EFFECTS OF SPINAL ANAESTHESIA ON HEARING

Thesis
Submitted in Partial Fulfillment
for the Master Degree
IN
AUDIOLOGY

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UNDER SUPERVISION OF

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AIN SHAMS UNIVERSITY

1994

الله

بسم الله الرحمن الرحيم

إنما يخشى الله من عباده العلماء

صدق الله العظيم — قرآن كريم

(فاطر ١٧)

Of His worshippers,
the learned fear Him most.

Holy Koran

بسم الله الرحمن الرحيم

Acknowledgements

I would like to express my thanks , sincere gratitude and appreciation to professor **Dr.Salah Soliman** , *professor and head of Audiology Unit ., E.N.T Department , Faculty of Medicine Ain Shams University* , whose meticulous experience , continuous generous help and cardial fatherly encouragement are endless sources of guidance for all his studients.

I would like to express my profound gratitude to **Dr. Nagwa M. Hazzaa,** *Lecturer of Audiology, E.N.T. Department ,faculty of Medicine, Ain Shams University* , for her valuable support to carry out this study .She offered me very useful ideas and guide lines. She gave much of her valuable times in discussing and revising this study .

I would like to thanks professor **Dr. Emad Rasmy Fahmy** , *Professor and head of E.N.T. Department, Faculty of Medicine, Zagazig University* ,and also **Dr. Mostafa Magdy Nasr**, *Lecturer of Anaesthesiology , Faculty of Medicine , Zagazig University* , for their help and advice.

I wish also to extend my thanks to all medical and para - medical staff of Audiology Unit.,Ain Shams University, and also staff of Oto -Rhino laryngology and Anaesthesia Departments, Zagazig University for their help and co-operation in the practical part .

Good thanks to my patients who co-operated with me .

Alaa El-Din Mohamed El- Sayed

1994

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INTRODUCTION AND RATIONALE

Spinal anaesthesia is used for a wide variety of operations, abdominal and extra-abdominal. These operations include urologic, orthopedic, herniotomy and cutaneous operations. Spinal anaesthesia may cause a decrease in cerebrospinal fluid (CSF) pressure due to leakage of spinal fluid at the puncture site, with cranial-nerve affection and typical post spinal headache, which have been found in several reports **(Vandum and Dripps, 1956; Panning et al., 1983).** Facial paresis and low frequency hearing loss was observed after spinal anaesthesia **(Panning, 1985).** The similarity of the chemical composition of the perilymph and CSF and the existence of the aqueduct of the cochlea which joins the subarachnoid space and perilymph space (scala tympani), have apparently suggested that perilymph is indeed CSF. Consequently CSF leakage through the needle puncture after spinal anaesthesia may alter the inner ear fluids (particularly perilymph) resulting in hearing loss.

Low frequency hearing loss is a known, but uncommon complication following spinal anaesthesia **(Walsted et al., 1991a).** The previously reported incidence of vestibulo-cochlear dysfunction after spinal anaesthesia varied between 0.2% and 8% **(Fog et al., 1990)**. **Panning et al. (1983)** reported 8 cases of transient hearing loss out of 100 patients operated upon under spinal anaesthesia. However, audiometry was performed in only 3 of the cases, demonstrating a transient hearing reduction of 10 - 40 dB in the low frequency range. **Gordon (1986)** reported a relationship between hearing changes and spinal anaesthesia and they found that these changes were a more sensitive indicator to monitor spinal fluid pressure changes rather than headache.

Spinal anaesthesia can be done using needles of variable sizes. Headache and hearing loss following spinal anaesthesia were recognized as being directly related to the size of the spinal needle used **(Fog et al., 1990 and Walsted et al., 1991a)**. Indeed, different needle sizes could cause differences in the sizes of the dural tears, allowing variable amounts of CSF leakage with subsequent alteration of CSF pressure **(Fog et al., 1990)**. It was hypothesized that low CSF pressure would produce perilymphatic hypotonia with relative endolymphatic hypertension, mimicking endolymphatic hydrops, and this might be the mechanism of post spinal hearing loss **(Gordon, 1981; 1983a, 1983b)**.

The prevalence of hearing loss after spinal anaesthesia and its relation to the needle size is not widely studied. In addition, the monitoring of post-spinal hearing loss may be a sensitive objective indicator to measure cerebrospinal fluid pressure changes other than headache. This work had been conducted to study the effect of spinal anaesthesia on hearing.

AIMS OF THE WORK

1. To determine the prevalence, type and degree of hearing loss (if any) in patients operated under spinal anaesthesia.

2. To determine the relationship between the degree of hearing loss (if any) and size of the spinal needles used.

REVIEW OF LITERATURE

INNER EAR FLUIDS

Fluids components and chemistry :

The earliest work about inner ear fluids was carried out by **Kaieda (1930),** who pooled the fluids of freshly killed sharks and found sodium, potassium and chloride to be about twice as concentrated in endolymph as in perilymph. In 1954, microchemical methods were employed by **Smith and Co-workers** in determining the electrolytes of the labyrinthine fluids as well as of serum and of cerebrospinal fluid (CSF) in guinea pigs, (Table 1). The remarkable thing about those findings was that endolymph, with its relatively high potassium content and low sodium content, resembled intracellular more than extracellular fluid, whereas the perilymphatic fluid resembled extracellular fluid with low potassium and high sodium concentrations. Those classic experiments were followed by others, and with some variation. They have now been confirmed many times **(Rauch and Kostlin, 1958; Rauch, 1963; Silverstein, 1966; Ulrich et al., 1966 and Salt and Konishi, 1986).**

Anniko and Wroblewski (1986) reported also the concentrations of electrolytes in the inner ear fluids. The relationship between electrolytes and protein concentration in the different fluid compartments is shown in (Table 2).

Table (1) : Distribution of electrolytes in labyrinthine fluids, serum and CSF of the guinea pig (mEq/L).

	Perilymph	**Endolymph (utricular)**	**C.S.F.**	**Serum**
Na	150.3	15.8	152	138.6
K	4.8	144.4	4.2	-
Cl	121.5	107.1	122.4	93.9

Table (1)
(Smith et al., 1954)

Table (2) : Distribution of electrolytes and protein in the different fluid compartments.

	Perilymph	**Endolymph**	**C.S.F.**
Na^+	140 mEq/L	5 mEq/L	152 mEq/L
K^+	10 mEq/L	144 mEq/L	4 mEq/L
Protein	200-400 mg%	126 mg%	20-50 mg%

Table (2)
(Anniko and Wroblewski, 1986 and Baloh and Honrubia, 1990).

Perilymph :

The similarity of the chemical composition of the perilymph and CSF and the existence of the aqueduct of the cochlea (which joins the subarachnoid space and perilymph space in the scala tympani) have apparently suggested that perilymph is indeed CSF. Accordingly, perilymph can be a direct product of CSF, perhaps acquiring a different chemical nature because the exchange between the two fluids is slow. However, other sources had been suggested such that, it can arise from endolymph, its chemical constituents being determined by the properties of the membranes separating the two fluids **(Naftalin and Harrison, 1958).** Another speculation is that, it can be an ultrafiltrate of blood arising from some appropriate vascular area in the inner ear itself.

The work of **Axelsson (1968)** for description of vascular anatomy of the cochlea in guinea pig and in man, suggested that the formation of perilymph is in the scala vestibuli, as a filtrate of arterial supply, and absorption is in the scala tympani. It seems that perilymph is produced at least in the scala vestibuli from the vessels of spiral ligament that lie just above the level of the attachment of the vestibular membrane, and since the circulation in the external wall of the scala tympani is venous, the collecting venules have been supposed to absorb the perilymph.