The Journal of Laryngology and Otology
October 1984. Vol. **98.** pp. 973–976

Middle-ear pressure changes during general N_2O Anaesthesia in Adeno-Tonsillectomies due to post-nasal packing

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During adeno-tonsillectomies performed under general anaesthesia with N_2O we observed and measured a serious increase in middle-ear pressure (M.E.P.). This is due to the fact that the rate of diffusion of N_2O is greater inwards than outwards. This rise in the middle-ear pressure is due to the packing of the nasopharynx after adenoidectomy for haemostasis.

Introduction

It is well recognized that N_2O diffuses into body cavities and especially into the middle ear 29.7 times more than N, when used as an anaesthetic agent. Because of this, the rate of N_2O diffusion inwards is greater than outwards. This causes an increase in middle-ear pressure which depends on the following factors:

(1) Duration of N_2O anaesthesia
(2) Percentage of N_2O used
(3) Intact tympanic membrane
(4) Function of eustachian tube (E.T.)
(5) Presence of a blocked or narrow eustachian tube.

Of the above factors, the duration of N_2O administration is the most important, especially when the function of the E.T. is abnormal or in the presence of a blocked or narrow E.T.

An open, well functioning E.T. is important in regulating M.E.P. Everything that impairs function or causes blockage of the E.T. can result in high M.E.P. during N_2O anaesthesia, which cannot always be predicted.

There is passive opening of a normal E.T. and this occurs when M.E.P. reaches approximately 120–180 mm H_2O.

Material—Method

This study investigates M.E.P. changes in 149 patients operated under N_2O anaesthesia. All patients included in the study had normal hearing, normal tympanograms and normal function of the E.T. Anaesthesia was maintained using a gas mixture of N_2O and O_2, 4.2 litres per minute.

The number of cases and the types of operation were as follows:

OPERATION	No
(A) Ts+Ads	64
(B) Ads	54
(C) Apendicectomy	10
Cholecystectomy	4
Rhinoplasty	10
Branchial cyst	2
Submandibular gland	2
Caldwell-Luc	3
	149

Under endotracheal intubation and complete muscular relaxation, the middle-ear pressure was measured by impedance audiometry using a type 1720 B Otoadmittance Meter (Grason-Stadler).

A tympanogram was carried out pre-

https://doi.org/10.1017/S0022215100147814 Published online by Cambridge University Press

operatively, once at the beginning of anaesthesia and then at 5-minute intervals, up to 1 hour following the end of the operation and anaesthesia. In the case of those undergoing adeno-tonsillectomy or adenoidectomy, a tympanogram was performed before and after removal of the post-nasal pack.

Results

The results of these measures are as follows:

180 mm H_2O. In cases of prolonged operation, as in group A with Ts+Ads, the increase of M.E.P. was greater owing to the longer duration for which the P.N. packing was in position.

In groups B and C, the M.E.P. remained at reasonable levels.

In the adenoidectomy group it was thought that, in spite of the P.N. packing, the same low M.E.P. was probably due to the shorter duration of the operation. Even in

GROUP	MINIMUM M.E.P.	MAXIMUM M.E.P.	AVERAGE
A	380 mm H_2O	over 450 mm H_2O*	94% over 450 mm H_2O
B	180 „	300 „	265 „
C	300 „	380 „	330 „

*range of our instrument inadequate to measure M.E.P. changes encountered in the study

It was observed that, while the M.E.P. in groups B and C were within reasonable levels, in group A it was very high on average, being above 450 mm H_2O, the upper limit of our instrument.

As can be seen in Fig. 1, the M.E.P. within 12 minutes from the begining of anaesthesia was 300 mm H_2O, while in 18 minutes it was over 450 mm H_2O. Following the removal of the P.N. pack, M.E.P. dropped sharply to that procedure, a sharp drop in the M.E.P. was observed following the removal of the P.N. pack (Fig. 1), indicating that the P.N. pack was the agent which produced the increase of M.E.P.

In group C it was observed that, while the M.E.P. at 20 minutes was 350 mm H_2O, at 25 minutes it was only 150 mm H_2O, owing to passive opening of the E.T. (Fig. 2).

This did not happen in group A, in which

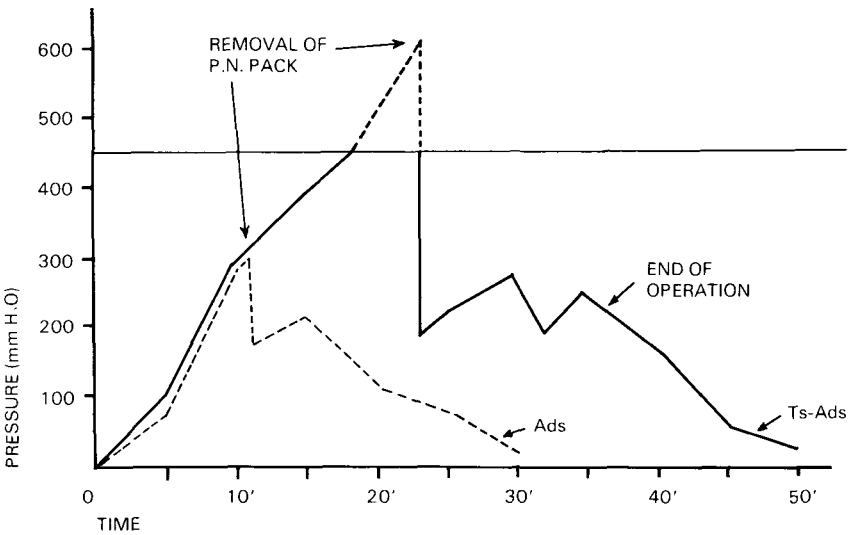


FIG. 1
M.E.Pressure changes during Ts+Ads and Ads.

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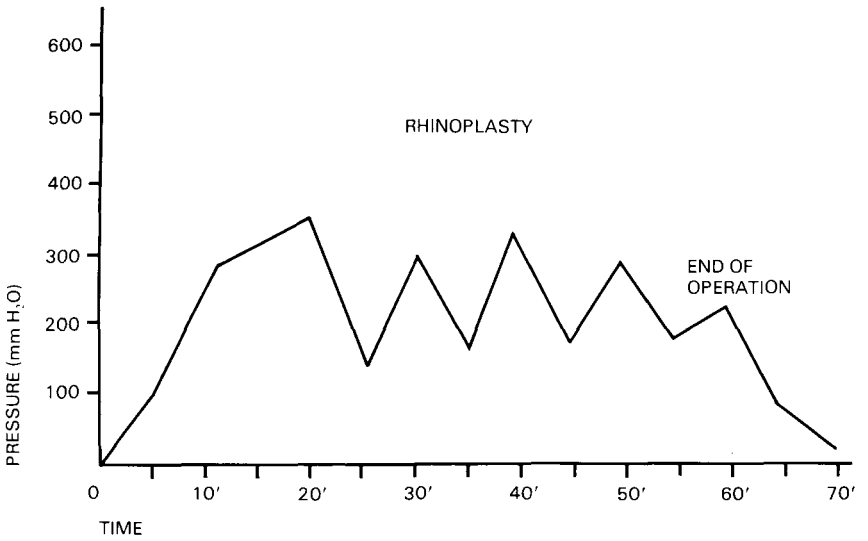


FIG. 2
M.E.Pressure changes during Rhinoplasty.

the sharp decrease in M.E.P. was observed only after removal of the pack, irrespective of the time or M.E.P.

Post-operatively 66 per cent of group A patients had some aural symptoms and signs, clinically and audiologically. The percentage was 43 per cent for group C, especially among those who had the highest M.E.P. during anaesthesia. Most patients did not complain of anything unless they were asked.

The patients complained of fullness, tinnitus and otalgia. Audiometry revealed a low frequency hearing loss in some patients, while tympanometry showed flat curves in patients who had normal tympanograms pre-operatively.

All these findings returned to normal within 3–5 days, without any treatment, apart from two patients with otitis media who were treated with antibiotics.

Serious complications have been reported when the M.E.P. reaches 400 mm H_2O. These include T.M. rupture (Owens *et al.*, 1978), prolonged hearing loss (Patterson and Bartlett, 1976), tinnitus (Matz *et al.*, 1967), serous otitis media (Waun, Sweitzer and Hamilton, 1967), oval window fistula (Patterson and Bartlett, 1976) haemotympanum, etc., and most of them are related to pre-operative pathological conditions and initiated by the high M.E.P. They do not happen with other types of anaesthetic agent, such as halothane.

Conclusion

Our work demonstrates the role of P.N. packing in seriously increasing M.E.P. during N_2O anaesthesia; it is caused by blockage of the E.T.

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https://doi.org/10.1017/S0022215100147814 Published online by Cambridge University Press