The Vascular Anatomy and Angiosome of the Posterior Auricular Artery

A Cadaver Study

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Background: Pedicled flaps based on the posterior auricular artery have been used for small auricular and mastoid cavity defects.

Objective: To precisely define the vascular anatomy and angiosome (cutaneous distribution) of the posterior auricular artery.

Methods: A fresh cadaver model was used for 3 separate investigations, studying the posterior auricular artery. Intra-arterial ink injections defined the angiosome, and subtraction angiography and latex injection defined the vascular anatomy in relation to bony and soft tissue landmarks.

Subjects: Eight fresh cadavers, 6 men and 2 women, were used, varying in age from 58 to 85 years.

Results: The posterior auricular artery has a predictable course in the posterior auricular sulcus. The branching pattern over the auricle and temporal bone and the artery’s relationship to bony and soft tissue landmarks were consistent. The angiosome includes the anterior and posterior surfaces of the auricle and the periauricular skin superiorly, posteriorly, and inferiorly.

Conclusions: The investigation documented the consistent vascular anatomy and angiosome of the posterior auricular artery. The cutaneous distribution suggests that a large pedicled or island flap based on the posterior auricular artery may be raised safely as a myocutaneous or myofasciocutaneous flap with temporalis fascia and/or perios- teum, extending previously published dimensions. Further studies may extend the clinical application to include free flaps based on the posterior auricular artery.

The measurements of the 14 PAA ink injections are shown in Table 1. Staining of this area was consistent. The anterior extent of the blush included the lobule and the middle and superior portions of the pinna posterior to the meatus of the external canal as seen in a representative sample in Figure 1. The mean distance from the mastoid to the tragus was 3.92 cm. Measuring from the superior portion of the tragus, the mean distance to the superior, posterior, and inferior borders of the ink blush (angiosome) were 6.88 cm, 5.31 cm, and 7.59 cm, respectively. Measuring from the mastoid tip, the mean distance to the superior, posterior, and inferior borders of the ink blush (angiosome) were 9.99 cm, 6.68 cm, and 3.99 cm, respectively.

Latex injections of the PAA are recorded in Table 2. The measurements for location of the latex-injected PAA were taken from the external carotid artery, mastoid tip, external auditory canal, and the superior attachment of the helix (Figures 2 and 3). The PAA had a mean distance of 0.29 cm anterior to the mastoid, just deep to the lobule and in the posterior auricular sulcus. Measuring parallel to the Frank-
MATERIALS AND METHODS

A fresh cadaver model was used for 3 separate investigations studying the PAA. A total of 8 cadavers were used, 6 men and 2 women, with an age range of 58 to 83 years (average age, 74 years). Through an incision 2 cm below the angle of the mandible, the branches of the external carotid were identified. The PAA was cannulated with a 20-gauge catheter. The remaining branches were suture ligated.

INK INJECTION

Fourteen PAAs underwent intra-arterial ink injections to define the angiosome, using the method described by Whetzel and Mathes. Commercially available fountain pen ink was used to determine the cutaneous area supplied by the PAAs. Ink was gently hand-injected through the catheter until the resulting cutaneous blush did not increase in size, approximately 10 mL in each case. The area of cutaneous ink blush was measured and photographed (Figure 1).

RADIOGRAPHIC EXAMINATION

Sixteen PAAs underwent subtraction angiography using intra-arterial radiographic contrast. Best results were achieved using a grid with the source set at 40 cm from the film with exposure settings of 70 kV and 10 mA/s. The cadaver was positioned and a mask film was exposed, followed by 10 mL of intra-arterial radiographic contrast hand-injected into the artery, with a second film exposed immediately on completion. The mask radiograph was subtracted from the injection radiograph to produce the final radiograph (Figure 2).

LATEX INJECTION

A total of 15 PAAs were hand-injected with red or blue latex (Batson #17 Plastic Kit; Polysciences Inc, Warrington, Pa). After the latex had been allowed to set overnight at 4°C, the skin at the perimeter of the most posterior ink blush was incised. As the dissection extended through the subdermal layer, the latex-filled perforators were traced to the junction of the PAA and external carotid artery. As the perforating vessels were identified, they were followed through the temporoparietal fascia. The PAA proceeded from the external carotid artery, then anterior to the mastoid tip, and deep to the posterior auricular muscle (Figure 3). Measurements of its course were obtained from bony and soft tissue landmarks.

STATISTICAL ANALYSIS

All measurements were entered into and statistical operations performed using a Microsoft Excel for Windows 95 worksheet (Microsoft Corp, Redmond, Wash). A 95% confidence interval (CI) was calculated to allow us to be 95% confident that the true population mean would be included in our interval, which was constructed around our mean sample.
lar branch to the posterior portion of the pinna (11 [65%] of 17 latex injections) and the occipital branch (11 [65%] of 17 dissections). Both the occipital and the pinna branches had their takeoff at or superior to the mastoid tip. The occipital branch mean distance was 0.84 cm above the mastoid tip, and the auricular branch mean distance was 0.68 cm above the mastoid tip. Below the mastoid tip, 6 dissections showed a parotid branch, one of which had multiple branches, and 5 dissections had sternocleidomastoid branches. Measured from the external carotid artery, the parotid branch was located at 1.75 cm, and the sternocleidomastoid branch was located at 1.44 cm. No cervical branches were identified, which could have been the result of placement of the catheter in the artery or a ligature at the insertion site that blocked the latex from filling the branch.

Figure 2. A, An example of plain angiography. B, The use of subtraction angiography documented the remarkable anastomotic network between the ipsilateral superficial temporal artery (STA), anterior auricular and occipital arteries, and the contralateral cutaneous vascular territories. PAA indicates posterior auricular artery.

Figure 3. A, An example of the latex-injected posterior auricular artery (PAA), the course of the vessel and location of PAA branches. B, The landmarks used for documenting the location of the latex-injected PAA. Line A marks the distance of the PAA anterior to the mastoid tip, and line B marks the length of the PAA superior to the mastoid tip. The posterior course was measured from the center of the external auditory canal as it passed through the Frankfort plane (line C), and posterior to the helical attachment in a plane drawn from the superior orbital rim through the superior attachment of the helix to the scalp (line D).
As seen in Figure 2, subtraction angiography documented the remarkable anastomotic network between the ipsilateral superficial temporal artery, anterior auricular artery, and the occipital artery, as well as the contralateral cutaneous vascular territories.

The posterior auricular skin has been used as a free graft to the face because it has been considered a good color and texture match, with an inconspicuous donor site. The PAA island flaps have been used for conchal repair and pedicled flaps for microtia, auricular reconstruction, and mastoid obliteration. Composite free flaps based on the anterior auricular artery branch of the superficial temporal artery to repair skin and cartilage defects of the nose have also been described.

The PAA has a predictable course in the posterior auricular sulcus. The artery’s branching pattern over the auricle and temporal bone and its relationship to bony and soft tissue landmarks were consistent. The angiosome includes the anterior and posterior surfaces of the auricle and the periauricular skin superiorly, posteriorly, and inferiorly.

Our results describing the vascular anatomy and angiosome of the PAA were consistent with the results of other studies, most notably Whetzel and Mathes. The angiosome of the PAA is substantial and consistent. Conservatively, a 4 × 8-cm myocutaneous free flap with a 2-cm vascular pedicle is feasible. A free flap of this size could prove useful in the repair and reconstruction of facial defects.

Not addressed by our study was the course and reliability of the venous drainage of this area. Recently Kobayashi et al evaluated the PAA and vein using ultrasound color Doppler flow imaging, finding that 77% had a readily identifiable vein. The use of ultrasound preoperatively and intraoperatively to locate the vascular pedicle may potentially expand the clinical applications for this versatile and underused flap.

The cutaneous distribution suggests that a large pedicled or island flap based on the PAA may be raised safely as a myocutaneous or myofasciocutaneous flap with temporalis fascia and/or peristeum. Further studies may extend the clinical application to include free flaps based on the PAA.

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