

Radiology in Focus

Excision of nasopharyngeal angiofibroma facilitated by intra-operative 3D-image guidance

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Abstract

The latest 3D-image guidance systems to assist surgeons have greatly improved over earlier models. We describe the use of an optical infra-red system to assist in the removal of a juvenile nasopharyngeal angiofibroma. The specific advantages of this system in pre-operative assessment, intra-operative evaluation and excision of the angiofibroma are discussed.

Key words: Computer assisted therapy; Angiofibroma; Surgery, operative

Introduction

Juvenile nasopharyngeal angiofibromas (JNA) are benign vascular tumours which occur in the nasopharynx of young males.¹ While JNA is a benign condition the tumours have a propensity for local extension into the adjacent pterygopalatine and infratemporal fossa. This can produce erosion of these adjacent structures and makes surgical excision technically difficult. A number of treatment options have been described for JNA but surgery forms the mainstay of therapy. The choice of surgical approach and extent of resection is determined by pre-operative imaging of tumour size and location^{2,3} and, as methods of radiological imaging have developed, the accuracy of this pre-operative assessment has improved.^{3–5} The importance of accurate pre-operative evaluation of tumour extent and location is underlined by the observation that incomplete resection can lead to recurrence rates as high as 40 per cent.^{2,6}

We present a case of JNA in which excision was planned and executed using a state-of-the-art 3D-image guidance system. Intra-operative 3D-image guidance facilitated a less invasive surgical approach, with combined open and endoscopic resection following initial embolization.

Case report

A 24-year-old male presented with a history of unilateral right-sided nasal obstruction. Clinical examination, endoscopy and radiological assessment with computed tomography (CT) and magnetic resonance imaging (MRI) confirmed the presence of a large tumour mass arising from the right sphenopalatine region and filling most of the nasopharynx. The history and clinical appearance were highly suggestive of angiofibroma. There were signs on MRI of extension into the pterygopalatine fossa (Figure 1) and endoscopy confirmed compression of the septum and ipsilateral inferior and middle turbinates. The treatment

planned was a combined transnasal endoscopic and transpalatal excision, which was performed 24 hours after embolization of the right internal maxillary artery (Figures 2 and 3). An optically-based infra-red three-dimensional image guidance system (Landmarx[®]) was used intra-operatively to reconstruct a 3-D model of the patient's anatomy from the CT scan (Figure 4), and using this instrumentation, the lateral extent of the tumour was defined endoscopically and confirmed on the 3D-representation of the patient's CT scan (Figure 5). This allowed a more accurate excision of tumour to be performed in this difficult site.



FIG. 1

Axial MRI of right-sided juvenile nasopharyngeal angiofibroma.

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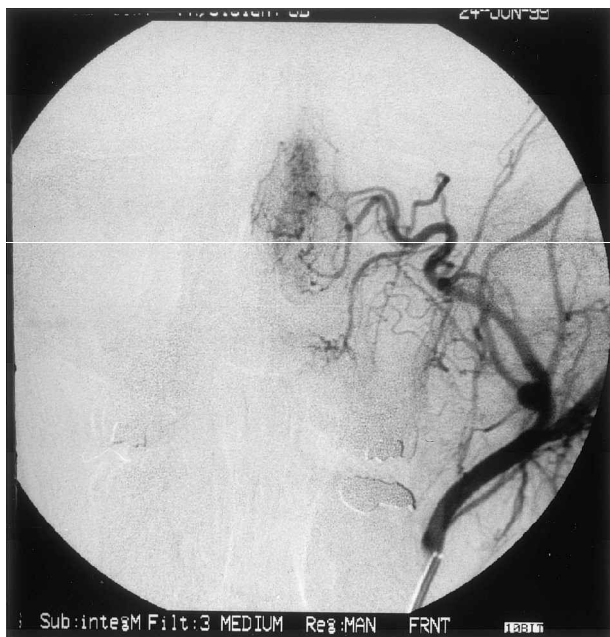


FIG. 2

Angiogram of juvenile nasopharyngeal angiofibroma immediately before embolization showing tumour vasculature.

The patient remains well three months post-operatively and he will be followed up by frequent endoscopic surveillance.

Discussion

Image guidance systems have been under development in many different specialties for the last two decades.^{7,8} The earliest devices used stereotactic frames which required the patient's head to be held in a fixed position and consequently impaired surgical access. Subsequent developments in image guidance technology have focused on the use of frameless wand-based systems, and electromagnetic and optical tracking equipment.⁹⁻¹¹ In the above case we used a commercially available otolaryngology

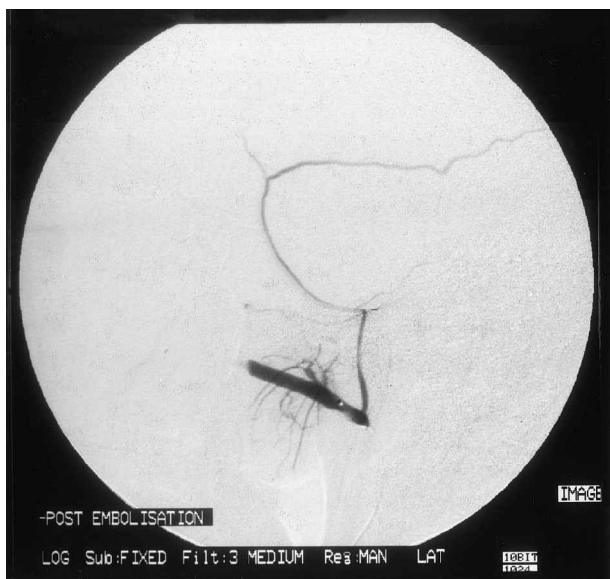


FIG. 3

Post-embolization angiogram showing tumour vasculature occluded.



FIG. 4

Intra-operative LandmarX[™] display with three-dimensional tumour reconstruction.

image guidance system (Landmarx[™], Xomed[™]). This is an optical tracking system which uses an infra-red field to track movements of surgical instruments. These movements in the surgical field are then interfaced with a 3-D-image generated from pre-operative CT or MRI scans. This system requires a standardized imaging protocol to be followed prior to surgery, but there is no requirement for the use of skin markers or a headframe during the scanning process. Intra-operatively the patient wears a headpiece or 'halo' that can move with the patient and does not impede surgical access. Surgical instrumentation is linked to the computer hardware via a cable and each new instrument position is shown on the computer display, as a cursor or crosshair moves around the scans and 3-D model. This real time intra-operative information can be compared with either the 3-D reconstructions of the tumour (Figure 4) or with an intra-operative endoscopic view which is shown adjacent to the 3-D representations of the scan (Figure 5). This ability to compare 3-D reconstructions of the tumour *in situ* with the operative endoscopic view allowed accurate definition of the limits of the tumour during resection.

The disadvantages of image guidance surgery include problems with accuracy, cost and the inconvenience of having to set-up the equipment prior to surgery.^{9,11,12} In addition, there are more theoretical disadvantages, such as

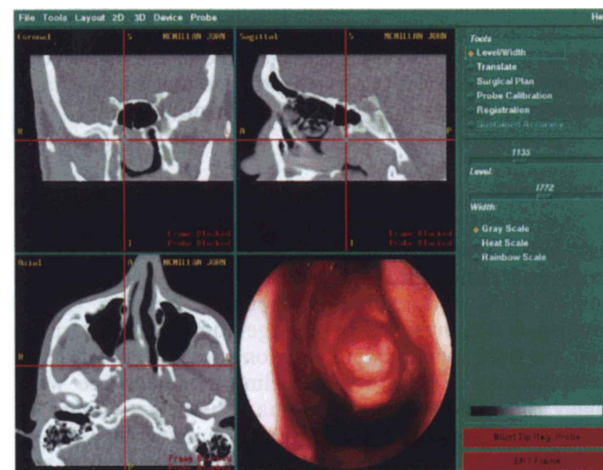


FIG. 5

Intra-operative LandmarX[™] display with picture-in-picture endoscopic view.

apparent reliance on imaging instead of anatomical knowledge. We found the set-up time to be approximately 30 minutes and, during this process, referencing of the scan model allowed accuracies of less than 1 mm error to be obtained. Such accuracy is well within accepted limits.^{9,11,12}

Thus, while we discourage reliance on the images as a sole reference during surgery, we found the additional information very useful when dealing with this complex case. The recent advances in image guidance systems with their ergonomic improvements, accuracy and increasing ease of use have continued to the extent that we now feel image guidance has a valuable role in selected otolaryngological procedures.

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Mr A. Murray takes responsibility for the integrity of the content of the paper.

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