenic nerve, sympathetic trunk, long thoracic nerve, and the proximal trunks of the brachial plexus are adjacent to the subclavian artery. They are unlikely to be injured during a percutaneous transaxillary approach. On the other hand, the posterior, medial, and lateral cords of the brachial plexus are intimately related to the axillary artery and named according to their positions relative to the first and second segments. The absence of a cord *anterior* to the second segment results in a safer window for percutaneous puncture and closure techniques. However, an unidentified expanding hematoma within the axillary fascia can potentially result in brachial plexus cord compression despite the absence of direct injury from a correct access path.

The median and ulnar nerves form from the brachial plexus cords and pass anterior to the third segment of the axillary artery, placing them at risk of injury if the third segment is chosen for access. The subscapular and circumflex humeral arteries mark this segment, and angiographic visualization can help the operator avoid that location. The median and ulnar nerve can also occasionally be visualized during ultrasound-guided access (Figure 2). Fluoroscopically, with the arm abducted, the inferior border of the glenoid cavity may represent a lateral marker distal to which the artery should not be punctured.

Knowledge of the anatomy and branches of the axillary artery facilitates safer angiographic guidance of access and endovascular treatment of any access-related complications. Similarly, identification of the relationship of the axillary artery to the pectoralis minor enables accurate ultrasound-guided access of the second segment of the axillary artery. This panel recommends the second segment of the axillary artery as the preferred location for percutaneous puncture due to its distance from the chest cavity (which reduces the risk of accidental intrathoracic