

# Influence of thoracoscopic sympathectomy on tendency to cry – case-controlled study

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## Abstract

**Introduction:** Primary hyperhidrosis (PHH) is a disease that is mainly characterized by increased palmar and plantar sweating that significantly affects the everyday functioning. It is not clear to what extent this surgical intervention has an effect on one's further emotional functioning.

**Aim:** To evaluate the impact of endoscopic thoracic sympathectomy (ETS) on crying tendency in PHH patients.

**Material and methods:** Eighty-six patients qualified for ETS due to PHH took part in the study. All patients completed the Adult Crying Inventory (ACI) and the Functional Assessment of Chronic Illness Therapy (FACIT) questionnaires before and 3 months after sympathectomy. The ACI questionnaire was additionally completed by a group of 60 volunteers.

**Results:** In females, the number of crying episodes increased after ETS, though it was still lower than the number observed in the control group (1.19 vs. 2.36 vs. 3.83;  $p < 0.05$ ). In males the number of crying episodes dropped insignificantly to the number observed in the control group (0.87 vs. 0.27 vs. 0.14;  $p = NS$ ). The tendency to cry in females decreased compared to the level prior to surgery, but it was lower than the level observed in the control group (respectively, 4.5 vs. 3.5 vs. 5.63;  $p < 0.05$ ). In males the differences were not statistically significant (1.03 vs. 1.5 vs. 1.77;  $p = NS$ ). There was no impact of emotional status on crying, either before or after the treatment.

**Conclusions:** Endoscopic thoracic sympathectomy decreases the subjective tendency to cry though it increases the number of crying episodes in women, but does not change crying behaviours in men.

**Key words:** crying, sympathectomy, autonomic system, thoracoscopic, sympathetic system.

## Introduction

Primary hyperhidrosis is a genetic, autosomal dominant disease that is mainly characterized by increased palmar and plantar sweating that significantly affects the everyday functioning of the patients. The sweating is initiated even by mild emotional arousal; even the thought about embarrass-

ment suffices to induce a strong sweating response. It has been documented that thoracic sympathectomy (blocking of the sympathetic system) results in immediate resolution of symptoms [1, 2].

However, it is not clear to what extent this surgical intervention has an effect on one's further emotional functioning, given the fact that the sympathet-

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ic nervous system plays a major role in the experience and expression of emotions. In particular, “active” emotions (e.g., anger, fright, joy) are accompanied by increased sympathetic activation. Although the role of the sympathetic nervous system in sadness and crying is less clear, it has been shown that the innervation of the lacrimal gland is also under the influence of sympathetic system nerves. More specifically, it has been documented that the sympathetic nervous system plays a direct and significant role in the process of crying (initiating and modulating tear secretion) [3], not only modulating blood flow to the gland. Ding *et al.* [3] showed that lacrimal glands (in rats and mice) are stimulated by  $\alpha_1$ - and  $\beta$ -adrenergic pathways. It has further been demonstrated that in Sjögren’s syndrome, with the characteristic decrease in secretion, the tear production and crying can be compromised due to impaired neural control [3]. On the other hand, Dartt [4] presented evidence strongly supporting the predominance of parasympathetic innervation in human lacrimal glands, but this author also emphasizes the important role of the  $\alpha_1$ -adrenergic pathway in crying regulation.

Crying is a frequent and typical form of human emotional behaviour, which may serve both intra-individual (e.g., catharsis; physiological recovery) and inter-individual (communication of one’s feeling state) functions. It can be elicited by a variety of factors, in particular pain, loss, conflicts and perceived inadequacy, but also empathy or sympathy, and by positive emotions and tender feelings.

It has also been demonstrated that the sequelae of crying and sympathetic/parasympathetic systems’ tone play an important role in self-regulatory mechanisms [5]. Rottenberg *et al.* evaluated the connection of tearful crying and autonomic nervous system activity represented by respiratory sinus arrhythmia (RSA), an index of the vagal (parasympathetic) control of heart rate that is associated with emotion regulatory capacity. They observed an RSA increase after tearful crying in non-depressed individuals, consistent with a homeostatic function for crying, whereas in depressed subjects crying did not result in an increased RSA. This suggests that the physiological self-regulatory mechanism invoked by crying is compromised in depression [5]. In that context, it seems obvious to control the emotional status of the participants involved in any study on crying.

## Aim

The aim of the present study was the prospective evaluation of the impact of thoracic sympathectomy on crying tendency in primary hyperhidrosis patients versus healthy age- and sex- matched controls. This raises the question whether thoracic sympathectomy may have effects on the experience and expression of emotions and in particular crying. Since the entire sympathetic system can be involved in physical arousal, it may be hypothesized that thoracic sympathectomy can influence the overall sympathetic tone and, additionally, the tendency to cry.

## Material and methods

### Study participants

Eighty-six consecutive patients qualified for thoracoscopic sympathectomy due to primary hyperhidrosis and facial blushing took part in the study.

Primary hyperhidrosis diagnosis was obtained with the gravimetric method, described previously by Hund *et al.* [6] and our team [7, 8]. In brief, a pre-measured tissue is given to the patient, who wipes his/her hands with it for 1 min. The weight of the tissue is recorded then again and a net result is obtained. The results are then compared to population reference values.

Thoracoscopic sympathectomy surgical technique has been previously described by many authors [7, 9–12]. It is a minimally invasive procedure performed through two small incisions in the thoracic cavity. The idea of the procedure is to disrupt the thoracic trunk at a specific level: in this case above the T3 ganglion (for hyperhidrosis). The procedure usually takes about 60 min bilaterally. The hospitalization is short term, in most cases not longer than 24–48 h [1, 10, 12]. All surgical interventions were performed by the same surgeon (TJS) and were uneventful.

The ACI questionnaire was additionally completed by a group of 60 volunteers – students of the Medical University. The results were further compared to national data published previously [13]. The experimental and control groups were comparable in terms of age (*t*-test,  $p = 0.865$ ), but there was a difference in gender distribution between the groups: the sympathectomy patient group contained 60 women and 19 men, while the control group consisted of 31 women and 29 men ( $\chi^2$  test,  $p = 0.0029$ ).

## Measures

The assessment of crying was conducted using a subset of questions from the Adult Crying Inventory questionnaire (ACI) [13]. The following items were used: (i) Crying Frequency – Estimated Number of Crying Episodes Within Previous Month, (ii) General Crying Proneness (18-item scale, ranging from 1 (never) to 7 (always)), (iii) Influence of Life Trauma on Crying (nominal yes vs. no variable), (iv) Influence of Crying on Mood (7-item scale, ranging from 1 (less) to 3 (more)) and (v) General Tendency to Cry (10-point scale, ranging from *hardly* to *very easily*).

The Influence of Crying on Mood (ACI Var 4) was evaluated on the basis of changes in positive and negative feelings. A positive score in this variable indicated positive mood after crying and a negative score indicated negative mood after crying.

The current mood of the patients was evaluated by the Functional Assessment of Chronic Illness Therapy (FACIT) – Emotional Well-Being Scale [14]. The same set of questionnaires was administered 3 months after sympathectomy. The only difference was an additional question addressing the Influence of Sympathectomy on Crying (nominal yes vs. no variable).

This study was approved by the Local Ethical Committee for the Medical University of Gdansk, Poland.

## Statistical analysis

All statistical analyses were performed using Statistica 10 software licensed to the Medical University of Gdansk, Poland.

## Results

Table I summarizes the descriptive data (mean and SD) of all variables, before and after treatment, and of the two control groups, separately for men and women. In females, the number of crying episodes increased significantly after ETS, though it was still low-

er than the number observed in the control group (1.19 vs. 2.36 vs. 3.83;  $p < 0.05$  in ANOVA). In males the number of crying episodes dropped insignificantly to the number observed in the control group (0.87 vs. 0.27 vs. 0.14;  $p = \text{NS}$  in ANOVA) (Figure 1).

There was no significant difference concerning crying in different situations (ACI Var 2).

In the control group, 38.71% (12 cases) of women declared that a traumatic event from the past significantly impacted their tendency to cry (ACI Var 3). In the ETS group, only 14.29% (6 cases) claimed the same relationship ( $p < 0.05$ ,  $\chi^2$  test). In male patients and male control participants the percentages were 6.9% (2 cases) and 13.33% (2 cases).

Interestingly, the patients did not find that sympathectomy itself influenced any aspect of their crying.

There were no significant differences concerning the impact of crying on expressed emotions (ACI Var 4).

The tendency to cry (ACI Var 5) is presented in Figure 2. In females, it decreased significantly compared to the level prior to surgery, but it was in both measured points lower than the level observed in the control group (respectively, 4.5 vs. 3.5 vs. 5.63;  $p < 0.05$  in ANOVA). It was also significantly lower than the level reported in the literature (5.66;  $p < 0.01$  in Student *t*-test). In males the differences were not statistically significant (1.03 vs. 1.5 vs. 1.77;  $p = \text{NS}$  in ANOVA), but in all groups lower than the level reported in the literature (2.47;  $p < 0.05$  in Student *t*-test).

There was no impact of emotional status on crying, neither before nor after the treatment. The correlation between FACIT-Emotional and ACI both prior to and after the surgery failed to reach statistical significance and did not exceed a low level of relationship (Table II). The only variable that reached statistical significance was ACI1 – the number of crying episodes post-operatively. Both in males and females, it presented a negative intermediate correlation.

## Discussion

The results of the present study suggest that thoracic sympathectomy leads to significant changes in

**Table I.** Crying variables were taken from the ISAC Questionnaire but not represented in this way before, i.e., split up by country [13]

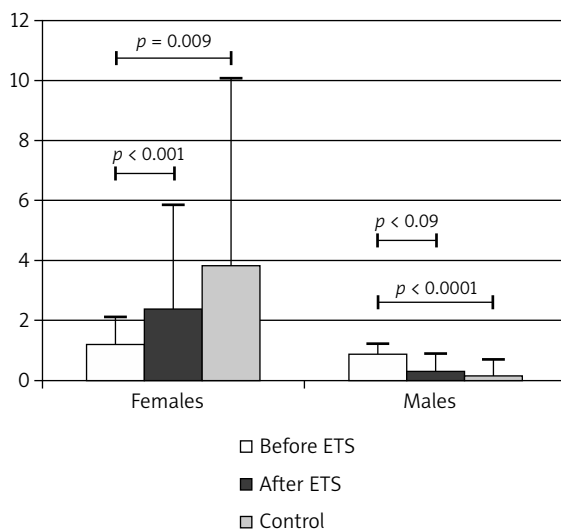
Country	Tendency to cry*		Time since last crying episode [days]		No. of respondents	
	Males	Females	Males	Females	Males	Females
Poland	2.47	5.66	4.85	3.00	53	56

\* $p < 0.05$  in *t*-Student test

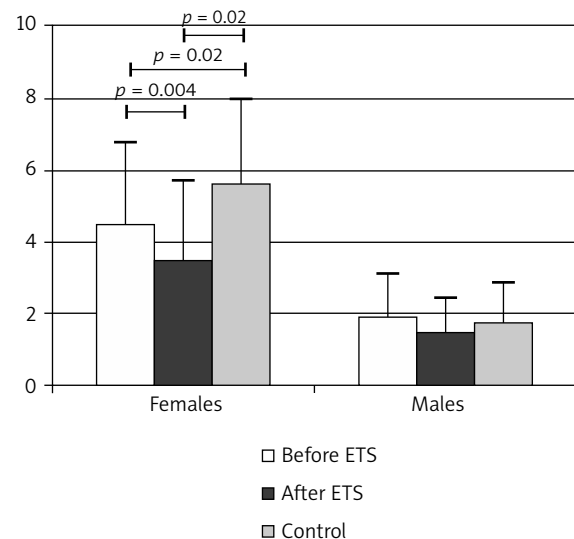
**Table II.** Correlation coefficients between ACI variables and FACIT-Emotional for female and male patients before and 3 months after surgery

		Before surgery				After surgery			
		ACI Var 1	ACI Var 2	ACI Var 4	ACI Var 5	ACI Var 1	ACI Var 2	ACI Var 4	ACI Var 5
Female	FACIT-Emotional	–	–0.27	–0.18	–0.34	–0.51*	0.01	0.03	–0.35
Male	FACIT-Emotional	–	0.23	–0.18	0.15	–0.68*	–0.43	–0.08	–0.09

\* $p < 0.05$  in Pearson's  $r$  correlation



**Figure 1.** Number of crying episodes (ACI Var 1: How many times did you cry in the past month? (0-infinity)) before and after ETS compared to non-operated controls. The results are presented for both women and men. Statistics: Student  $t$ -test for cross-evaluation and for paired analysis



**Figure 2.** Var 5. Subjective tendency to cry (1–10) in male and female participants before and after ETS compared to controls

crying both in male and female patients with an over-active sympathetic system. In the group of female patients, sympathectomy resulted in an increased number of crying episodes, though the subjective tendency to cry was diminished. In men, the subjective tendency to cry was unchanged and did not differ significantly from the data obtained from the control group.

It can be hypothesised that the successful operation resulted in improved mood and therefore the number of crying episodes should be lower [15–18]. In contrast, in our study, the number of crying episodes increased after surgery. The emotional status, as expected, affected the number of crying episodes but not the overall tendency to cry. Moreover, both the

number of crying episodes and overall tendency to cry were both prior to and after surgery significantly lower than the levels of those variables observed in the control group.

It can be explained by the increase of parasympathetic tone in lacrimal glands after surgery and, further, the increase of crying due to the lack of compensatory effect of the sympathetic system against the parasympathetic one, which is in agreement with the findings of Dartt [4].

This lacrimal glands are innervated by the autonomic nervous system, with the predominance of the parasympathetic [3]. Nevertheless, there is evidence that the sympathetic nervous system plays a direct and significant role in initiating and modu-

lating tear secretion, not only influencing the blood flow to the gland [3].

Tears are shed for many reasons, in situations characterized by loss, conflicts, and perceived inadequacy [19]. Moreover, there is a seeming association with the experience of happy situations, sentimental reactions [20], and tender feelings [21]. As mentioned above, crying can best be conceptualized as an attachment behaviour, serving to signal distress and to obtain caregiving and emotional support [22]. Bekker and Vingerhoets [23] introduced a model for systematic investigations in crying. In this model, the following factors are distinguished: (a) a baseline threshold for shedding tears; (b) the amount of exposure to cry-eliciting stimulation; (c) appraisal processes and capacity to regulate emotional impulses; and (d) social factors that may encourage or prevent the shedding of tears. Those variables have been investigated in our study.

It can also be hypothesised that the lower level of tendency to cry and less frequent crying episodes prior to surgery observed in the female participants of our study may be associated with permanently increased sympathetic tone. Thus, the physiological capacity of the sympathetic system would be permanently overloaded and there would be no more capacity for crying reactions.

On the other hand, it is also possible that long-term struggle with chronic disease increases the hardness of the patients and makes them less susceptible to stress-inducing situations and therefore they are less prone to crying.

As mentioned above, the subjective tendency to cry was unchanged in men and did not differ significantly from the data obtained from the control group. This finding supports the perspective of separate evaluation of crying in different genders. The number of crying episodes was decreased after surgery to the level observed in the control group. These results are most likely associated with the improved emotional status of the patients, together with increased quality of life and decreased life-burden caused by the symptoms of the disease.

It is also worth noting that the patients treated with ETS did not find that the surgery influenced their crying. It is even more interesting in the context of the above-mentioned results.

This study has several drawbacks that should be considered when evaluating the results. First, after

the division into genders the numbers of participants may be considered small, though the consistency of the structure of the results (quantified as the ratio of standard deviation to mean) is satisfactory. Second, this is strictly an observational longitudinal study, as no randomization was performed. It can be proposed that randomization between ETS and some other form of treatment of hyperhidrosis (such as Botox or iontophoresis) might provide an interesting insight into the problem as the latter does not destroy the sympathetic system while it also provides at least a temporary decrease of the intensity of the symptoms.

## Conclusions

It has been presented that thoracic sympathectomy decreases the subjective tendency to cry though it increases the number of crying episodes in women, but does not affect crying behaviours in men.

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