

**ORIGINAL ARTICLE, MEDICINE****Identification of the External Branch of the Superior Laryngeal Nerve during Thyroid Surgery****Lyubka Aleksova<sup>1</sup>, Metin M. Ali<sup>1</sup>, Djevdet I. Chakarov<sup>2</sup>, Zeynep M. Yozgyur<sup>3</sup>**<sup>1</sup> Department of Special Surgery, Faculty of Medicine, Medical University of Plovdiv, Plovdiv, Bulgaria<sup>2</sup> Department of General Surgery, Faculty of Medicine, Medical University of Plovdiv, Plovdiv, Bulgaria<sup>3</sup> Department of Biological Sciences, Wellesley College, USA**Correspondence:**

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**Aim:** To compare the level of intra-operative identification of external branch of the superior laryngeal nerve (EBSLN) through classical conventional clinical methods of prevention against those applying intraoperative neuromonitoring (IONM).

**Materials and methods:** The study included 102 patients with interventions on the thyroid gland performed in the surgical clinics of St George University Hospital and the Department of Special Surgery of Plovdiv Medical University. All operative procedures were performed by the standard technique of capsular dissection and IONM.

**Results:** Of all 102 thyroid procedures 87 (85.3%) patients underwent total thyroidectomy and 15 (14.7%) had unilateral thyroid lobectomy. One hundred fifty-five (82.01%) out of 189 expected EBSLN were identified and investigated intraoperatively when trying to identify visually EBSLN by the so called classical (conventional) methods of prevention. With the use of IONM, 181 (96.76%) EBSLN were correctly identified. Compared to the preliminary results of visual identification - 155/189 (82.01%) EBSLN, the degree of identification of EBSLN through IONM reached 96.76% which is a statistically significant difference ( $P < 0.05$ )

**Conclusion:** The use of IONM during thyroid resection significantly improves the degree of identification of EBSLN compared to conventional means of prevention. Routine use of IONM in surgical interventions on the thyroid gland will be beneficial for more secure identification and prevention of EBSLN.

**BACKGROUND**

Thyroid gland surgeries are among the most common surgical interventions worldwide and are considered by many surgeons as relatively easy and safe procedures. But there are still a number of complications with unacceptable and unpleasant consequences for the patient. Most significant among these are the postoperative hypoparathyroidism and the injuries of the laryngeal nerves - recurrent laryngeal nerve (RLN) and the external branch of the superior laryngeal nerve (EBSLN). EBSLN injury leads to paralysis of cricothyroid muscle (CTM) and often remains unspotted due to lack of clear laryngoscopic signs. Main postoperative symptoms are accompanied mostly by qualitative voice disturbances of the patients. A relatively new method for timely assessment of the risk of iatrogenic lesions of the laryngeal nerves in thyroid surgery is intraoperative neuromonitoring (IONM).

Thyroid resection is one of the most common surgical procedures worldwide.<sup>1,2</sup> Protection of the laryngeal nerves (RLN and EBSLN) and preservation of vital parathyroid glands are the two main technical challenges for the operating surgeon.<sup>1-3</sup> Medical literature nowadays provides detailed description of surgical anatomy of the RLN and a relevant approach to it. Unintentional injuries associated with the above are perhaps the best known and most studied complications.<sup>4,5</sup> EBSLN unduly receives less attention for a longer period and remains ‘the neglected nerve’ in thyroid surgery.<sup>6-8</sup> EBSLN injury results in paralysis of cricothyroid muscles and often remains unspotted due to lack of clear laryngoscopic signs.<sup>9-11</sup> The prevalence of EBSLN injury varies widely from 0% to 58%.<sup>12</sup> Leading postoperative symptoms include hoarseness or quick voice fatigue, especially after continuous talking. A relatively innovative method for timely

assessment of the risk of iatrogenic lesions of the laryngeal nerves is IONM, which is the gold standard of care for prevention of RLN and more recently in the context and purpose of high quality medical service, its performance on EBSLN is the subject of detailed analysis.<sup>11,12</sup>

## AIM

The aim of the present study was to compare the rates of intra-operative identification of EBSLN through classical conventional clinical methods of prevention and through those applying IONM.

## MATERIALS AND METHODS

The study includes 102 patients with interventions on the thyroid gland performed in the surgical clinics of St George University Hospital and the Department of Special Surgery at Plovdiv Medical University. All operative procedures were performed by the standard technique of capsular dissection and IONM using Neurosign 100 (Magstim Company Limited, UK). Contractility or twitching of CTM after stimulation of the structure in question was accepted as correct identification of EBSLN. Fisher's exact test and Chi-square test were used to find if there was correlation between categorical variables and to analyze the results.

**Table 1.** Demographic characteristics of the studied patients, indications, surgery and performed thyroid procedure

Indications	n	%
<b>Gender</b>		
Male	9	9
Female	93	91
<b>Total</b>	102	100
<b>Age</b>		
Average age	46.80	
Scope	21 – 76	
<b>Diagnosis</b>		
Basedowified goiter	19	18.63
Toxic multinodular goiter	14	13.73
Unilateral goiter	13	12.74
Bilateral goiter	30	29.41
Hashimoto's thyroiditis	16	15.69
Thyroid cancer	10	9.80
<b>Surgical procedure</b>		
Total thyroidectomy	87	85.3
Thyroid lobectomy	15	14.7
<b>Total</b>	102	100

## RESULTS AND DISCUSSION

A total of 102 surgeries of thyroid gland with IONM were performed between February 2015 and October 2016. Demographic characteristics of the studied patients, the indications for surgery and performed thyroid procedure are presented in **Table 1**.

Of all 102 thyroid procedures 87 (85.3%) patients underwent total thyroidectomy and 15 (14.7%) had unilateral thyroid lobectomy (**Table 1**). In unilateral thyroid lobectomy and total thyroidectomy each side (lobe) of the gland was considered as a separate entity. Thus the scope of this analysis includes 189 EBSLN.

Depending on the identification of EBSLN by classical methods of prevention or IONM assisted identification two groups were formed: (1) visual and (2) IONM identified EBSLN (**Table 2**).

One hundred and fifty-five (82.01%) out of 189 expected EBSLN were identified and investigated intraoperatively when trying to identify visually EBSLN by the so called classical (conventional) methods of prevention. Using IONM, 181 (96.76%) EBSLN were correctly identified (**Table 2**). Compared to the preliminary results of visual identification - 155/189 (82.01%) EBSLN, the rate of identification of EBSLN through IONM reached 96.76% which is a statistically significant difference ( $P<0.05$ ) (**Table 2**).

This analysis focuses solely on the surgical technique of dissection of the upper pole region of the thyroid gland. By means of the so called classical-conventional methods of EBSLN prevention we have applied a method of 'lateralization' of the respective lobe. Briefly, after dissection of the upper pole region through lower-lateral traction of the thyroid lobe (lateralization of thyroid lobe) the 'sternothyroid - laryngeal triangle', known as the triangle of Jolles or the space of Reeve was presented.<sup>10,14,15</sup> Ligation of upper-pole thyroid vessels was performed always after attempts of clear presentation followed by IONM confirmation of

**Table 2.** Distribution of EBSLN identified by visual assessment and by IONM

Identification of EBSLN (95% ID)		
	n-number EBSLN	%
Visual identification	155	82.01% $p<0.05$
IONM identification	181	96.76%

EBSLN and the cricothyroid muscles of the respective lobe. By strict adherence to the principles of capsular dissection the presented avascular space of Reeve made it possible for us to find and inspect EBSLN in nearly 82.01% of cases. In other words, a total of 155 of the expected 189 EBSLN were identified without the assistance of IONM. This relatively high percentage of identification of EBSLN only by conventional means of dissection in our analysis corresponds adequately to most of the literature data for the degree of verification of EBSLN with figures ranging from 10 to 80% in some analyses, and from 33 to 93% in others.<sup>16,17</sup>

IONM recently gained wide use in the visual identification of both the RLN and EBSLN.<sup>11,12</sup> In support of the above there is abundant data in literature, e.g. Barczynski et al. in a study on 210 patients established 84% IONM assisted identification of EBSLN versus 33% in cases without the use of IONM.<sup>11</sup>

A high percentage of identification - up to 96.76% of EBSLN and secure protection with the use of IONM is evident also in our analysis ( $P<0.05$ ). It is worth noting that no one of the patients in our study had persistent phonetic disturbances during the period of monitoring which lasted almost for six months. Although complications associated with damage to EBSLN are not life-threatening, they would have been catastrophic for patients who use their voice in their job.<sup>9-11,13</sup>

## CONCLUSION

In this study we attempted to check the benefits or disadvantages of classical conventional methods of intraoperative identification and prevention of EBSLN compared with those assisted by IONM. Results of analysis clearly demonstrate that the use of IONM during thyroid resection significantly improves the degree of identification of EBSLN compared to conventional means of prevention. Routine use of IONM in surgical interventions on the thyroid gland will be beneficial for more secure identification and prevention of EBSLN.

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## Идентификация внешней ветви верхнего гортанного нерва во время операции на щитовидной железе

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интраоперационный нейромониторинг (ИОНМ), внешняя ветвь верхнего гортанного нерва (ВВВГН), крикотиреоидные мышцы (КТМ)

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**Цель:** Целью настоящего исследования является сопоставление уровней интраоперационной идентификации внешней ветви верхнего гортанного нерва (ВВВГН) между классическими конвенциональными клиническими методами профилактики и применением интраоперационного нейромониторинга (ИОНМ).

**Материалы и методы:** В исследовании приняло участие 102 пациента с операцией на щитовидной железе, проведённой в хирургических клиниках Университетской больницы „Св. Георги“ и на кафедре специальной хирургии Медицинского университета – Пловдив. Все оперативные процедуры были осуществлены при помощи стандартной методики капсулной диссекции и ИОНМ.

**Результаты:** Из всех 102 случаев - 87 (85.3%) пациентов прошли полную тиреоидэктомию, а 15 (14.7%) – одностороннюю лобэктомию щитовидной железы. Сто пятьдесят пять (82.01%) из 189 прогнозируемых ВВВГН были идентифицированы и исследованы интраоперационно во время наших попыток идентифицировать визуально ВВВГН с помощью так называемых классических (конвенциональных) методов профилактики. При использовании ИОНМ были правильно идентифицированы 181 (96.76%) ВВВГН. По сравнению с предварительными результатами визуальной идентификации - 155/189 (82.01%) ВВВГН, степень идентификации ВВВГН при помощи ИОНМ достигла 96.76%, что является статистически значимой разницей ( $P <0.05$ ).

**Заключение:** Применение ИОНМ во время операции на щитовидной железе значительно улучшает степень идентификации ВВВГН по сравнению с конвенциональными методами профилактики. Рутинное применение ИОНМ в хирургических операциях на щитовидной железе будет полезным для более надёжной идентификации и профилактики ВВВГН.