

# The effect of hormonal factors on the hearing organ in women, after surgical castration. Preliminary Report.

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## Abstract

**BACKGROUND:** Estrogens have not only direct and beneficial effect on relaxation of the arteries increasing the blood flow in the blood vessels, but also their level of secretion has considerable effect on synthesis of acetylcholine – a neurotransmitter indispensable for appropriate functioning of the hearing organ. The aim of this study is analysis of the effect of hormones on the hearing organ in women who underwent surgical castration.

**MATERIAL:** The study included 40 females, aged between 32–55 years who had undergone an operative treatment mainly because of uterine myoma. A group of 50 women aged between 32–50 years with appropriate hormone level comprised the control group.

**METHOD:** Each woman investigated underwent the following examinations: gynaecological, otolaryngological and laboratory tests, such as: evaluation of levels of estradiol (E) and folliculin stimulating hormone (FSH). The assessment of hearing was carried out using tone and speech audiometry, tympanometry, test registration of auditory brain stem responses (ABR) and otoacoustic emissions (EOAE). The examinations mentioned above are performed in women as initial examinations before surgical treatment and as follow-up examinations 1, 3 and 12 months after the surgery.

**RESULTS:** The results presented in this paper include initial examinations and follow-ups 3 months after the surgical treatment taking into consideration the correlation with the results of laboratory tests and the results obtained in the control group.

## Introduction.

During the last years, it has become established that operational castration of women during hysterectomy with adnexectomy rapidly decreased circulating estrogens, mainly estradiol (E) which level 3 hours post operation is about 60% of preoperation values and in fifth day after operation level of E is very low – below 20 pg/ml. It is surgical menopause which a sevenfold increase in myocardial infarction and twofold increase in the death rate from cardiovascular disease compared with their premenopausal women [11]. Results of this study strongly suggest that estrogens may have an important role in maintaining cardiovascular health in women.

Beneficial effect on relaxation of the arteries increasing the blood flow in the blood vessels, but also their beneficial effect of estrogens includes its ability to reduce low-density lipoprotein (LDL) and increase high-density lipoprotein (HDL) cholesterol levels [3,4,10,13,15]. In postmenopausal and

in postcastration women estrogen replacement therapy (ERT) independently decreases the risk for cardiovascular events and mortality [2,4]. But Best P.J. et al. suggest that only about 50% of the reduction in cardiovascular events is attributable to the lipid-lowering effects of ERT [1]. Estrogen may also directly enhance the activity of the endothelium – derived relaxing factor – nitric oxide. Many recent studies have suggested that ERT improves endothelium-dependent vasodilatation of the coronary and cerebral arteries of post-menopausal women [1,5].

The hearing organ is one of the most sensitive organs to hypoxia. Hence drop in estrogens level in postcastration women and its metabolic consequences, presented above, may influence the hearing organ.

**Objective**

Our purpose was to assess the effect of changing hormone levels: estradiol (E) and folliculin stimulating hormone (FSH) on the hearing organ in women who underwent surgical procedures because of gynaecological disturbances.

**Material and Methods**

Between September 1<sup>st</sup> 1999 and the end of April 2000 40 women from 32 to 55 years of age (average 49,34 years) underwent operative treatment (Group I <sup>1</sup>). A group of 50 women aged between 32–50 (average 47,40 years) with appropriate hormone levels comprised the control group (Group II <sup>2</sup>).

The extension of surgery depended on patient’s age, number of children, size and number of the myomas, which were the main indication for operation, and macroscopic assessment of ovaries. Patients, which were qualified for otolaryngological examinations and hormonal laboratory tests had undergone hysterectomy with adnexa. These all patients received 10 mg Oestradiol-Depot one day after the operation to prevent postcastration syndrome.

**Group I**

No. of cases: 40. The mean age: 49.34 years.  
– Total abdominal hysterectomy with bilateral salpingo-oophorectomy.

**Group II**

No. of cases: 50. The mean age: 47.4 years.  
– Control group with appropriate hormone levels.

For the study were qualified patients free from systemic disorders, which could have significant influence on the results of both hormonal and laryngological examinations – such as diseases of the kidneys, liver, cardiovascular system, endocrine system and mental disorders. Among many biochemical indices assessed factors which, from clinical point of view play a special role in the process of biological adaptation, the most reliable are: estradiol (E) and folliculin stimulating hormone (FSH).

Operational treatment e.i. total abdominal hysterectomy with bilateral salpingo-oophorectomy and laboratory tests of E and FSH levels were performed in the Obstetrics and Gynaecology Department of the Jagiellonian University. Audiologic examinations were carried out in the Audiologic Unit Otolaryngology Department of the Jagiellonian University.

The assessment of the hearing organ in each woman was done before the operative treatment as an initial examination and in the follow-up examinations 3 and 12 months after the operation.

The presented study results comprise only the initial examinations and the first follow-up examination three months after the operation.

The assessment of the hearing organ was done by means of subjective audiometry tests, i.e. Pure Tone Audiometry, Speech Discrimination Tests and High Frequency Audiometry (HFA) in frequency rate between 8 and 20 kHz as well as objective tests based on the recording of:

**Tab. 1.** Serum Oestradiol (E) values in the studied groups of women.

Group	No of cases	Serum Oestradiol (µg/ml)				Significance
		Before operation		After operation		
		Mean ± SD		Mean ± SD		
Study group	40	263.29	202.81	194.24	184.36	NS

SD = standard deviation  
NS = not statistical

**Tab. 2.** Serum FSH values in the studied groups of women.

Group	No of cases	Serum FSH (mIU/ml)				Significance
		Before operation		After operation		
		Mean ± SD		Mean ± SD		
Study group	40	22.04	10.04	26.06	10.89	NS

SD = standard deviation  
NS = not statistical

**Tab. 3.** Threshold hearing values in the studied groups of women.

Group	Before operation				After operation			
	Normal hearing level		Mild hearing loss		Normal hearing level		Mild hearing loss	
Study group (n=40)	37	92.5%	3	7.5%	34	85%	6	15%
Control group (n=50)	30	100%	–	–	–	–	–	–

**Tab. 4.** Average threshold values in Pure Tone Audiometry (PTA).

Group	PTA				Average age
	Before operation		After operation		
	Normal hearing level	Mild hearing loss	Normal hearing level	Mild hearing loss	
Study group (n=40)	10.61	27.5	11.31	25.5	49.34
Control group (n=50)	5.0	–	–	–	47.40

**Tab. 5.** Otoacoustic emission (EOAE) in the studied groups of women.

Group	EOAE			
	Before operation		After operation	
	Presence of EOAE	Lack of EOAE	Presence of EOAE	Lack of EOAE
Study group (n=40)	36	4	34	6
Control group (n=50)	30	–	–	–

**Tab. 6.** Average values of EOAE parameters.

Group	EOAE				Average age
	Before operation		After operation		
	% of reproduction	Amplitude	% of reproduction	Amplitude	
Study group (n=40)	80.44	12.76	78.57	11.97	49.34
Control group (n=50)	89.04	18.55	–	–	47.40

1. Auditory Brain stem Responses (ABR)
2. Click Evoked Otoacoustic Emissions (EOAE)
3. Tympanometry tests.

Audiologic examinations were carried out for each ears and averaged results presented in Tables 3–6.

In the present work only the result of the pure tone audiometry, EOAE and tympanometry tests are analysed. Hearing acuity in pure tone audiometry was assessed by means of PTA (Pure Tone Average).

Considering the hearing impairment classification according to the established criteria (1–19), hearing impairment was revealed by finding the hearing threshold of more than 20 dB in one or both ears. Hearing impairment was considered mild (21–40 dB), moderate (41–55 dB), moderately severe (56–70 dB) and severe (more than 71 dB).

## Results

The results of examinations are presented in six tables. Having analysed the hormonal examination results presented in Tables 1 and 2 one has to say that the average levels of estradiol (Table 1) and FSH (Table 2) before and after the operation are similar, and the differences between them are statistically insignificant. These results probably follows similar age of both analysed groups, because it is common knowledge that the E levels are decreasing and FSH levels are increasing as before as the age of 50 in women [2].

That is undoubtedly associated with estrogen administration after hysterectomy with adnexa (10 mg Oestradiol-Depot) in order to eliminate the unpleasant postcastration syndrome symptoms.

Having analysed the average hearing threshold values obtained in the initial examination by means of pure tone audiometry one has to say that hearing

within normal range was found in 93 to 100% of the women examined (Table 3).

Mild hearing loss was found in only 6 cases. The differences in average hearing threshold values in the initial examination between each group of women has to be referred to the differences in the average age values, because the lowest threshold values were found in group III of the lowest average age. The average values in that group of women are, however, slightly higher than the average threshold in the women from control group.

The first follow-up examination indicates slight increase in threshold values, especially in the group of women with normal hearing, but the analysis of the frequency of the occurrence of normal threshold values indicates their slight decrease, i.e. from 93–100% in the initial examination to 83.3–54.3% in the follow-up examination. That means that the number of women with mild hearing loss increased from 6 to 16%.

The analysis of the average threshold values indicates their slight increase (Table 4), but the differences are insignificant and there is only a tendency towards an increase in average hearing threshold values in the women from the study groups.

The above observations are also confirmed by evoked otoacoustic emission evaluation (Table 5), which indicates the fact that with the increase in the average threshold values the number of evoked otoacoustic emissions recorded in reduced from 90% in the initial examinations to 84% in the follow-up examination. The analysis of the EOAE parameters (Table 6) also indicates the clear association with the age of the women examined, and that concerns both reproduction and amplitude. These values are highest in the women from the control group of the lowest average age, and they consequently decrease with older age. The differences in the average values of both reproduction and amplitude between the initial examination and the follow-up examination are minute and insignificant, and there is only a tendency towards the decrease in those values in the first follow-up examination. Tympanometric examinations allowed for the assessment of the normal condition of the middle ear in all the women examined, because in each case tympanometry A obtained, with the average ear pressure values not exceeding 68 da Pa.

## Discussion

However, in many European countries (excluding Finland) the percentage of women treated with estrogens after operation does not exceed 10%. One may, therefore, expect that in later studies the respective differences in both estrogen and FSH levels will be greater.

As we have mentioned in the introduction, the hearing organ is one of the most sensitive organs to hypoxia. For that reason the drop in estrogens level after gynaecological operations, especially in women who do not take, or take irregularly, estrogen replacement therapy, should influence the function of the hearing organ. Unfortunately there is a lot of this kind of women in Poland.

The results of audiologic tests which we obtained before operation and one month after were not statistically significant but showed only a tendency towards the decrease in reproduction percentage and amplitude in examination of otoacoustic emissions. A short period – one month – from the operation to the audiologic examination effected that metabolic changes connected with the operation had not significantly influenced the function of the hearing organ.

## Conclusion

Comparative analysis of the examination results of hearing threshold before and after the operation did not reveal any statistically significant differences, but only a tendency towards their increase in the postoperative examination.

This is also confirmed by comparative analysis of otoacoustic emission parameters, which show only a tendency towards the decrease in reproduction percentage and amplitude.

*Approval of Ethical Committee.* The President of Bioethical Committee at Jagellonian University, Prof. P. Thor, M.D., has forwarded the agreement of the Committee concerning the enclosed study by A. Reron et al, on July 9, 2002.

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