

Role of otoscan-assisted laser myringotomy in hyperbaric oxygen therapy

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Bent JP, April MM, Ward RF, Packard AM. Role of otoscan-assisted laser myringotomy in hyperbaric oxygen therapy. *Undersea Hyper Med* 2000; 27(3):159-161—Patients undergoing hyperbaric oxygen (HBO₂) therapy often experience middle ear barotrauma. Not infrequently this disrupts therapy and may require myringotomy tube placement. A new, simple, office-based procedure known as OtoScan Laser Assisted Myringotomy (OtoLAM) provides temporary middle ear ventilation, which offers significant potential benefits for HBO₂ patients. Five patients whose middle ear disease complicated their HBO₂ therapy have undergone nine OtoLAM procedures in 11 ears. All patients tolerated the procedure without complications and immediately returned to HBO₂ treatment. Based on this preliminary experience, we recommend OtoLAM for selected HBO₂ patients with problematic middle ear dysfunction.

hyperbaric oxygenation, laser myringotomy

Hyperbaric oxygen (HBO₂) therapy plays an important role in the treatment of many clinical problems, particularly burns, chronic infections, and non-healing wounds. Treatment involves simulated “dives” which expose the patient to 1–3 times atmospheric pressure. During the descent, the patient’s middle ear spaces may not remain in equilibrium with rising atmospheric pressure, resulting in otalgia and potentially hemotympanum, middle ear effusions, tympanic membrane perforations, or, in the worst case scenario, perilymph fistula or deafness or both. This applies particularly to young children or mentally disabled individuals who cannot perform maneuvers such as a Valsalva to actively open their eustachian tubes. Delays in therapy secondary to eustachian tube dysfunction occur in 10–40% of HBO₂ patients (1,2). As many as 82% of patients experience some middle ear discomfort, such as a sensation of fullness, during HBO₂ therapy (2).

Traditionally, otolaryngologists have used myringotomy tubes to manage any degree of eustachian tube dysfunction threatening to delay HBO₂. Myringotomy tubes provide excellent relief and allow immediate resumption of therapy, but they come with several minor disadvantages. Children or mentally disabled individuals typically require general anesthesia. The tube tends to remain in the tympanic membrane for 9–12 mo., a much longer interval than standard HBO₂ regimens. The

indwelling tubes predispose the patient to risks of chronic otorrhea or tympanic membrane perforation, and in some situations require special precautions to avoid water exposure of the ear during swimming (3). Tube removal, although possible, requires either some discomfort and risk of trauma, or more anesthesia. As a solution to these problems, Potocki and Hoffman (4) proposed a thermal myringotomy with a hand-held device. However, the created perforation still remains open considerably longer than necessary (15% still open at 6-mo. follow up) (4), and the safety of this procedure in young or uncooperative patients has not been established. Vrabec et al. (5) compared CO₂ laser tympanostomy to tympanostomy tubes for HBO₂ barotitis in adults, and found that the laser resulted in less pain and otorrhea than myringotomy tubes. However, the laser used in their study requires a microscope as well as a handpiece that is not coaxial with the optical image, which does not allow for any patient movement.

OtoScan Laser-Assisted Myringotomy (OtoLAM) was developed in Israel and approved by the Food Drug Administration in 1996. Because the endoscopically generated optical image and the laser beam are coaxial and contained within one handpiece, the surgeon can move with the patient, making the procedure particularly well suited to children. Brodsky et al. (6) established its safety and efficacy for acute otitis media and otitis media

with effusion in patients of all ages. Topical anesthesia can be achieved with a solution placed in the external auditory canal. The operator creates a circular myringotomy with the CO₂ laser beam diameter adjusted anywhere between 1.0 and 3.0 mm. The procedure takes 0.1 s per ear using a laser power setting based on the perceived tympanic membrane thickness. The myringotomy generally closes within 3 wk, and to date there have been no reported cases of lasting tympanic membrane perforations or other complications. The duration of the myringotomy makes OtoLAM well suited for all HBO₂ patients. The speed of the procedure without need for general anesthesia makes it particularly appropriate for children.

METHODS AND MATERIALS

Between 19 April 1999 and 27 December 1999, we offered OtoLAM to five patients with otologic symptoms accompanied by abnormal otoscopic finding that were encountered during HBO₂ therapy (Table I). Patient age ranged from 1 to 78 yr (four females, one male). Four patients had the procedure repeated at a later date, for a total of nine procedures. Two procedures were done bilaterally, and nine were performed unilaterally. The indications for HBO₂ were cerebral palsy (BG, MP, MN), dementia (RB), and accompanying child during treatment (JN, mother of MN, *see* Discussion). All of these patients were part of two independent, ongoing, privately funded, Institute Review Board-approved studies.

The procedure was performed after approximately 30 min of topical anesthesia using a 16% tetracaine solution. Children were held in their parent's lap during the procedure, which takes 0.1 s. Laser settings ranged from 8 to 15 W, with a diameter between 1.4 and 2.4 mm. All myringotomies were placed in the anterior-inferior quadrant of the tympanic membrane. Two patients required the laser to be refired to completely penetrate the tympanic membrane.

RESULTS

All patients experienced rapid resolution of otologic abnormalities and were able to resume HBO₂ immediately. Pain ranged from mild to moderate for all patients and lasted less than 3 min in each case. The myringotomy closed within 3 wk in each case. No complications occurred.

Of the four patients who had the procedure repeated at a later date, only one had the myringotomy close before he finished his prescribed therapy (MP). Two patients had a second procedure in the opposite ear (RB, JN), and one had the procedure repeated 3 mo. later in the same ear upon returning for another round of therapy (MN).

DISCUSSION

OtoLAM offers several advantages over myringotomy tubes. There are no risks of an indwelling tympanic membrane prosthesis, and no concerns about when the tube will extrude or require removal. Two other advantages apply to children or uncooperative patients: OtoLAM requires no general anesthesia, and as an office-based procedure there is no need to delay the myringotomy hours, days, or weeks while awaiting an anesthesiologist or operating room. Families universally expressed satisfaction with the procedure, and none hesitated to return if a repeat procedure was required. The mother of one patient (JN) developed an upper respiratory infection and subsequently had such discomfort during and after accompanying her child on dives that she consented to an OtoLAM in her own right ear. It immediately relieved her discomfort, and given that experience, when the symptoms appeared in the left ear the next day, she promptly returned to have a contralateral OtoLAM. She preferred this alternative to having her child held by another caretaker without pressure equalization problems because of the strong mother-child bond and her daughter's overwhelming anxiety with a stranger.

Table 1: Otoscan Laser-Assisted Myringotomy for Hyperbaric Oxygen Therapy

Name	Date, 1999	Age	Ear	Indication	Outcome
BG	19 April	2	both	OME	completed therapy, myringotomy closed
RB	17 August	78	right	ETD with otalgia	completed therapy, myringotomy closed
MN	17 September	1	left	AOM	completed therapy, myringotomy closed
MP	20 September	2	right	AOM	myringotomy closed before therapy complete
RB	1 October	78	left	ETD with otalgia	completed therapy, myringotomy closed
MP	8 October	2	both	OME	completed therapy, myringotomy closed
JN	12 October	32	right	hemotympanum	completed therapy, myringotomy closed
JN	13 October	32	left	ETD with otalgia	completed therapy, myringotomy closed
MN	27 December	1	left	AOM	completed therapy, myringotomy closed
Total, n = 5	9		11		

Key: OME = otitis media with effusion; ETD = eustachian tube dysfunction, AOM = acute otitis media.

A potential disadvantage of OtoLAM concerns potential premature closure of the laser myringotomy, requiring a repeat procedure if the symptoms return before the end of treatment. In patients expected to undergo HBO₂ for longer than 3 wk, myringotomy tubes may be more appropriate. It was our subjective impression that the laser myringotomies performed in this report closed more rapidly than laser myringotomies in other patients, possibly as a result of the HBO₂ effect on wound healing. MP's premature myringotomy closure exemplifies this phenomenon. To compensate for this, the operator may create a larger myringotomy for HBO₂ patients.

The cost to the patient for OtoLAM is less than myringotomy tubes, and all the costs of anesthesia and operating suites are avoided. Even though the OtoLAM can be adapted to certain CO₂ lasers already available in many medical centers, this equipment still involves a minimum cost to the physician of \$20,000, and many providers may not have access to the necessary technology. In such instances, myringotomy tubes certainly provide an acceptable alternative. Although there has been some

marketing of the OtoLAM to non-otolaryngologists, the cost of the device combined with the requisite training will limit the performance of the procedure to physicians experienced in surgical otology.

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