The Posterior Auricular Artery of the Cat

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Summary: The posterior auricular artery and its whole ramifications of the cat were investigated by means of the acryl plastic injection method. This artery arose directly from the second curvature of the external carotid artery or rarely in common with the superficial temporal artery, between the origins of the digastric and the styloglossal muscles, and gave rise to the styloglossal, the sternomastoid, the mandibular glandular and the mandibular lymph nodular branches on the lateral side of the styloglossal muscle. The stylomastoid artery, one of the important branches of this artery, gave off branches to the external auditory meatus and the mucous membrane lining the tympanic cavity. The parent artery then gave rise to the temporal branch, and many branches supplying the auricle: the primary lateral, the secondary lateral, the intermediate auricular and the occipital branches. It finally divided into the medial auricular and the frontal branches. The main stream of this artery represented an important vessel which sent not only a majority of the blood to the auricle, but also to the middle ear and the retro-mandibular region.

Concerning the posterior auricular artery of the cat, Hürlimann (1913) published a description, as the major auricular artery, of its distributing branches to the auricle, but did not provide details on many other important ramifications. Since then, many scholars working on the blood supply of the masticatory muscles, the ear and the salivary glands, have studied the branches of this artery, relating to these structures to some extent.

The present paper deals with the whole ramifications and distributional features of the posterior auricular artery of the cat, discussing the previous literature.

Materials and Methods
Sixty adult cats were used for this study. Acryl plastic was injected via the common carotid arteries by the method of Taniguchi et al. (1952, 1955). Fifty of the above injected heads were treated with sodium hydroxide to prepare corrosion specimens of the carotid arterial system. The remained ten heads were preserved in formalin solution for dissection. The corrosions were used mainly for observation and measurement of the posterior auricular artery and its branches. For dissecting the stylomastoid artery, the petrosal region decalcified with
5% HCQ was employed. This artery was fine and fragile because of its passage within the hard temporal petrosa, so that only ten examples could be obtained as satisfactory specimens of this branch.

Findings

I. General aspect of the posterior auricular artery

When the external carotid artery passed posterosuperiorly between the digastric and the styloglossal muscles, that is, between the anteroinferolateral margin of the tympanic bulla and the mandibular gland, the posterior auricular artery (0.60~1.35, M. 0.95 mm in diameter) diverged posterosuperiorly from the posterior wall of the secondary curvature (Hürlimann 1913) of the external carotid between the origins of the facial and the superficial temporal arteries in 118 of the 120 examples observed (Figs. 2, 4, 5, 7), or in common with the superficial temporal in two cases (Fig. 6). The styloglossal branches were the first branch of this artery (Figs. 2, 7). In the above two cases, the common trunk bifurcated after sending off these branches (Fig. 6). The posterior auricular still continued along the inferior margin of the anular cartilage, superomedial to the mandibular gland, and posterosuperiorly across and medial to the facial nerve up to lateral to the stylomastoid foramen (Fig. 5), where it gave rise to the stylomastoid artery (Figs. 7, 8). The parent vessel en route gave rise to the sternomastoid, the mandibular glandular, the mandibular lymph nodular, the external auditory meatus and the parotid branches (Figs. 7, 8, 10), showing many variations as regards the locations of the origins of these branches.

The artery, after bending superoposteriorly along the anular cartilage, gave rise to the primary and secondary lateral auricular and the occipital branches, independently or in common with them, in the height of the superior margin of the stylomastoid foramen (Fig. 7). Then, after giving off the temporal branch (Fig. 2, 21), it bent forwards behind the cartilage to pass beneath the middle cervico-auricular muscle, where the intermediate auricular branch diverged (Figs. 3, 22). On reaching a position behind a recess at the medial crus of the helix, the artery terminated in the medial auricular and the frontal branches (Figs. 3, 23).

II. Branches of the posterior auricular artery (Table 1)

1) Styloglossal branches

These branches (0.05~0.35, M. 0.15 mm in diameter), which numbered one to three (two in 46 cases, one in 45 cases and three in 19 cases), diverged from the parent artery in 110 of the examples observed (Figs. 7, 8), from the external carotid in eight cases, and via the common trunk between the parent and the superficial temporal arteries in two cases. They were the first branch of the parent artery in 98 cases, and in common with the mandibular lymph nodular branch, or the parotid branch, rarely the mandibular glandular or the stylomastoid artery. Such common trunks were mostly the first branch. In 25 of the above 65 cases in which the branches were two or more, the distal one arose in common with the sternomastoid branch as the second branch. This branch passed superomedially along the styloglossal muscle to supply it from its origin (Figs. 5, 7). It gave off a branch to the hypotympanicum (about 0.09 mm) (branch to the anteroinferior wall of the tympanic groove by Goto 1959) superomedially (Fig. 2), which entered the hypotympanicum penetrating the bone tissue at the inferoposterior margin of the external auditory meatus and supplied the mucous membrane lining the tympanicum with twigs of the stylomastoid artery.
Table 1. The whole ramification of the posterior auricular artery of the cat. Numbers and abbreviations in this table coincide with those in the text and list of abbreviations.

### Posterior auricular artery (pa)

1. **Styloglossal brr. (sy)** → Br. to the hypotympanicum
2. **Sternomastoid br. (se)** → Styloglossal br. (sy)
3. **Mandibular gland. br. (mg)**
4. **Mandibular lymph nod. br. (mL)**
5. **Parotid gland. br. (pg)** → Parotid lymph nod. br.
   - Mandibular gland. br. (mg)
   - Mandibular lymph nod. br. (mL)
   - Styloglossal art. (sa)
   - External audi. meatus br. (ea)
6. **External audi. meatus br. (ea)**
7. **Styloglossal art. (sa)** → i) **Sternomastoid br. (se)**
   - ii) **External audi. meatus br. (ea)**
   - iii) Br. to the promontorium → Br. to the auricul. br. of the vagus n.
   - iv) **Br. to the chorda tympani**
   - v) **Br. to the mastoid cells**
   - vi) **Tympanic tensor br.**
8. **Lateral auricul. brr.** → Parotid gland. brr.
9. **Occipital br. (oc)** → Parotid lymph nod. br.
10. **Temporal br. (to)** → i) **Br. to the crus of the helix (ch)** → Twig to the scapha (sc)
    - ii) **Br. to the epiotympanicum (ep)**
    - iii) **Temporomand. joint br.**
11. **Intermediate auricul. br. (ia)**
12. **Medial auricul. br. (ma)**
13. **Frontal br. (ft)** → i) **Anterior temporal br. (at)** → The deep layer br. (dl)
    - ii) **Br. to the zygomaticomandibular m.**
    - iii) **Middle temporal br. (mt)** → Br. to the zygomaticomandibular m.
    - iv) **Accessory posterior temporal br.**
    - v) **Posterior temporal br.**
2) Sternomastoid branches

These branches (0.15~0.35, M. 0.21 mm in diameter) were found to be two in 84 cases and one in 36 cases of the examples observed. They arose from the stylomastoid artery in all cases (Fig. 7), and additionally from the posterior auricular directly in 83 cases and from the parotid branch in one case. They mostly were the secondary branch of the posterior auricular, but sometimes arose distal to the origin of the mandibular glandular branch as the third branch.

This branch arising from the posterior auricular was located above the origin of the styloglossal muscle and bent inferomedially to supply the insertion of the sternomastoid (Fig. 7) after giving off a twig to the origin of the digastric (about 0.15 mm). This branch arising from the stylomastoid supplied the insertion of the same named muscle. Those arising from both the posterior auricular and the styloglossal arteries anastomosed with each other intramuscularly. When the branch of the former was lacking, the latter was thickened to supplement for it.

3) Mandibular glandular branch

This branch arose from the facial in 109 cases, from the lingual, and the external carotid in one case, respectively. It arose directly from the posterior auricular in 26 cases, but in 17 of them (Fig. 18) was an accessory of the similar branch arising from other vessels.

Two types of origin related to the posterior auricular were observed as follows.

i) The branch (0.75~1.15, M. 0.85 mm in diameter) arising from the posterior auricular directly, seen in nine of the above 26 cases, arose from its posterolateral wall as its secondary or rarely its fourth branch. It passed posterolaterally to enter the hilus on the posterior margin of the gland.

ii) The branch (0.10~0.50, M. 0.35 mm in diameter) arising from the parotid branch, seen in 17 of the above 26 cases, and numbering two in ten cases and one in seven cases, arose from its superolateral wall (Fig. 18) between the parotid and the mandibular glands. It ran inferolaterally to enter the gland from its superomedial surface. This type of branch was usually thinner than the former i), since the main glandular branch was supplied from the facial, the external carotid or the lingual artery.

4) Mandibular lymph nodular branch

This branch (0.25~0.55, M. 0.34 mm) arose from the posterior auricular in 80 of the examples observed (Figs. 8, 10), from the external carotid in 35 cases, from the facial in three cases and from the superficial temporal in two cases.

Various features were shown in the origin of the branch arising from the posterior auricular as follows. It derived i) independently from the parent artery in 42 cases, ii) in common with the parotid branch in 23 cases (Figs. 1, 7), iii) via a common trunk between the parotid and the mandibular glandular branches in eight cases, iv) in common with the styloglossal branch as the first branch of the parent artery in six cases, and v) from the mandibular glandular branch arising from the parent artery in one case. Medial and lateral mandibular lymph nodes (Miyata 1966) were seen on both sides of the facial vein. The lymph nodular branches in 14 cases of the above i) and one case of the above ii), supplied both nodes, and those in the remaining 65 cases only the lateral nodes. Branches supplying only the medial nodes were not observed. The lymph nodular branch diverged from the anterolateral wall of the posterior auricular at the anterior margin of the external auditory cartilage, independently or in common with other branches. It ran inferolaterally between the mandibular gland and the
masseter muscle, giving off twigs to the facial nerve in company with it, on the massteric fascia up to the lateral nodes (Fig. 8). This branch sent off small twigs to the masster (Fig. 9) in three cases, although the massteric branch of the external carotid was lacking.

5) Parotid branch

This branch (0.35~0.75, M. 0.45 mm in diameter, Figs. 8, 10) arose directly from the posterior auricular or from the primary and secondary lateral auricular branches of the parent artery. The former, always one in number, was seen in 115 of the examples observed. In the remaining five cases, it was not seen, but the latter was well-developed.

The parotid branch demonstrated various relations with other branches in its origin, as shown in Figure 2, in 107 of the above 115 cases. In the remaining eight cases, it arose independently from the parent artery. This branch passed superolaterally, lateral to the facial nerve passing inferolaterally, and penetrated laterally into the anterior portion of the parotid gland from its inferomedial surface. Intragnadularly, it gave off twigs to this portion and the accessory parotid gland, while some of those emerging on the surface of the gland bent forwards to supply the facial portion (Crouch 1969) of the platysma and the zygomatic branch of the facial nerve in company with it. They spread into a fine network to anastomose with branches to the platysma of the superficial temporal and of the facial nerve (Fig. 11). The parotid lymph nodular branches (0.15~0.40, M. 0.25 mm in diameter) numbered one to three (one in 16 cases, two in five cases and three in three cases) in 24 of the examples observed. In the 16 single cases, this branch always arose from the parotid branch (Fig. 10). In the five double cases, an additional branch arose from the secondary lateral auricular branch. In the three triple cases, a similar branch addition-ally arose directly from the posterior auricular. In the remaining eight cases, only one similar branch arose from the secondary lateral auricular branch. The parotid lymph nodular branches supplied the anteroposteriorly elongated lymph node located on the posterior margin of the parotid gland.

6) External auditory meatus branch

This branch (0.10~0.35, M. 0.21 mm), one or two in number, arose from the posterior auricular in 24 cases (two in one of them), from the parotid branch in 73 cases (two in two of them) (Fig. 10), and from both sources in 23 cases. It diverged superolaterally from the anterior wall of the parent vessel passing posterosuperiorly beneath the external auditory meatus, or from the parotid branch (Fig. 10). This branch ran superolaterally outside the meatus cartilage (Fig. 10), and penetrated it to supply the posterior wall of the skin of the meatus including the cartilage.

7) Stylomastoid artery

This artery (0.25~0.40, M. 0.31 mm in diameter) arose posterosuperomedially from the posterior or lateral wall of the posterior auricular, when it passed posterosuperiorly across and medial to the facial nerve, and ran posterosuperiorly towards the stylomastoid foramen (Figs. 2, 7, 8). Before entering it, the artery gave rise to the sternomastoid and the external auditory meatus branches mentioned above (Figs. 2, 13). Immediately after entrance, it gave off a branch to the promontorium (Goto 1959) superomedially, which was rather thicker than the main continuation of the artery in company with the facial nerve (Figs. 14, 16, 17). The stylomastoid artery gave off a branch to the chorda tympani (Fig. 15) (Goto 1959) in the facial nerve canal and posteromedial to the nerve, and passed superomedially medial to the communicat-
The parotid branch mostly arises in common with other branches, except in eight cases examined here, in which the parotid branch arises separately.
ran across and above the facial nerve antero-laterally up to its anterolateral margin (Figs. 16, 17), where one to three branches were supplied to the mastoid cells posterosuperiorly (Fig. 14). The parent artery, becoming thinner, continued medially to supply the ggl. geniculi, after giving off the tympanic tensor branch (Goto 1959) anteromedially.

i) Sternomastoid branch
This branch arose from the posterior wall of the parent artery and ran posteroinfero-medially along the tympanic bulla to supply the insertion of the same named muscle (Fig. 7). It became thicker when the above-mentioned similar branch of the posterior auricular artery was lacking.

ii) External auditory meatus branch
This branch mostly arose from the anterior wall of the parent artery (Figs. 13, 14). In 29 cases, however, it arose from the medial wall near the origin of the stylo-mastoid artery (Figs. 2, 12). This branch

Fig. 2. Schematic illustration of the ramifications of the posterior auricular artery.
The main stream of this artery was removed distal to the origin of the temporal branch. The branch to the hypotympanicum can be seen to arise from the sternomastoid branch, and penetrates the bone wall of the tympanic bulla. In this case, the temporomandibular joint branch (cp1) arises from the branch to the epitympanicum and anastomoses with the similar branch (tj) of the maxillary artery. The temporal branch gives rise to the branch to the crus of the helix and the anterior temporal branch. The deep layer branch diverges from the anterior temporal branch, and the zygomaticomandibular branch from the deep layer branch. The temporal branch gives rise to the middle temporal, the accessory posterior temporal (ap) and the posterior temporal (pt). Also see abbreviations on page 258.
entered the stylomastoid foramen with the parent artery, behind the facial nerve, and bent immediately forwards to penetrate the anterior wall of the foramen to supply the posterior wall of the osseous external auditory meatus (Figs. 2, 12).

iii) Branch to the promontorium

This branch ascended anteromedial to the facial nerve up to the communicating point between it and the auricular branch of the vagus nerve, where it gave off an extremely fine twig to this auricular branch (Figs. 16, 17). The main stream curved inferomedially in the inferior wall, which lacked osseous elements, of the facial nerve canal, and divided into the stapedial branch (Goto 1959) and the posterior branch to the promontorium (Goto 1959) between the chochlear and vestibular fenestrae. The former passed anteromedially to supply the same named muscle and bone. The latter ascended between both fenestrae to supply the mucous membrane lining the posterior half of the promontorium and the hypotympanicum.

iv) Branch to the chorda tympani

This branch leaving the facial nerve canal with the same named nerve, passed forwards along the lateral surface of the chorda tympani process (Goto 1959), then the supero-posterior margin of the malleus and beneath the insertion of the tympanic tensor muscle, to supply the chorda (Fig. 15).

v) Branches to the mastoid cells

These branches passed backwards to supply the mastoid cells (Fig. 14).

vi) Tympanic tensor branch

This branch, being rather fine, passed anteromedially to supply the insertion of this muscle, not anastomosing with the same named branch of the internal retial branch (Takemura 1982).

8) Lateral auricular branches.

These branches were observed as the proximal (0.15~0.55, M. 0.35 mm, Hürli-
the secondary branch was well-developed to supplement it.

9) Occipital branch

This branch (0.15~0.50, M. 0.37 mm), observed in all examples, arose separately distal to the origin of the secondary auricular, in common with the secondary auricular, or between it and the primary auricular. This branch passed superomedially posteromedial to the antitragus on the convexity of the auricle down to the superficial cervicocutaneous portion (Crouch 1969) of the platysma, where it spread anterior to the posterior and lateral branches (Figs. 3, 4, 22). The former supplied the superficial cervicoauricular and the cervicoscutular muscles, superficial to the supply area of the auricular branches mentioned above. The second supplied the cutaneous colli muscle of the platysma, the trapezius muscle and the skin covering them. The last supplied the skin of the retroauricular portion, anastomosing with the peripheries of the secondary lateral auricular (Fig. 3).

10) Temporal branch

This branch (0.45~0.70, M. 0.58 mm) passed superoposteriorly up to lateral to the origin of the zygomaticomandibular muscle, where it gave off the branch to the crus of the helix forwards from its anterior wall (Figs. 2, 19, 21). It continued to pass lateral to the zygomaticomandibular muscle (Toldt 1905, Yoshikawa et al. 1961, 1965, 1969, Suzuki 1977) up to a position between it and the temporal muscle, where the anterior temporal branch (about 0.34 mm, Fujimoto 1959) was derived inferomedially from its posterior wall (Figs. 2, 19). It then ran along the posterior border of the temporal muscle up to its posterior end, where it gave off the middle temporal branch (about 0.30 mm) superomedially from its posterior wall (Figs. 2, 19). However, a common trunk between the anterior and the middle temporal was seen in 23 cases. The temporal branch in the middle of the posterior border of the temporal muscle, gave rise to the accessory posterior temporal branch (about 0.35 mm, Fujimoto 1959), which entered its deep layer as the posterior temporal branch (about 0.55 mm, Fujimoto 1959) (Fig. 2).

i) Branch to the crus of the helix (a. auricularis profunda by Hurlimann 1913)

This branch (0.35~0.55, M. 0.47 mm) passed forwards between the temporal and the lateral tragic muscles, and gave off a twig (about 0.18 mm) to the scapha from its inferior wall (Figs. 2, 3, 21). This twig to the scapha in 116 cases penetrated the auricular cartilage at its basis and passed to its concavity to supply the scapha and part of the antihelix (Fig. 3). In cases where two twigs to the scapha were seen, the branch to the epitympanicum ( tympanic suprafossal branch by Goto 1959) arose from the twig to the scapha arising from the branch to the crus.

The branch to the epitympanicum passed forwards between the upper border of the anular cartilage and the temporal crest (in the crab-eating monkey, Suwa 1981) and gradually curved inferomedially. In 49 cases, it spread en route forwards into the temporomandibular joint branches (Figs. 2, 19, 21) which communicated with those of the maxillary artery beneath the basis of the zygomatic process (Figs. 2, 19, 21).

The branch to the epitympanicum entered the tympanic cavity after penetrating the bone above the external auditory meatus, to supply the mucous membrane lining the epitympanicum. A similar branch arising from the stylomastoid artery followed a similar course in four cases (Figs. 13, 14).

The branch to the crus of the helix curved anterosuperolaterally at the meeting between the lateral tragicus and the rotator auris muscles (Crouch 1969), also deep to
The latter onto its lateral side, up to before the helicis muscle. Here it gave off twigs to this muscle posteriorly and superiorly. The latter arborized on the convexity of the lateral crus of the helix to supply it, anastomosing with twigs of the medial auricular branch (Figs. 3, 22). The parent branch still continued anteromedially inferolateral to the adductor auris superior (Crouch 1969), along the lower border of the auricular cartilage, giving off small twigs to anastomose with the medial auricular branch. It was distributed finally to the frontal portion after giving off small twigs to the anterior border of the medial crus, anastomosing with the same fellows and the superior palpebral branch of the superficial temporal.

ii) Anterior temporal branch (Fujimoto 1959)

This branch passed inferomedially between the temporal and the zygomaticomandibular muscles and ran within the temporal muscle after giving off the deep layer branch (about 0.28 mm). It reached a position between the periosteum of the temporal crest and the fascia of origin of the zygomaticomandibular (Fig. 20), and gave rise to the same named branch supplying its origin (about 0.22 mm) in 83 cases (Figs. 2, 19). In the remaining 37 cases, however, this branch arose from the anterior temporal branch extramuscularly. The deep layer branch still running on the periostium curved medially along the basis of the zygomatic process towards the infratemporal fossa to supply the anterior half of the origin of the deep layer.

The anterior temporal branch passed anterosuperiorly in an arc to supply the deep layer, anastomosing with the peripheries of the deep temporal arteries.

iii) Middle temporal branch (Fujimoto 1959) (Fig. 2)

This branch followed a similar course to the branch ii), although somewhat superficially, and supplied the deep layer.

iv) Accessory posterior temporal branch (Fujimoto 1959) (Fig. 2)

This branch passed forwards on the temporal fascia to supply it and the superficial layer.

v) Posterior temporal branch (Fujimoto 1959) (Fig. 2)

This branch, being a course continuation of the temporal branch, passed forwards in an arc before the lambdoidal margin of the occipital bone on the deep layer and terminated to anastomose with the peripheries of the superficial temporal. En route it gave off thick twigs upwards and many fine twigs downwards, which supplied the origin of the deep layer.

11) Intermediate auricular branch
(Hürlimann 1913)

This branch (0.45~0.75, M. 0.57 mm) was the largest of the other auricular branches, and arose anterosuperiorly from the posterior wall of the posterior auricular artery (Figs. 3, 22). It passed in the same direction at the basis of the convexity of the auricle, parallel to and above the parent artery, and then towards the auricular apex after bending superolaterally at the medial end of the m. transversus auriculi (Crouch 1969). Here, it spread into branches to the anterior, the apex and the posterior, all of which ascended on the muscle located in the middle of the convexity of the auricle arborizingly. The former anastomosed with the medial auricular branch, and the latter with the lateral auricular branch (Figs. 3, 22). The distribution territory of this branch was in general both the convexity and concavity of the auricle ranging from the m. transversus auriculi to the apex. Some of the three branches supplied the concavity after penetrating the center of the auricular cartilage, then spread arborizingly on the convexity (Fig. 23), and penetrated the
Fig. 3. Dorsal view of the arterial distribution of the auricle.

The auricle of the cat is supplied mostly with many branches of the posterior auricular artery. They penetrate the auricular from its dorsal surface (convexity) to its ventral surface (concavity) to supply both surfaces, and again penetrate the cartilage at the helix to anastomose with one another.

The primary (la₁), secondary (la₂) lateral auricular and the occipital branches arise via a common trunk. They are distributed to behind the saccus cutaneous marginalis, the intermediate auricular (ia) to the center of the auricle, the medial auricular (ma) to its anterior portion, and the branch to the crus of the helix (ch) to the medial and lateral crura, respectively.

The posterior auricular artery terminates in the frontal and the medial auricular branches. Also see abbreviation on page 258.
cartilage at the helix onto the convexity to make rich anastomoses between themselves, twigs of the medial auricular, the primary and the secondary auricular penetrating the cartilage as well as the branch to the crus (Fig. 3).

12) Medial auricular branch (Hürlimann 1913)

This branch (0.30~0.50, M. 0.41 mm), which was one of the terminal branches of the posterior auricular artery, curved and arborized superolaterally (Figs. 3, 22). The rather thicker twigs were distributed to the concavity of the auricle after penetrating the cartilage. The others anastomosed with the peripheries of the intermediate auricular branch near the apex, or on the concavity of the helix with themselves and the peripheries of the intermediate branch (Figs. 3, 22). The distribution territory of this branch was both the convexity and concavity of the anterior portion of the auricle, except the medial and lateral crura of the helix (Fig. 3).

13) Frontal branch

This vessel (0.20~0.30, M. 0.24 mm), being another terminal branch, passed anterosuperomedially to supply the mm. interoscutularis (N.A.V.), scutuloauricularis superficialis (N.A.V.) and levator anguli oculi medialis and the skin of the frontoparietal region (Figs. 3, 23).

Discussion

Concerning the origin of the posterior auricular artery in the cat, Hürlimann (1913) noted that it was located on the second curvature of the external carotid. In addition to his description, Fujimoto (1959) stated that its location was in the anterior margin of the osseous tympanic bulla. The statement of Miller (1964) that its location was medial to the digastric muscle in the dog, was also given consideration.

The present author observed a common trunk between the posterior auricular and the superficial temporal in two cases, although such a trunk was not reported by Hürlimann, Ryumon (1970) and others. The formation of this trunk appeared to occur because the superficial temporal was pulled up towards the posterior auricular. This was one reason why the origin of the trunk was located at that of the usual posterior auricular, and the styloglossal branch arising from this artery in usual cases left the trunk.

The styloglossal and the digastric branches were reported by Hürlimann. Although they were distributed to the insertion of these muscles, such branches in this study supplied only the origin of the same muscles, not extending towards the insertion. Considering the locational relation between the origin of the muscle and the passage of the parent artery, the insertion described by Hürlimann appeared strange as the supply area of these arteries.

Goto (1959) stated that the branch to the anteroinferior wall of the tympanic groove arose from the posterior auricular right distal to its origin. This branch, however, was termed the branch to the hypotympanicum, since this branch arising from the styloglossal branch actually supplied mainly the hypotympanicum.

No previous workers have described the sternomastoid branch arising from the posterior auricular. The same named branch reported by Goto represented ramifications of the stylomastoid artery.

The submandibular glandular branch in the cat was reported to some extent in earlier work, in which the blood supply of this gland in some mammals was investigated by Takashima (1967). He noted that it (corresponding to the mandibular glandular branch in this study) diverged from the posterior auricular and the facial arteries. The present author, in addition to his report, observed those vessels diverging from the
external carotid, or the lingual, in only two cases.

Concerning the mandibular lymph nodular branch, Miyata (1966) stated that it gave off many twigs to both the parotid and the submandibular (designated as the mandibular in this paper) glands in its course. This lymph nodular branch was found in 80 of the 120 examples observed, and directly reached the lymph node without any ramification in about half of the 80 cases. In three of these, it supplied small twigs to the masseter muscle. Such cases with branches supplying both glands as reported by Miyata, that is, arising in common with each other as mentioned above, do not represent more than 10% of all examples observed. Hürlimann reported that the small twigs to the masseter, though not pointed out by Miyata, were seen in cases where a similar branch was not derived from the external carotid as described in this paper. Fujimoto stated that the posterior anuricular gave rise to the massesteric branch proximal to the origin of the temporal branch. This massesteric branch proximal to the origin of the temporal branch. This massesteric may correspond to that of Hürlimann and of Fujimoto. Suzuki (1977) referred only to the zygomatico-mandibular branch.

Miyata reported that the mandibular lymph nodular branch was supplied mainly from the facial artery. In the present study all the nodes could be observed in two, medial and lateral groups. The former was supplied mainly from the facial artery as mentioned by Miyata, but the latter was mainly from the posterior auricular at least.

The parotid branch was described by Kitamura (1970) as a direct branch arising from the posterior auricular and from the occipital branch of it. The parotid branch in this paper may correspond to the former vessel of Kitamura, and the latter to the primary and secondary lateral auricular branches mentioned by Hürlimann. Both lateral branches, however, would not correspond to the parotid branch employed in the present paper, since they were located in contact with the medial surface of the parotid gland and just gave off numerous twigs to it.

No description has been offered for the parotid lymph nodular branches. The number and thickness of these branches may show variations according to those of the nodes themselves. The external auditory meatus branch employed in this paper was that supplying the cartilaginous portion of the meatus, and the similar one arising from the stylomastoid artery was distributed chiefly to the osseous portion. The present description is the first to refer to the parotid nodular and the external auditory meatus branches.

Hürlimann and Nickel et al. (1976) pointed out the existence of the stylomastoid artery, but no detailed statement was given. The present author did not obtain such measured values at the origin of this artery as reported by Hürlimann; the latter dimensions were three to five times as thick as those in the present study. In the investigation undertaken by Goto, referring to the blood supply of the middle ear in the cat, he stated that the stylomastoid artery was the source of many branches, that is, the primary and secondary inferior tympanic, the promontory, the stapedial and the tympanic tensor branches, etc. The present author will discuss these branches below. The branch to the epitympanicum, usually arising from the temporal branch, rarely diverged from the stylomastpanicum. Additionally, Goto did not describe the origins of this artery, the external auditory meatus branch and the branch to the mastoid cells. The branch to the promontorium was actually rather thicker than the main continuation running along the facial nerve. Such par-
ticular features may appear as a result of the huge tympanic bulla of the cat. That is to say, although it was supplied with many twigs deriving from other sources, they were so tiny that the bulla was not sufficiently supplied even by all of them. Naturally, the vessel arising from the stylomastoid artery was necessary as a nutrient supply for the bulla. Goto recognized differences between the primary and secondary inferior tympanic branches. However, the present author regarded them as small twigs based on the indistinguishability between them, and was able to confirm that this area was actually supplied by them and the branch to the hypotympanicum.

The blood supply of the auricle in the cat was discussed in detail by Hürlimann. In particular, the primary and secondary lateral, the intermediate and the medial auricular branches, were termed by him. He also noted that the third arose in common with the fourth, and that the temporal branch was one of the termini of the posterior auricular; namely, he concluded that this artery terminated in the temporal branch and the common trunk mentioned above. However, since the arising direction and steep curvature of the temporal branch were not natural, the above common trunk should be employed as the main stream of the posterior auricular artery. The two termini of this artery were thus found to be the medial auricular and the frontal branches.

The temporal branch was described by Fujimoto who investigated the distributing arteries of the temporal muscle in some mammals. The tympanic suprafossal branch arising from the posterior auricular as reported by Goto, may correspond to the branch to the epitympanicum in the present work. This branch, however, diverged from the twig to the scapha of the temporal branch, not being a direct branch of the parent artery, and was distributed to the epitympanicum. This vessel was therefore termed the branch to the epitympanicum on reference to the branch to the hypotympanicum. The twig arising from the posterior auricular and supplying the zygomaticomandibular muscle mentioned by Suzuki (1977), diverged from the anterior temporal of the temporal branch. This was also termed the zygomaticomandibular branch.

The branch to the crus of the helix was certainly equal to the a. auricularis profunda mentioned by Hürlimann. Miller also described this vessel arising from the posterior auricular artery in the dog. A similar description in carnivora has been given for this artery in Nomina anatomica veterinaria (N.A.V.). The branch to the crus of the helix in the cat, however, arose from the temporal branch of the posterior auricular, and was distributed to this limited area. Further, the deep auricular artery arising from the maxillary artery in man supplied the posterior surface of the temporomandibular joint, the external auditory meatus and the outer surface of the tympanic membrane. According to the descriptions of N.A.V. and Hürlimann, the joint branch in the cat has been employed as the deep auricular artery in man. Davis et al. (1943) mentioned that the deep auricular in the cat arose from the maxillary as seen in man, and corresponded to the joint branch described by Hürlimann. The present author has thus employed this branch as the branch to the crus of the helix, but does not agree with the name, the deep auricular.

Acknowledgements

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Literature Cited


<table>
<thead>
<tr>
<th>Abbreviations</th>
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<tr>
<td>at : Anterior temporal br.</td>
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<tr>
<td>ch : Br. to the crus of the helix</td>
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<tr>
<td>dl : The deep layer br. of the ant. temp. br.</td>
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<td>E : External auditory meatus</td>
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<tr>
<td>ea : External auditory meatus br.</td>
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<td>ec : External carotid artery</td>
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<tr>
<td>ep : Br. to the epitympanicum</td>
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<tr>
<td>fr : Frontal br.</td>
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<tr>
<td>ia : Intermediate auricul. br.</td>
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<tr>
<td>M : Mandibular gland</td>
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<tr>
<td>la₁ : Primary lateral auricul. br.</td>
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<tr>
<td>la₂ : Secondary lateral auricul. br.</td>
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<tr>
<td>ma : Medial auricul. br.</td>
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<td>mg : Mandibular gland. br.</td>
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<td>ml : Mandibular lymph nod. br.</td>
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<td>MS : Masseter muscle</td>
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<td>mt : Middle temporal br.</td>
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<tr>
<td>oc : Occipital br.</td>
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<tr>
<td>P : Parotid gland</td>
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<tr>
<td>pa : Posterior auricular artery</td>
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<td>pg : Parotid br.</td>
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<tr>
<td>sa : Stylomastoid artery</td>
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<td>sc : Twig to the scapha</td>
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<td>se : Sternomastoid br.</td>
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<td>SF : Stylomastoid foramen</td>
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<td>SG : Styloglossal muscle</td>
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<td>su : Superficial temporal artery</td>
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<td>sy : Styloglossal br.</td>
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<tr>
<td>te : Temporal br.</td>
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<td>TP : Temporal muscle</td>
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PLATES
Explanations of Figures

Plate I

Fig. 4.  Posteroinferolateral view, showing the general ramification of the posterior auricular artery. ca. × 1.2.

Fig. 5.  Lateral view, showing the origin of the posterior auricular artery. ca. × 3.4.
The mandibular gland was removed and the digastric muscle was cut at its origin. The origin of the artery is located at the secondary curvature of the external carotid, distal to the origin of the facial artery (fa) and between the digastric and the styloglossal muscles. (F) Facial nerve.
Plate II

Fig. 6. Medial view. ca. X 3.2.

In this case, the posterior auricular artery arises via a common trunk (co) with the superficial temporal. This trunk is located at the level of origin of the usual posterior auricular, and divides after giving off the styloglossal branch. (fa) Facial artery.

Figs. 7 and 8. Lateral views, showing the course and branches of the posterior auricular artery covered by the parotid gland. ca. X 2.5, X 2.8.

In Figure 7, the sternomastoid branch supplies a twig to the digastric (*) and anastomoses with the sternomastoid branch (sa₁) of the stylomastoid artery. A common trunk (cl) is seen between the primary and secondary lateral auricular branches at the level of the stylomastoid foramen.

In Figure 8, the masseteric branch (me) arises from the external carotid.

Fig. 9. Anteroinferolateral view, showing the twigs to the masseter (mp) of the posterior auricular artery. ca. X 3.5.

In this case, the twigs diverge from the mandibular lymph nodular branch, usually without ramifications, but a similar branch to the external carotid shown in Figure 8 is lacking.

Fig. 10. Inferolateral view. ca. X 2.5.

The external auditory meatus branch running along the lower margin of the meatus laterally, penetrates the cartilage onto the skin behind it. Several twigs (1) of the parotid branch extend to supply the cervicofacial portion of the platysma. In this case, the parotid branch gives rise to the parotid lymph nodular branch (py). (PN) Parotid lymph node.

Fig. 11. Lateral view of the parotid branch in Figure 10. ca. X 1.1.

This branch gives rise to the twig (1) to the cervicofacial portion of the platysma, which makes a network intramuscularly with the similar twig (2) of the superficial temporal and the similar twigs (3) of the facial artery.
Plate III

Fig. 12. Lateral view, ca. X 4.2.
In this case, the external auditory meatus branch arising from the stylomastoid artery in usual cases diverges from the posterior auricular. This branch immediately enters the stylomastoid foramen in company with the same named artery, and penetrates its anterior wall (✓) or the skin of it (?).

Figs. 13 and 14. Lateral views, showing the stylomastoid artery. ca. X 6.5, X 6.0.
In Figure 13, this artery gives off the sternomastoid branch (sa₁) before entering the sternomastoid foramen.
In both figures, the branch to the epitympanicum arising from the twig to the scapha in usual cases, diverges in common with the external auditory meatus branch of the stylomastoid artery. The branch to the promontorium is rather thicker than the stylomastoid artery itself.
In Figure 14, the lateral wall of the epitympanicum has been removed to observe the course of the stylomastoid artery and the branches to the matoid cells. A loop-like course of this artery at the orifice of the stylomastoid foramen is formed due to the existence of the facial nerve. (S) Stapes.

Fig. 15. Medial view of the tympanic cavity. ca. X 6.2.
The branch (ct) to the chorda tympani runs forwards from the chorda tympanic process (PC) in company with the chorda (c) between the insertion of the tympanic tensor muscle (T) and the manubrium mallei (MM). (TM) tympanic membrane. (S) Stapes.

Figs. 16 and 17. Dissection and corrosion specimens, respectively. ca. X 8.5, X 9.8.
The bone wall of the tympanic cavity was removed to show the stylomastoid artery. The twig (vn) to the auricular branch of the vagus nerve diverges from the branch to the promontorium, medial to the communicating point between the above branch (V) of the vagus nerve and the facial nerve (F), where the stylomastoid artery runs forwards across the facial nerve. The branch to the promontorium is rather thick as seen in Figure 14.
Plate IV

Fig. 18.  Posterior view. ca. × 2.7.
In this case, the mandibular glandular branch diverging from the parotid branch is seen as an accessory supply route, not through the hilus since the main route (pe) comes from the external carotid to enter the hilus.

Fig. 19.  Lateral view, showing the ramifications of the temporal branch. ca. × 1.2.
The anterior temporal branch gives rise to the deep layer branch, from which the zygomatico-mandibular branch (zy) arises. The temporomandibular joint branch (tj) of the maxillary artery anastomoses with the similar branch (ep1) of the branch to the epitympanicum.

Fig. 20.  Posterosuperior view. ca. × 2.2.
The zygomaticomandibular muscle was removed. The deep layer branch of the temporal branch runs forwards on the temporal crest (TC) of the temporal bone.

Fig. 21.  Lateral view. ca. × 2.4.
The twig to the scapha arises from the branch to the crus of the helix. The temporomandibular joint branch (tj) anastomoses with the similar branch (ep1) of the branch to the epitympanicum.

Fig. 22.  Posterosuperior view of the auricular dorsum shown in Figure 4. ca. × 0.8.
The distribution features of the following vessels can be seen: the temporal, the branch to the crus of the helix, the primary and secondary lateral, the intermediate, and the medial auricular, the occipital and the frontal branches.

Fig. 23.  Posterosuperior view of the anterior portion of the auricular dorsum. ca. × 2.9.
The posterior auricular artery divides into the frontal and the medial auricular branches. The latter penetrates the auricular cartilage onto the concave side (*). The intermediate auricular branch runs on the transversus auriculi towards the apex of the auricle.