

ARAŞTIRMA / RESEARCH ARTICLE

Effect of ketamine anaesthesia on middle ear pressure in rabbits: a pilot study

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Tavşanlarda orta kulak basıncı üzerine ketamin anestezisinin etkisi: pilot çalışma

Amaç: Anestezik maddelerin orta kulak basıncı üzerine etkileri hakkındaki çalışmaların çoğu gazlarla yapılmış olmasına rağmen, ketaminin orta kulak basıncı üzerine etkisi hakkında herhangi bir çalışma bildirilmemiştir. Bu çalışmanın amacı ketaminin orta kulak basıncı üzerine etkisini değerlendirmektir.

Yöntem: Ağırlıkları 2.5 ila 3.2 kg arasında değişen 15 adet erkek Yeni Zelanda türü tavşan randomize olarak iki gruba bölündü. Grup I'de dokuz tavşan intravenöz ketamin 50 mg/kg¹ ile anestezize edilirken, Grup II'deki 6 tavşana serum fizyolojik enjeksiyonu yapıldı. Otoskopik değerlendirme sonrası başlangıçta her iki kulakta timpanometrik ölçümler yapıldı ve bu ölçümler 5 ve 20 dakika sonrasında tekrarlandı.

Bulgular: Her iki grupta grup içi değerlendirmede ketamin verilmeden önce ve verildikten 5 ve 20 dakika sonraki timpanometrik ölçümlerde istatistiksel olarak anlamlı değişimler gözlenmedi ($p>0.05$). Gruplararası değerlendirmede ise 20. dakikada hafif bir anlamlı fark gözlemlendi (Grup I: -55.6 ± 29.5 ; Grup II: -29.0 ± 33.5) ($p=0.03$).

Sonuç: Bu çalışmada sonuç olarak ketamin anestezisinin orta kulak basıncı üzerine etkisinin olmadığı düşünüldü.

Anahtar Sözcükler: Ketamin, timpanometri, orta kulak basıncı, serum fizyolojik, tavşan.

Abstract

Objectives: Although most studies about effect of anaesthetics on middle ear pressure were explained with gas effect there are no studies about effect of ketamine on middle ear pressure. The aim of this study was to evaluate the effect of ketamine anaesthesia on middle ear pressure.

Methods: Male New Zealand rabbits ($n=15$), weighing between 2.5-3.2 kg were randomly divided into two groups. Those in Group I ($n=9$) were anaesthetized by intravenous ketamine 50 mg.kg⁻¹ whilst Group II ($n=6$) were injected with the same volume of saline. Baseline tympanometry readings were performed on the left and right ears after otoscopy examination and again at 5 and 20 minutes.

Results: The change of tympanometric measurements before ketamine, at 5th and 20th minutes of the administration was no statistically significant in both of Group I and II ($p>0.05$). There was a slightly significant difference at 20th min of administration when ketamine group compared with control group (-55.6 ± 29.5 in Group I; -29.0 ± 33.5 in Group II) ($p=0.03$).

Conclusion: In this study it is concluded that ketamine anaesthesia has no effect on the pressure in middle ear.

Key Words: Ketamine, tympanometry, middle ear pressure, saline, rabbit.

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Introduction

Measures of middle ear inmittance (tympanometry and acoustic reflexes) are used routinely for audiological assessment, frequently in research applications to document middle ear status, and often in primary medical settings to identify middle ear disease.¹ The use of an acoustic inmittance instrument to obtain a tym-

panogram is an excellent way of determining the status of the tympanic membrane and middle-ear system, and it can be helpful in the assessment of eustachian tube function.² Regulation of pressure within the middle ear is the most important function of the eustachian tube because hearing is optimum when gas pressure in the middle ear is nearly the same as air pressure in the external auditory canal. In ideal tubal function, intermittent active opening of the eustachian tube, resulting only from contraction of the tensor veli palatini muscle during swallowing, maintains nearly ambient pressures in the middle ear.^{3,4} The presence of a middle-ear effusion or high negative middle ear pressure (MEP) as determined by tympanometry usually indicates impaired eustachian tube function. Impaired eustachian tube function seems to be the most important factor in the pathogenesis of middle-ear disease in all age groups.⁵

Ketamine is a suitable intravenous anaesthetic agent in certain situations because of its alleged preservation of upper airway reflexes and effects as a dissociative anaesthetic, onset of action in 3-5 minutes and duration of action lasting 20-30 minutes. It is freely soluble in water, forming an acidic solution of pH: 3.5-5.5. It causes increased muscle tone and salivation, twitching, blinking and nystagmus^{6,7} and has little effect on the muscles of mastication and facial expression.⁸

It was hypothesized that ketamine could change MEP either through increasing the tone of muscles associated with the eustachian tube or by altering salivation. Although there are many studies on ketamine's effect on stapedial reflexes, clinical or experimental studies on the effect of ketamine on middle ear pressure are not known to us.

Materials and Methods

This study was approved by the Local Animal Care and Use Committee. Appropriate guidelines for the use of animals were observed throughout this study. Male New Zealand rabbits (n=15), weighing between 2.5 to 3.2 kg, were caged individually with free access to standard laboratory Chow and tap water. The rabbits were randomly divided into two groups. Baseline middle ear pressures were measured in both groups whilst the rab-

bits were awake. The rabbits in Group I (n=9) were given 50 mg.kg⁻¹ ketamine (KETALAR: 50 mg.ml⁻¹) and group II (n=6; control group) were given the same volume (ml) placebo (saline) intravenously. The study drugs were prepared by another anaesthetist. Baseline tympanometry (Interacoustic Az 26) reading was performed on the left and right ears after otoscopy examination and again at 5 and 20 minutes. All rabbits breathed room air throughout the study.

Tympanometric functions were defined using a positive-to-negative pressure sweep beginning at +200 daPa and ending at -400 daPa. Tympanograms were classified as type A (compensated compliance peak between +200 and -50 daPa), type B (a flat pressure/compliance function), and type C (either peak compensated compliance between -50 and -400 daPa or a rounded function with no discernible peak).⁵

The data were tested with Wilcoxon test within groups and Mann Whitney U test between groups.

Results

In both groups the otoscopy examinations of all ears were assessed as normal. The mean MEPs of eighteen ears in Group I were calculated immediately before, at 5 and 20 minutes (Table 1). They were -39.8 daPa (\pm 30.4), -39.1 daPa (\pm 40.5) and -55.6 daPa (\pm 29.5), respectively. All of the tympanometric changes are demonstrated in Table 1.

The mean MEPs of 12 ears in Group II (control group) were -47.3 daPa (\pm 34.2), and -29.0 daPa (\pm 33.5) before and at 20 minutes respectively. At 5th minutes of the administration, unsuccessful tympanometric examinations were recorded for one ear in Group II because of discordance with device. The mean MEP of 11 ears at 5th minutes in Group II were -38.9 daPa (\pm 31.9). The change of tympanometric measurements before ketamine and at 5th min after ketamine was similar ($p>0.05$); although the measurement at 20th min was approximately 16 daPa lower, it was not statistically significant in Group I ($p>0.05$). There was also no statistically significant difference in Group II ($p>0.05$). However there was a slightly statistically significant difference at 20th min of administration between groups ($p=0.03$).

Table 1. The middle ear pressure values before ketamine and placebo and after 5-20 minutes of administration.

	N	Mean ± SD			P value
		Pre-injection	At 5th min	At 20th min	
Group I	18	-39.8±30.4	-39.1±40.5	-55.6±29.5	p>0.05
Group II	12	-47.3±34.2	-38.9±31.9	-29.0±33.5	p>0.05
p value		p>0.05	p>0.05	p=0.03	

SD: standart deviation, min: minute.

Discussion

Counter et al⁹ showed that reliable acoustic middle ear reflexes and tympanograms can be recorded in small mammals with clinical impedance instruments. Standard oto-impedance instruments can be used effectively in experimental studies in non-anaesthetised laboratory animals, such as rabbits and rats. The rabbit serves as an excellent animal model for the assesment of the acoustic middle ear reflexes in that measurements can be made on this animal without anaesthesia or head restraint.¹⁰

Most studies of the effects of anaesthesia on MEP have involved inhalational anaesthetics, especially N₂O, which has been found to increase MEP.¹¹⁻¹³ It was observed in this study that there was a slight increase in negative pressure in the middle ear with ketamine, in contrast to the increase on middle ear pressure with anaesthetic gases.

High negative middle ear pressure does not necessarily indicate disease; it may indicate only physiologic tubal obstruction. There are many reasons for functional obstruction of eustachian tube, one of which is failure of the eustachian tube's opening mechanism due to an inefficient tensor veli palatini muscle, which is related to the effect of age on the cranial base.¹⁴ Children have less efficient eustachian tube function than adults. Some studies have shown that even otologically healthy children, eustachian tube function is not as good as in adults.^{15,16} For that reason, the authors had

considered that ketamine could affect eustachian tube function especially in children.

The mean MEP level of 18 ears at 5th minutes after ketamine administration was similar to that before ketamine (baseline value). Although it was not statistically significant, the mean MEP level at 20th min was approximately 16 daPa lower than baseline (p>0.05) in Group I. We think that it isn't meaningful clinically. This was slightly increase in negative pressure may be explained by the result of depression of paratubal muscles or intensification of secretions.

The studies about the effect of anaesthetics on MEP subject have mostly been performed with patients who had a middle ear pathology. As different from other studies, this study was performed with healthy rabbits which were known to have well pneumatised ears. Therefore, this result has to be confirmed both in children and adults especially in patients with otolaryngological diseases. Unfortunately, it may be seen as a deficiency of this study that there is no data in awakening after ketamine. If it was performed, it will be known if the slight increase in negative pressure is reversable or not.

Conclusion

Ketamine anaesthesia was found ineffective on middle ear pressure. Therefore ketamine may be used safely in patients with middle ear pathologies but the implication of this needs further studies in humans.

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