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### Research Article

# Extended Valsalva's Maneuver a Method to Improve the Efficacy of Autoinflation Procedures

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### Abstract

The Valsalva maneuver is recommended to clear a negative middle ear pressure and in case of Eustachian tube dysfunction. We describe a new method to improve the efficacy of autoinflation procedures. The subjects of the study comprises of a cohort of children, followed since age 2 years at annual examinations until age 10 year and then called in for a final examination at age 25 years including otomicroscopy and tympanometry. 113 subjects were included in the study.

### Methods

At the last examination all subjects with negative middle ear pressure in one or two ears, were asked to perform Valsalva's maneuver, after which tympanometry was repeated. In case of remaining negative middle ear pressure after Valsalva, the extended Valsalva' maneuver was performed and tympanometry was repeated.

### Results

Among the 116 ears with initial negative middle ear pressure, after Valsalva's maneuver the pressure was equalized to zero or positive pressure in 70 ears (60%). In 46 ears with remaining negative pressure after Valsalva's maneuver, 14 (30%) could equalize the pressure by performing the extended Valsalva's maneuver. In 10 ears the pressure were improved but still negative.

**Keywords:** Valsalva's Manoeuvre; Middle Ear Ventilation; Autoinflation

### Introduction

Eustachius [1,2] gave the first anatomical description of the tube in 1563. He regarded the tube, which was named after him, only as a pathway for draining pathological material from the tympanic cavity. Du Verney (3) in 1683 realized that an important function of the tube was replacing and adjusting the pressure of the air in the tympanic cavity, he thought that the tube is permanently open, thus offering a vent to the air, when the tympanic membrane is moving inwards and outwards. Valsalva [1,4] in 1704 discovered a muscle for opening the tube, and presumed that in the pro-

cess of hearing this muscle would come into action. Valsalva described the maneuver that is named after him as a method to expel pus from the tympanic cavity into the external auditory canal. Now the Valsalva's maneuver is widely known as a method to equalize "clear" the middle ear in case of negative pressure.

Today the three known functions of the Eustachian tube are; pressure regulation, protection and drainage of the middle ear. The pressure regulation and protection are accomplished by active and passive functions of the Eustachian tube. The active function is tubal opening after active infero-lateral

pull of the tensor veli palatini muscle. If there is a pressure difference between the nasopharynx and the middle ear this equalizes when the tube opens. Closing the tube after termination of muscle tensor veli palatini activity is a passive event due to elasticity of the surrounding tissue and if the pressure exceeds the closing forces around the lumen, the tube may open passively and the gas will flow through the tube.

The Valsalva maneuver is recommended in case of Eustachian tube dysfunction: In children with glue ear, as a method to avoid barotrauma in aviation and in Scuba diving. In patients who have undergone middle ear surgery, the procedure is advised in order to ventilate the middle ear, and hereby to prevent retractions and adhesions of the tympanic membrane or the graft to the promontory.

Most adults are able to perform a Valsalva maneuver. In a previous study [5] we found that 51% of healthy adults were able to equalize a negative middle ear pressure obtained after airflight by performing the Valsalva maneuver. In a follow-up study of patients previously operated for cholesteatoma, of the patients with negative middle ear pressure, 41% were able to equalize this by performing Valsalva's maneuver [6].

### Aim of The Study

From clinical experience with Valsalva's maneuver we have developed a method, by which it is possible to improve the effectiveness of Valsalva's maneuver. We call the method for "extended Valsalva's maneuver". In this report we wish to introduce this method.

### Subjects

The subjects of the study comprises of subjects recruited from a follow-up study of a cohort, followed since age 2 years at annual examinations until age 10 years in 1987 and then called in for a final examination in February 2001 at age 25 years including otomicroscopy and tympanometry. 113 subjects were included in the study

### Methods

At the last examination all subjects with negative middle ear pressure in one or two ears, were asked to perform Valsalva's maneuver, after which tympanometry was repeated. In case of remaining negative middle ear pressure after Valsalva, the extended Valsalva' maneuver was performed and tympanometry was repeated.

### Valsalva's Maneuver

The Valsalva's maneuver is performed by pressing the air into the nasopharynx, with the mouth closed and the nostrils compressed with the fingers.

### Extended Valsalva's Maneuver

Basically the maneuver is performed as the ordinary Valsalva's maneuver, but first the neck is stretched maximally by flexion forward (Figure 1) and then the head is turned, positioning the ear to be inflated upwards (Figure 2). In this position the Valsalva maneuver is performed (Figure 3), increasing the chance of inflation in the elevated ear. When the opposite ear is to be inflated, the head is turned in the opposite position.

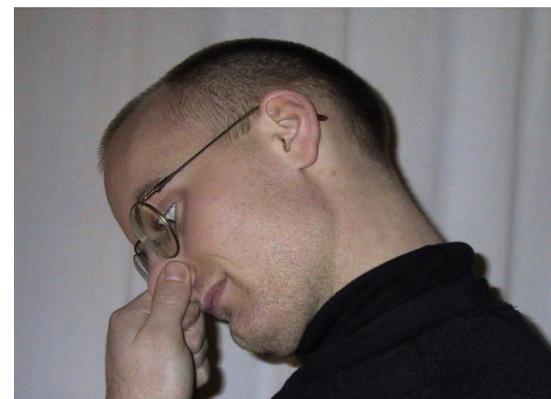
**Figure 1.** Head position before Extended Valsalva's Manoeuvre. Side view



**Figure. 2** Head position before. Extended Valsalva's Manoeuvre. Front view



**Figure. 3** Extended Valsalva's Manoeuvre.



## Results

**Initial Tympanometry:** At the initial tympanometry in 2001, positive or completely normal pressure was found in 110 ears. 116 ears (51%) had negative middle ear pressure ranging from -5 dPa to -210 dPa (Table 1).

**Table 1.** Tympanometric findings in ears with and without pathology.

Middle ear Pressure dPa	Otosopic findings	
	Normal drum	Attic and/or tensa pathology
Positive	60	17
zero	29	4
Negative	93	23
Total	182	44
Total negative	93	23

**Middle Ear Pressure After Valsalva's Maneuver:** Among the 116 ears with initial negative middle ear pressure, Valsalva's maneuver was performed. After performing Valsalva's maneuver, the pressure was equalized to zero or positive pressure in 70 ears (60%). In 46 ears the pressure remained negative (Table 2).

**Table 2.** Middle ear pressure before and after Valsalva's manoeuvre in ears with negative pressure at the initial tympanometry.

Middle ear Pressure dPa	Tympanometry		
	Initial	After	After extended
	tympanometry	Valsalva	Valsalva
	n.	n.	n.
Positive	77	66	10
zero	33	4	4
Negative	116	46	32
Total	226	116	46
Total negative	116	46	32

**Middle Ear Pressure After Extended Valsalva's Maneuver:** In the 46 ears with remaining negative pressure after Valsalva's maneuver, 14 (30%) could equalize the pressure by performing the extended Valsalva's maneuver. In 10 ears the pressure were improved but still negative (Table 2).

**Efficacy the Autoinflation Procedures:** Of the 116 ears with negative middle ear pressure, after the Valsalva or extended Valsalva maneuver, the middle ear pressure were equalized in 72%. Deterioration occurred surprisingly in some ears after the different procedures (Table 3)

**Table 3.** Effect of the different manoeuvres on middle ear pressure in ears with negative pressure before the manoeuvre.

Middle ear pressure	After	After
	Valsalva	Ext. Valsalva
	n	N
Equalized	70	14
Improved	22	10
Unchanged	8	10
Deteriorated	16	12
Total (n)	116	46
Total negative (n)	46	32

## Discussion

Only few subjects of this study had significant negative pressure of clinical relevance, the majority of ears with negative pressure had pressure ranging from -10 to -80 dPa. If the Eustachian tube is patent and normal functioning, the subjects should be able to equalize this to zero or positive pressure, by performing the Valsalva's maneuver. It is a surprise that only 60% of this age group were able to equalize the middle ear pressure by performing Valsalva's maneuver. We can not explain why stretching the neck and turning the head improves the effectiveness of Valsalva's maneuver. But it is possible that during this maneuver the parapharyngeal mussels stretches, and hereby improves the opening of the tubal orifice. Ad other point of interest with the extended Valsalva's maneuver is that it is possible to "direct" the ventilation to the ear in focus and to decrease the ventilation of the contralateral ear. This may be of clinical importance, since many children, especially children with unilateral adhesions in the middle ear, where the opposite ear needs ventilation, is afraid to do autoinflation because pain may be experienced in the ear. If this direction effect is due to improved opening of the tube to the ear in focus, or is due to "blockage" of the contralateral tube we do not know.

## Conclusion

40% of adults are not able to clear a negative middle ear pressure by performing Valsalva's maneuver, of these 30% can achieve this by stretching the neck and turning the head. In total 72% may clear the middle ear after a combination of the two autoinflation procedures.

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