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Chloral hydrate and middle ear pressure

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Abstract
Middle ear pressure and tympanic membrane compliance were measured in 34 infants and young children (66 ears) with normal middle ears under oral choral hydrate hypnosis. Tympanograms were performed before and 40 to 60 minutes after administration of the drug. Results showed that the middle ear pressure increased significantly in all cases and in both sexes. This increase ranged between +19 and +219 mm H_2O. In all cases the pressure returned to its prehypnotic values after recovery. Results of tympanic membrane compliance showed significant increase in males and not significant decrease in females.

Introduction

Many researchers have studied the effect of inhalation anaesthetics on middle ear pressure (MEP) (Thomsen *et al.*, 1965; Singh and Kirk, 1979; Richards *et al.*, 1982). They found that MEP increases during nitrous oxide anaesthesia. Others reported a decrease in tympanic membrane compliance (TMC) under nitrous oxide anaesthesia (Thomsen *et al.*, 1965; Rasmussen, 1967; Waun *et al.*, 1967). Richards *et al.* (1982) proved that halothane does increase the MEP but to a lesser extent than nitrous oxide. Hypnotics are different from inhalational anaesthetics in having a slower elimination from the body and longer duration of their effects (DiPalma, 1971). He cited that 'chloral hydrate was first introduced into medicine by Liebreich in 1869' (p. 227).

Chloral hydrate is widely used, either as a sedative or hypnotic, because of its rapid action when given orally, with little hangover. Laurence and Bennett (1980) said that 'it is rapidly metabolized in the erythrocytes, liver and kidney by alcohol dehydrogenase into the active hypnotic trichloroethanol that is responsible for the prolonged effect.' There do not appear to be any studies on the changes in the MEP that occur when children are hypnotized with chloral hydrate. The purpose of this work is to study the influence of chloral hydrate on MEP in normal ears in children, based on observations of fluctuation of wave V threshold during brainstem evoked response audiometry (BERA).

Materials and Methods

Thirty-four children (66 ears) were randomly selected from cases who were scheduled for BERA testing. None of the children had otological disease and their middle ear function and pressure were within normal range. There were 26 males and 8 females, whose age ranged between 9 months and 7 years with mean age of 3 years. Tympanograms were performed before and 40 to 60 minutes after admnistration of chloral hydrate depending on the duration of BERA testing using an Interacoustics tympanograph, model AT2 (Denmark). Children who were irritable and crying during the prehypnotic tympanogram testing were excluded from the

TABLE I
MEANS OF MEP IN PRE- AND DURING CHLORAL HYDRATE HYPNOSIS AND THE DIFFERENCE (±SD)

		MEP in mm H_2O			
	No. of ears	Pre-	during	difference	P
Males	50	−4.92 (±55.33)	85.6 (±69.02)	+ 90.52 (±47.17)	<0.001
Females	16	14.87 (±38.18)	122.75 (±56.12)	+107.87 (±55.63)	<0.001
Both	66	−0.12 (±52.13)	94.61 (±67.64)	+ 94.73 (±49.47)	<0.001

TABLE II
MEANS OF TMC IN PRE- AND DURING CHLORAL HYDRATE HYPNOSIS AND THE DIFFERENCE. (±SD)

		TMC in ml			
No. of ears	Pre-	during	difference	P	
Males	50	0.46 (±0.27)	0.51 (±0.37)	+0.05 (±0.15)	<0.05
Females	16	0.288 (±0.187)	0.273 (±0.217)	−0.015 (±0.1)	>0.05
Both	66	0.417 (±0.26)	0.451 (±0.35)	+0.034 (±0.14)	<0.05

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TABLE III
MEANS DIFFERENCE OF MEP AND TMC FOR MALES AND FEMALES (±SD)

	Males (n = 50)	Females (n = 16)	P
MEP	90.52 (±47.17)	107.87 (±55.63)	>0.2
TMC	+0.05 (± 0.15)	−0.015 (±0.1)	<0.05

study. Chloral hydrate was given orally at a dose of 40 mg/kg body weight.

Results

A total of 34 infants and young children (66 ears) were subjected to middle ear function (tympanogram) and BERA testing. The range of MEP prior to hypnosis was −144 to +87 mm H_2O. The lower limit of normal MEP in infants and children is considered to be −200 mm H_2O. All cases showed an increase in the MEP during hypnosis. The absolute increase in pressure ranged between 19 and 219 mm H_2O. In all cases, the MEP returned to its pre-hypnotic values after recovery. The TMC measurements showed an increase in 32 ears, a decrease in 28 ears, and six ears showed no change.

Tables I and II show the mean values for MEP and TMC respectively before and during hypnosis conditions with their differences. Table III illustrates the means difference of MEP and TMC for both sexes. Figure 1 shows a representative graphic recording of MEP and TMC before and during hypnosis. Figures 2 and 3 represent the graphs of overall means in Tables I and II respectively.

Discussion

The results of this work demonstrate that chloral hydrate did increase the MEP in children significantly ($p<0.001$) in both sexes. There was no statistically significant difference between MEP changes between males and females ($p<0.2$). Chloral hydrate, also increased the TMC significantly in males ($p<0.05$), while it decreased, but not significantly, the TMC in females ($p<0.05$). In the pooled ratings (both sexes), the increase in TMC was statistically significant ($p<0.05$). The difference between TMC changes between males and females was statistically significant ($p<0.05$).

Some authors discussed the cyclical pattern of MEP change during nitrous oxide anaesthesia (Rasmussen, 1967; Patterson and Barlett, 1976; Singh and Kirk, 1979). They indicated that it was due to passive opening of the Eustachian tube. The large differences between the absolute increase in MEP in this study, which ranged between 19 and 219 mm H_2O is due to the lack of continuous monitoring of MEP, and to the passive opening of Eustachian tube before measurement in some cases and after measurement in others.

It has been well documented that chloral hydrate, is either oxidized to trichloroacetic acid or reduced to trichloroethanol. Previous studies indicated that other unknown metabolites of chloral hydrate are formed. King (1983) reported that volatile organic chlorides were extracted from the liver of a 35-year-old woman at post mortem after she took approximately 35 g of chloral hydrate. Cabana and Gessner (1970) concluded that unknown metabolites of chloral hydrate account for 28 per cent of the administered chloral hydrate formed in mice.

The results of this work suggest that unknown volatile metabolites of chloral hydrate diffuse into the middle ear space and increased its pressure. Careful interpretation of BERA results or any other audiological test should always be considered whenever chloral hydrate or some other volatile anaesthetic agent is used.

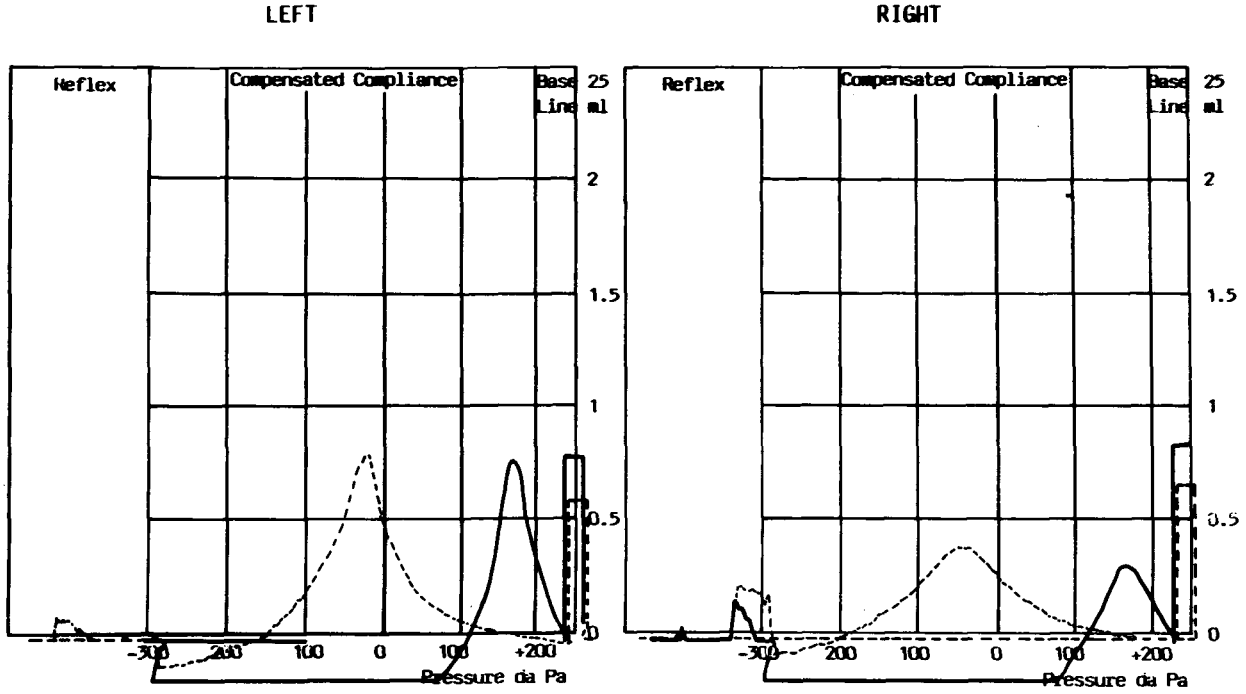

FIG. 1
Representative graphic recording of middle ear pressure in pre and during chloral hydrate hypnosis conditions. —— tympongram before hypnosis. ———— tympongram during hypnosis.

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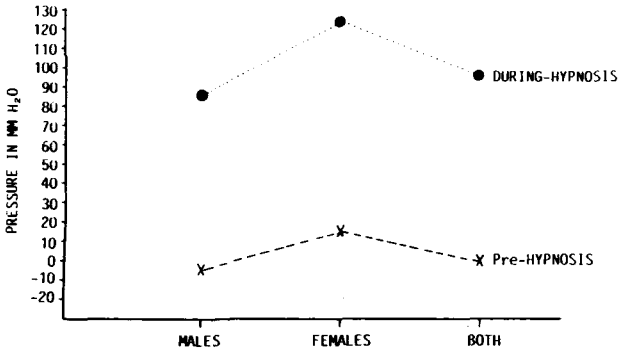

FIG. 2

Means of middle ear pressure in pre and during hypnosis conditions.

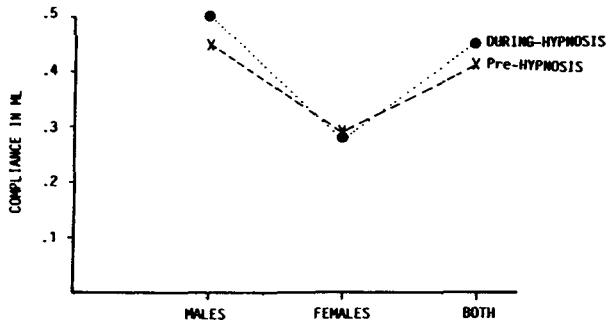

FIG. 3

Means of tympanic membrane compliance in pre and during hypnosis conditions.

References

Cabana, B. E., Gessner, P. K. (1970) The kinetics of chloral hydrate metabolism in mice and the effect thereon of ethanol. *Journal of Pharmacology and Experimental Therapeutics,* **174:** 260–275.

Devis, I., Moore, J. R. M., Lahiri, S. K. (1979) Nitrous oxide and the middle ear. *Anaesthesia,* **34:** 147–151.

DiPalma, J. R. (1971) Drill's pharmacology in medicine (4th ed.) New York: McGraw Hill.

King, K. (1963) Chloral hydrate (Noctec) overdose. *Medical Journal of Australia,* **2:** 260.

Laurence, D. R., Bennett, P. N. (1980) Clinical Pharmacology (5th ed.) New York: Churchill Livingstone, p. 331.

Patterson, M. E., Bartlett, P. C. (1976) Hearing impairment caused by intra-tympanic pressure changes during general anaesthesia. *Laryngoscope,* **86:** 399–404.

Rasmussen, P. E. (1967) Middle ear and maxillary sinus during nitrous oxide anaesthesia. *Acta Otolaryngologica,* **63:** 7–16.

Richards, S. H., O'Neill, G., Wilson, F. (1982) Middle ear pressure variations during general anaesthesia. *Journal of Laryngology and Otlogy,* **96:** 883–892.

Singh, C. B., Kirk, R. (1979) The effect of nitrous oxide on middle ear pressure in children during anaesthesia. *Journal of Laryngology and Otology,* **93:** 349–356.

Thomsen, K. A., Terkildsen, K., Arnfred, I. (1965) Middle ear pressure variations during anaesthesia. *Archives of Otolaryngology,* **82:** 609–611.

Waun, J. E., Swietzer, R. S., Hamilton, W. K. (1967) Effect of nitrous oxide on middle ear mechanics and hearing acuity. *Anaesthesiology,* **28:** 846–850.

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