Cadaver studies of the anatomy of arterial supply to the inferior turbinates

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Keywords: inferior turbinate; blood supply

Summary
The anatomy of the arterial supply of the inferior turbinate was studied by dissection and serial histological sections. The arrangement was found to be constant, with a single main descending branch of the sphenopalatine artery entering its substance from above, 1-1.5 cm from its posterior border. This artery branches as it passes forwards within the turbinate, remaining close to the bone. As these pass anteriorly they give rise to arterial arcades which remain close to or within the bone, with the main artery increasing in diameter. The implications of these findings are discussed in a surgical context.

Introduction
Standard textbook descriptions of the arterial supply to the inferior turbinate have remained largely unchanged since the latter half of the last century[1-3], albeit that such descriptions have been more diagrammatic than verbal. The most common textbook description is that of superficial vessels, coursing over the surface of the inferior turbinate, forming an interlacing re-anastomozing network of vessels. These vessels are shown as being derived from two or more branches descending from the sphenopalatine foramen, dividing soon after they have exited from it. The latter is depicted as lying on the lateral wall of the nose, in the superior meatus behind the attachment of the middle turbinate.

In otolaryngological practice a concept has been formed of an 'exposed' portion of the feeding artery in the posterior extremity of the inferior turbinate, leading into a bony canal which is limited to its posterior half.

This study aimed to clarify the true position of the arteries supplying the inferior turbinates by dissections of cadavers, histological sections of the inferior turbinates, and review of the literature. Particular attention was paid to anatomy relevant to operations that are performed on the inferior turbinate, possible causes of persistent postoperative haemorrhage, and to the factors that might affect the efficacy of packs placed to arrest haemorrhage from them.

Paper read to Section of Laryngology, 4 May 1990

Methods
Dissections were performed on one side of 16 hemisected cadaver heads, and both on sides of one, including four right and 14 left. Firstly the anatomy of the main arterial branches supplying the inferior turbinates was established. Further dissection of the distribution of the vessels was performed under an operating microscope in three, after they had been amputated. All other turbinates were dissected in situ under a magnifying loop. From another hemisected head the inferior turbinates were removed and sections were taken at 5 mm intervals throughout their length for histological identification of the arteries, allowing detailed study of their relation to the bony skeleton of the turbinate.

Results
The findings demonstrated that previous textbook descriptions were largely inaccurate. Although there were minor variations, a general pattern emerged where the arterial blood supply was from a single descending arterial trunk (Figure 1). This was the main descending branch of the sphenopalatine artery, given off in the sphenopalatine foramen; the latter being under cover of the middle turbinate rather than

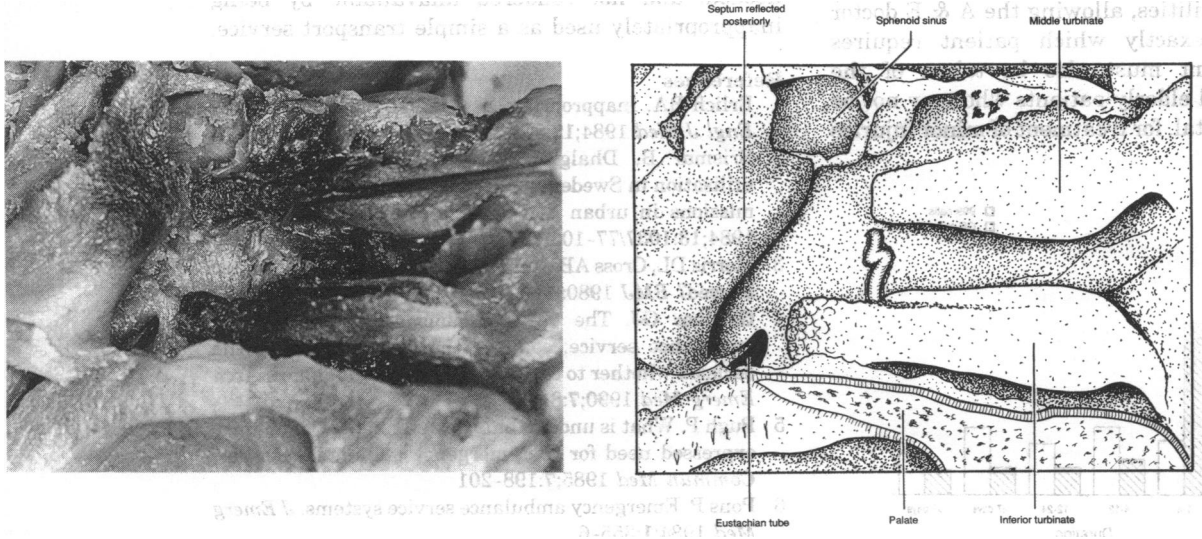

Figure 1. Photograph and drawing showing main arterial trunk to inferior turbinate

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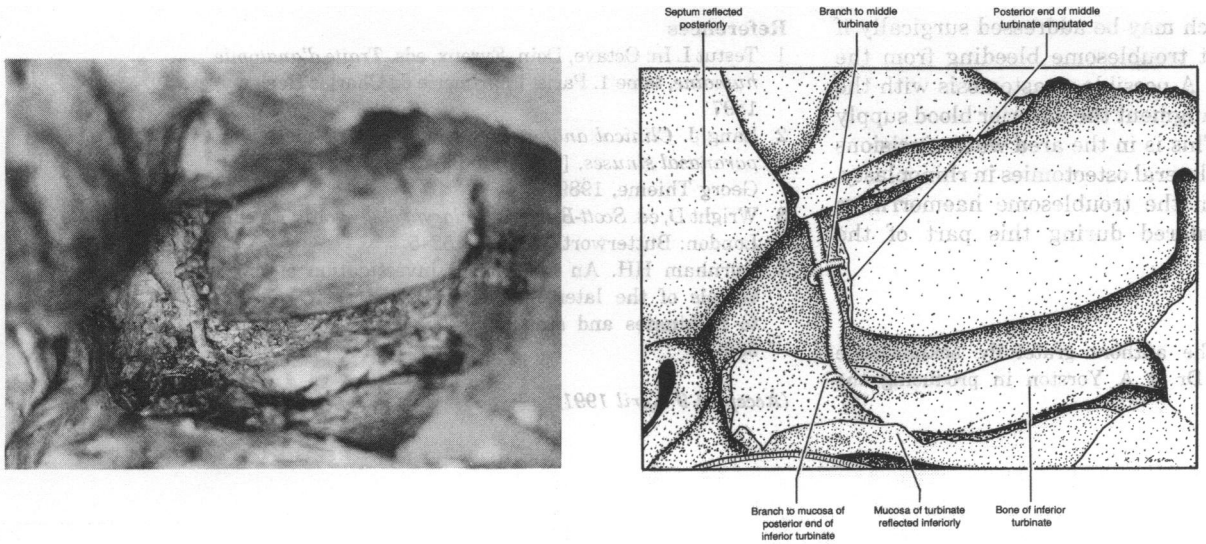

Figure 2. Main descending branch of sphenopalatine artery with branches into middle turbinate

behind it. Two cases were found in which the sphenopalatine foramen was in the superior meatus.

Whilst under cover of the posterior part of the attachment of the middle turbinate, a substantial branch is given off medially (Figure 2). This branch enters the substance of the middle turbinate and branches anteriorly and posteriorly, remaining close to the bone.

The descending main arterial trunk then passes down and slightly forward in a remarkably constant position. It enters the inferior turbinate on the superior aspect of its lateral attachment between 1.0 and 1.5 cm from its posterior tip. Here the artery enters a bony canal and branches into two. One branch remains high and lateral, while the other runs in a lower and more medial position. Both remain in bony canals or are closely applied to the bone for much of the length of the turbinate. The lower (medial) branch gives off branches which pierce the bone of the interior turbinate in its anterior part and form a regular pattern of alternating superior and inferior branches at right angles to the main artery (Figure 3). These branches remain close to the bone. Despite these frequent large branches, the artery increases in size as it passes anteriorly, suggesting that there is a significant additional bloodflow from anteriorly. This may be from an anastomosis with the facial artery via the pyriform aperture, or other intra-nasal vessels.

Posteriorly the fleshy tip of the inferior turbinate has a small branch supplying it that lies entirely within soft tissue.

Discussion

A previous anatomical study of this vasculature drew attention to the lack of anatomical descriptions, but appears itself to have been ignored[4]. This study shows a constant anatomical arrangement of considerable importance to those engaging in nasal surgery (especially endoscopic nasal surgery). The large vessel supplying the inferior turbinate crosses the middle meatus posteriorly and is at risk of injury, should surgery proceed posteriorly. There are many other surgical implications of these findings. They explain why trimming of any part of the turbinate bone may be followed by brisk and prolonged haemorrhage. The artery which is inevitably transected may be splinted open by fibrous attachment to the bone and be unable to contract. Venous bleeding may also occur by a similar mechanism. If the traditional view of the surgical anatomy[3] were correct, snaring of the posterior end of the inferior turbinate could be expected to be met with persistent haemorrhage. As the artery to the posterior tip of the inferior turbinate is not within a bony canal, and is a very small branch of the main artery to the inferior turbinate, the lack of haemorrhage associated with this procedure is explained. A constant main arterial trunk is

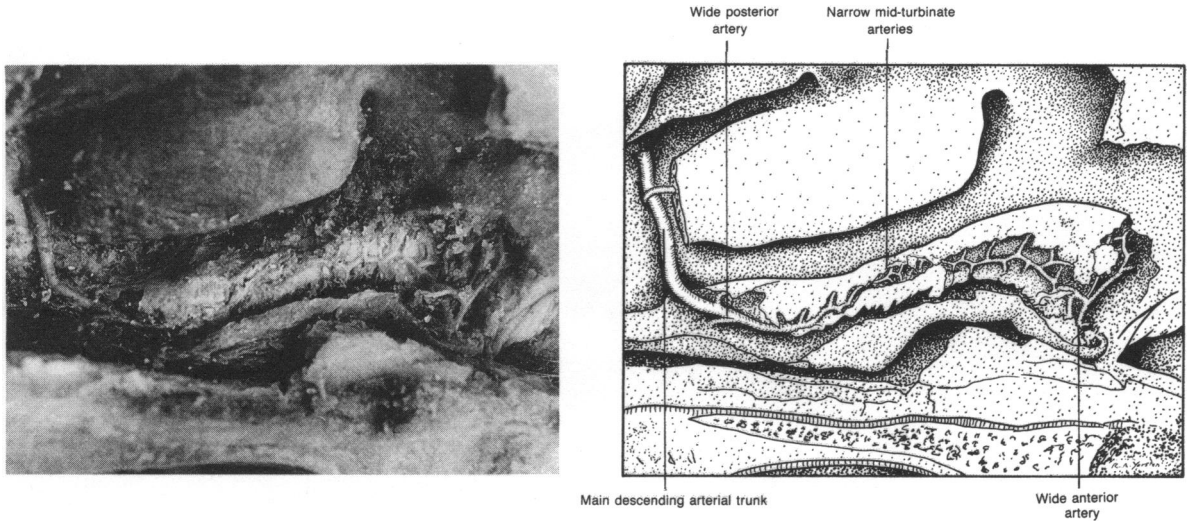

Figure 3. Intraturbinate arterial distribution, demonstrating arcades and the narrow mid-point of the artery

demonstrated which may be addressed surgically if there is persistent troublesome bleeding from the inferior turbinate. A possible anastomosis with the facial artery may augment the anterior blood supply of the turbinate. This is in the area where incisions are often made for lateral osteotomies in rhinoplasty, and would explain the troublesome haemorrhage sometimes encountered during this part of the procedure.

Acknowledgment: The authors gratefully acknowledge the help given by Dr R A Yorston in producing the illustrations.

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(Accepted 9 April 1991)