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Main Article

Application of holmium yttrium aluminium garnet (YAG) laser in treatment of acquired posterior choanal atresia following radiotherapy for nasopharyngeal carcinoma

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Abstract

Aims: To report on the use of holmium yttrium aluminium garnet (YAG) laser in the treatment of acquired posterior choanal atresia following radiotherapy in patients with nasopharyngeal carcinoma.

Materials and methods: Five patients with acquired bilateral choanal atresia and two with unilateral choanal atresia in the posterior choanae were identified following treatment of nasopharyngeal carcinoma by external radiotherapy, from July 1998 to April 1999. The mean age was 44.6 years (range, 22–65 years). Two patients had stage two and five had stage three disease according to Ho's classification. All patients received 66 Gy of external irradiation delivered to the nasopharynx and a mean dose of 61 Gy (39.8–72 Gy) to the neck. Five patients received an additional external boost of 20 Gy and two received 14 Gy delivered to the parapharyngeal region. Two other patients also received intracavitatory brachytherapy of 18 Gy delivered to the nasopharynx. One patient had concurrent chemotherapy by cisplatinum during external radiotherapy. The mean onset of nasal symptoms was 17 months (range, 2–38 months) following irradiation. All patients were treated by transnasal endoscopic holmium YAG laser resection. Merocel® epistaxis packing and a modified nasopharyngeal tube were used to stent the nasal airway for two weeks post-operatively.

Results: The mean follow up was 26.8 months (range, 20–32 months) after surgery. All patients were symptom free on follow up. Five patients (71 per cent) retained full patency in the posterior choanae. Two patients (28 per cent) had bilateral mild restenosis in the postnasal space, not requiring revision surgery. The surgical fields were almost bloodless. No adverse post-operative complications occurred, except for delayed nasal septal perforation in one patient and unilateral exposure of the septal cartilage in another; no further treatment was required in either patient.

Conclusion: Acquired posterior choanal atresia is an unusual complication following radiotherapy, and it can occur early after treatment. It can be successfully treated by transnasal endoscopic holmium YAG laser resection of the scar tissue, with minimal bleeding. A two week period of Merocel® nasal packing and nasopharyngeal tube stenting was sufficient to prevent severe restenosis in the posterior choanae; nasal breathing through the tube lumen was possible during this time.

Key words: Choanal Atresia; Radiotherapy; Nasopharyngeal Neoplasms; Laser Surgery

Introduction

Nasopharyngeal carcinoma has a high prevalence in Southeast Asia, and the tumour is highly radiosensitive. The long term side effects of radiotherapy in the primary treatment of this tumour have been well documented.[1] We have previously reported our first series of six patients with posterior choanal stenosis or atresia as a complication of external radiotherapy, managed by transnasal endoscopic surgical treatment (cold steel dissection), with initial success.[2] We report here another series of seven patients diagnosed with posterior choanal atresia following radiotherapy for nasopharyngeal carcinoma, subsequently treated by endoscopic holmium yttrium aluminium garnet (YAG) laser surgery, which allowed better surgical control of resection and minimal intra-operative bleeding.

Materials and methods

Between July 1998 and April 1999, seven patients (one women, six men) with a mean age of 44.6 years (range, 22–65 years) who had been treated primarily with radiotherapy for nasopharyngeal carcinoma had complained of severe nasal obstruction and

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rhinorrhoea. On rigid nasoendoscopic examination using a 0°, 2.7 mm diameter Hopkin's endoscope, all patients were diagnosed with posterior choanal obstruction. Five patients had bilateral posterior choanal atresia and two had unilateral posterior choanal atresia occurring in the postnasal space (Figure 1). The mean onset of patients' nasal symptoms was 17 months (range, 2–38 months) post-irradiation.

Two of the seven patients had been diagnosed with stage two and remaining five with stage three nasopharyngeal tumours, according to Ho's classification.[3] They had received 66 Gy of external irradiation delivered to the nasopharynx and a mean dose of 61 Gy (range, 39.8–72 Gy) to the neck. Five patients had received an additional 20 Gy and two had received 14 Gy of external irradiation delivered to one side of the parapharyngeal area. Two patients had also received intracavitatory brachytherapy, delivering 18 Gy to the nasopharynx. One patient had received three cycles of concurrent chemotherapy, using cisplatinum, during the course of radiotherapy.

These patients were all treated by transnasal endoscopic holmium YAG laser resection of the scar tissue, under general anaesthesia. During the procedure, the patients were placed in a supine position with their necks slightly extended. Two millilitres of 4 per cent cocaine was applied to each nasal cavity for 10 minutes. A Hopkin's rigid endoscope (Karl Storz, Tuttlingen, Germany) with a 4 mm diameter and a 0° viewing angle, connected to a charge-coupled device (CCD) camera (Karl Storz), a video-monitor and a video recorder (for documentation) was used for examination of the nasal airway and to guide the surgeon during the operation. Holmium YAG laser was delivered to the postnasal space by an optic fibre incorporated into the sheath of the suction monopolar diathermy (without the diathermy probe); the side arm of the sheath was connected to suction to enable clearance of smoke during laser vaporization of posterior choanae scar tissue. The laser power was set to 1–2.4 J and the rate of firing was 15–30 per second. The centre of the atretic membrane in the posterior choana was opened by the laser, followed by the periphery of the scar tissue (Figure 2). Random biopsies were taken from each quadrant of the posterior choana scar tissue during the procedure. Additional scar tissue on the posterior septum and the posterior end of the inferior or middle turbinate was divided if present. Caution was taken not to damage the normal adjacent nasal mucosa. The thickness of the scarring in the posterior choanae was grossly estimated by placing the tip of a straight, rigid suction tube at the most posterior extent of the scar while the part of the suction tube at the nasal alar (on the operated side) was marked as a reference point. The tip of the suction tube was then gradually withdrawn until it reached the most anterior extent of the scar. The thickness of the scar thus corresponded approximately to the additional length of suction tube exposed at the nasal alar. The nasopharynx was carefully examined to rule out tumour recurrence, and surgical specimens were sent for histological study.

Post-operatively, Merocel® epistaxis packing (Xomed, Medtronic, Jacksonville Florida, United States) soaked with normal saline was used to stent the postnasal space on one side (Figure 3), maintaining haemostasis and preventing post-operative adhesions. A nasopharyngeal airway tube (size six or seven; Portex, Smith Medical, London, United Kingdom) with the tip trimmed to an appropriate

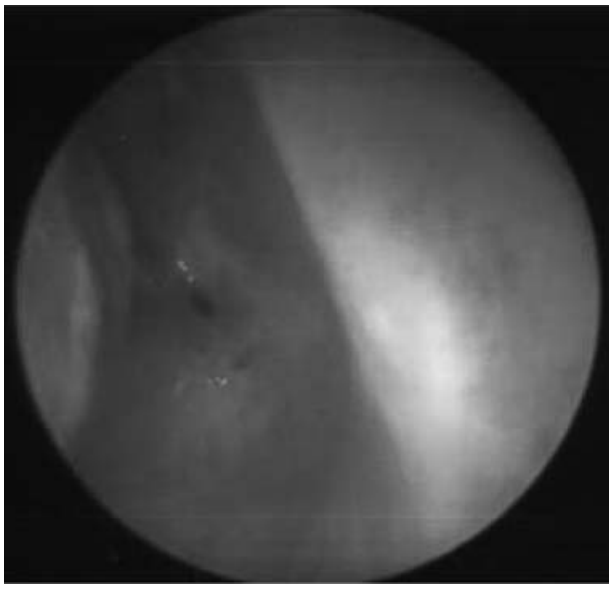

FIG. 1

Membranous atresia of the right posterior choana, with a small dimple in the centre causing complete nasal blockage. Note the relative positions of the posterior attachment of the inferior turbinate, the nasal septum and the floor of the nose.

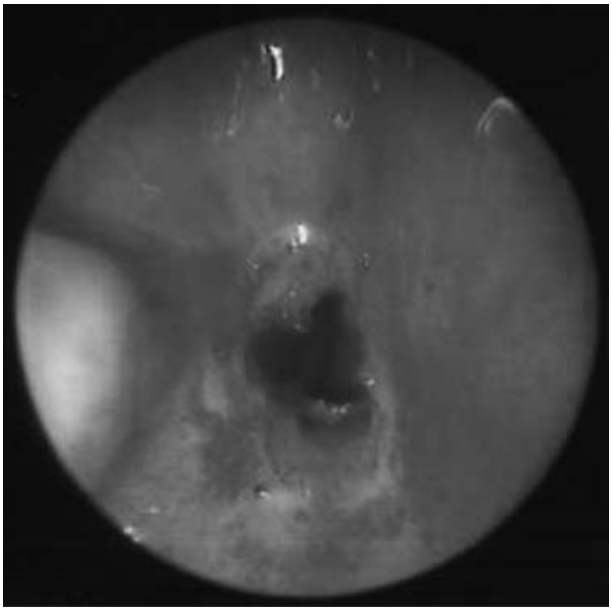

FIG. 2

An opening in the 'membranous atretic plate' in the posterior choana was created using holmium yttrium aluminium garnet laser. Note the bloodless surgical field and the minimal char generated during laser firing.

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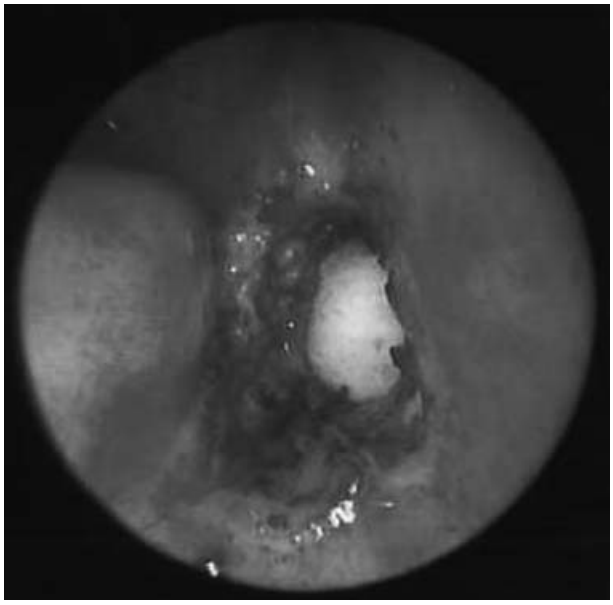

FIG. 3

The size of the airway in the right posterior choana immediately after laser resection. Merocel® nasal packing was inserted into the left posterior choana, abutting the posterior wall of the nasopharynx. Note the scar thickness, greater than 5 mm.

FIG. 4

The nasal airway in the right posterior choana, reassessed 32 months after surgery. The patency of the posterior choana was well maintained. A good mucociliary flow of nasal discharge was demonstrated and the patient remained symptom free.

length was inserted through the other side of the nose in order to prevent restenosis. The packing and nasopharyngeal tube were left in the postnasal space for two weeks post-operatively. For those patients with unilateral atresia, the nasopharyngeal tube alone was used for stenting of the postnasal space. Oral amoxicillin with clavulinic acid (augmentin, 375 mg, thrice daily) was prescribed for two weeks to prevent infection. The nasal packings were removed in the clinic without application of any local anaesthesia. Following removal of the nasal packs and the nasopharyngeal tube, all patients were advised to perform nasal douches using normal saline at least three times a day (and were given training in this). The patients were seen weekly for the first two post-operative weeks in order to renew the Merdel nasal packing while keeping it for another week. They were then followed up fortnightly for one month, monthly for two months and then once over the next three months. Video-endoscopic photographs were used to compare the immediate post-operative nasal airway with that observed during subsequent follow-up visits (Figure 4), and the percentage nasal airway restenosis was estimated for all seven patients.

Results

After scar tissue resection, the nasopharynx of all patients appeared normal on endoscopic examination. The mean thickness of the atretic scar in the posterior choanae was 1.2 mm (5–15 mm). The mean setting of the laser energy was 2.1 J with a firing rate of 23 per second. The surgical fields were almost bloodless. No adverse post-operative complications occurred, and all patients were discharged on the second post-operative day.

The mean follow up was 26.8 months (range, 20–32 months). All patients remained free of symptoms after the operation, although two (28 per cent), who had initially had bilateral posterior choanal stenosis, were noticed to have restenoses on one side of the postnasal space. These restenoses had occurred during the fourth post-operative week, and both had occurred in the area between the postero-inferior end of the middle turbinates and the nasal septum. No attempt to dilate the restenotic posterior choanae was required in the follow-up clinic, and no surgical revision was necessary in any of the patients. No nasopharyngeal recurrence was detected endoscopically in any of the patients on subsequent follow up, nor was any tumour noted histologically in any of the surgical specimens. One patient was noted to have a delayed nasal septal perforation (1.5 cm in diameter) and one patient showed exposure of the septal cartilage on one side. Both patients were asymptomatic and no treatment was required.

The nasal airway remained fully patent in five patients, 50 per cent patent on one side in one patient and 25 per cent patent on one side in another patient, for at least 20 months (mean, 26.8 months) after the operation. All patients were satisfied with the operative results and outcomes.

Discussion

The prevalence of the acquired choanal atresia and stenosis in our patients with nasopharyngeal carcinoma who had received radiotherapy was estimated to be 10.7 per cent, based on our study of 56 consecutive patients with nasopharyngeal carcinoma who underwent endoscopic examination of the postnasal

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space.[2] The detection rate for this entity is low due to the use of postnasal mirrors in routine follow-up examination of the nasopharynx. A sizable proportion of patients with mild obstructive symptoms and pathology in the postnasal space but a relatively healthy-looking nasopharynx may be missed. Therefore, we highly recommend routine endoscopic examination of the nasal cavities in nasopharyngeal carcinoma patients with symptoms of nasal obstruction in order to rule out the possibility of posterior choanal stenosis or atresia.

As in our previous series of patients (treated with cold steel dissection), our present series also demonstrated a membranous diaphragm in the posterior choanae, mimicking the membranous type of posterior choanal atresia. Most patients had a late onset of symptoms, distinguishing the condition from acute mucositis following radiotherapy, which may also cause nasal obstruction or rhinorrhoea. However, three patients with posterior choanal atresia were detected within six months of completing radiotherapy. The shortest time for development of atretic changes following radiotherapy was two months, seen in one patient.

As with our last series, there was no direct evidence to suggest that our patients' choanal atresia was related to either intracavitatory brachytherapy or subsequent follow-up fibre-optic endoscopy; the condition had developed before the first follow-up nasal endoscopy was performed, and only two patients received intracavitatory brachytherapy. Furthermore, there was no change in the technique of irradiation, and the dose delivered to our patients was the same as that received by other patients without stenosis or atresia. We believe that the development of choanal atresia is associated with a severe nasal mucosal inflammatory reaction that occurs in the posterior choanae after radiotherapy, with ensuing fibrosis. The relatively high doses of external irradiation delivered to the circumferential edges of the posterior choanae and nasopharynx, and their close proximity to the posterior end of the middle and inferior turbinates and to the nasal septum and floor, could have induced enhanced adhesion formation and scarring, resulting in posterior choanal atresia.

Nasopharyngeal carcinoma recurrence is not a causative factor in post-irradiation choanal atresia, as neither of our series demonstrated any histologically detectable recurrence within the scar tissue or the nasopharynx, and no recurrences were detected during follow up. Resection of the posterior choanae scar tissue enabled both restoration of airway patency and monitoring of the nasopharynx in order to rule out tumour recurrence.

The use of holmium YAG laser to resect the scar tissue in the posterior choanae has obvious advantages. The fibrous membrane in the postnasal space is of variable thickness (up to 15 mm in our series), and it may be difficult to use conventional surgical instruments to resect such tough scar tissue. The operative area in the nasal cavity is usually restricted, which makes the patient more prone to the formation of cicatricial scarring of the postnasal space and also limits the manipulation of bulky instruments. Holmium YAG laser, delivered through a fine optic fibre, can be incorporated into a rigid monopolar diathermy suction tube in order to access hidden areas in the postnasal space. This laser has been demonstrated to be powerful enough to vaporize any thickness of scar tissue in the postnasal space in our series. Its almost bloodless surgical field enhances visualization of the operating area and prevents unnecessary damage to the surrounding tissue, particularly the superior-lateral quadrant of the posterior choanae where the main trunk of the sphenopalatine arteries exit from the sphenopalatine foramina. Massive haemorrhage had previously occurred in one of our patients when a branch of the sphenopalatine artery was torn by cutting forceps during cold steel dissection; postnasal packing followed by sphenopalatine artery ligation had been required.

One of the potential complications of laser surgery in those patients with bilateral posterior choanal atresia is nasal septal perforation, as occurred in one of our patients, if the mucoperichondria of the corresponding areas of both sides of the nasal septum are damaged and avascular necrosis of the septal cartilage ensues. Although this did not create any extra discomfort for our patient, great caution must be taken, in particular during laser adhesiolysis between the middle turbinates and the nasal septum; a layer of soft tissue must be preserved over the nasal septum so as to maintain the viability of the mucoperichondria.

- **During follow up of patients with nasopharyngeal neoplasms, the clinician should be aware of the possibility of acquired posterior choanal atresia, which can occur as a complication following radiotherapy**
- **Endoscopic examination of the nose is mandatory in those patients with complaints of persistent nasal obstruction following radiotherapy for nasopharyngeal carcinoma**
- **Acquired posterior choanal atresia is an unusual complication following radiotherapy, which can be successfully treated by transnasal endoscopic holmium yttrium aluminium garnet laser, with improved surgical control during resection and minimal blood loss**

Traditionally, stenting of the posterior choanae after surgery is achieved using Silastic tubes that are left in situ and removed by the sixth postoperative week.[4] We modified the stenting procedure by using Merocel® epistaxis packing. Although this was tolerated by all patients, as it caused less discomfort and was less conspicuous, the total nasal blockage after bilateral nasal package can potentially create problems related to mouth-breathing. As most patients with nasopharyngeal carcinoma post-irradiation are not obese, obstructive sleep apnoea was not a concern in our patients. Modification of

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our nasal stenting protocol to incorporate Merocel® nasal pack stenting on one side and a nasopharyngeal tube on the other side for two weeks substantially eased the discomfort of bilateral total nasal blockage. This modified protocol reduced the morbidity of nasal obstruction (i.e. nasal pain and crusting caused by prolonged nasal stenting), and none of our patients experienced symptoms or signs suggesting rhinosinusitis or nasopharyngitis related to nasal stenting.

Conclusions

Acquired posterior choanal atresia is an unusual complication following radiotherapy. It can be successfully treated by transnasal endoscopic holmium YAG laser, allowing improved surgical control of resection and minimal blood loss. During the follow up of patients receiving irradiation for nasopharyngeal carcinoma, the clinician should be aware of the possibility of acquired posterior choanal atresia, which can occur as a complication following radiotherapy. During follow up of such patients complaining of persistent nasal obstruction, an endoscopic examination of the nose is mandatory. Following surgical correction of posterior choanal atresia, Merocel® nasal packing on one side and nasopharyngeal tube stenting on the other side is recommended for two weeks in order to prevent restenosis in the posterior choanae while still enabling nasal breathing.

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