

# UPPER ESOPHAGEAL SPHINCTER RESTING PRESSURE VARIES DURING ESOPHAGEAL MANOMETRY

*A pressão do esfíncter esofágico superior varia durante a manometria esofágica*

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**ABSTRACT - Background:** The upper esophageal sphincter is composed of striated muscle. The stress of intubation and the need to inhibit dry swallows during an esophageal manometry test may lead to variations in basal pressure of this sphincter. Upper esophageal sphincter is usually only studied at the final part of the test. Was observed during the performance of high resolution manometry that sphincter pressure may vary significantly over the course of the test. **Aim:** To evaluate the variation of the resting pressure of the upper esophageal sphincter during high resolution manometry. **Methods:** Was evaluated the variation of the basal pressure of the upper esophageal sphincter during high resolution manometry. Were reviewed the high resolution manometry tests of 36 healthy volunteers (mean age 31 years, 55% females). The basal pressure of the upper esophageal sphincter was measured at the beginning and at the end of a standard test. **Results:** The mean time of the test was eight minutes. The basal pressure of the upper esophageal sphincter was 100 mmHg at the beginning of the test and 70 mmHg at the end ( $p < 0.001$ ). At the beginning, one patient had hypotonic upper esophageal sphincter and 14 hypertonic. At the end of the test, one patient had hypotonic upper esophageal sphincter (same patient as the beginning) and seven hypertonic upper esophageal sphincter. **Conclusion:** A significant variation of the basal pressure of the upper esophageal sphincter was observed in the course of high resolution manometry. Probably, the value obtained at the end of the test may be more clinically relevant.

**HEADINGS** - Esophageal sphincter, upper. Manometry. Pressure.

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**DESCRITORES** - Esfíncter esofágico superior. Manometria. Pressão.

**RESUMO - Racional:** O esfíncter esofágico superior é constituído de musculatura estriada. O estresse da intubação e a necessidade de coibir as deglutições secas durante a manometria esofágica podem alterar a pressão basal do esfíncter esofágico superior que geralmente é estudado somente ao final da manometria convencional. Notou-se na manometria de alta resolução significativa variação no decorrer do exame. **Objetivo:** Avaliar a variação da pressão basal do esfíncter esofágico superior durante a manometria de alta resolução. **Método:** Foi avaliada a variação de pressão basal do esfíncter esofágico superior durante manometria de alta resolução. Foram estudados 36 voluntários sadios (idade média de 31 anos, 55% de mulheres). A pressão basal foi aferida no início e ao término do exame. **Resultados:** O tempo médio dos exames foi de oito minutos. A pressão basal do esfíncter esofágico superior foi de 100 mmHg no início do exame e de 70 mmHg ao final, em média ( $p < 0.001$ ). No início do teste, um paciente tinha o esfíncter esofágico superior hipotônico e 14 hipertônicos. No final, um paciente tinha o esfíncter esofágico superior hipotônico (o mesmo do início) e sete hipertônicos. **Conclusão:** Há significativa variação na pressão basal do esfíncter esofágico superior no curso manometria de alta resolução. Provavelmente, o valor obtido ao final do exame possa ser mais clinicamente relevante.

## INTRODUCTION

The upper esophageal sphincter (UES) is composed of striated muscle<sup>1</sup>. The stress of intubation and the need to inhibit dry swallows during an esophageal manometry test may lead to variations in its basal pressure. Conventional manometry may be inadequate for the study of the UES due to artifacts of movement and the low frequency response of water perfused systems<sup>1</sup>. Moreover, the UES is usually studied only at the end of the manometry test. During the performance of high resolution manometry (HRM) was observed that the UES pressure may vary significantly over the course of the test.

This study aimed to evaluate the variation of the resting pressure of the UES during HRM to determine the most appropriate moment to measure this pressure.

## METHODS

The study was approved by the Institutional Review Board. Informed consent was signed by all individuals. There are no conflicts of interest. The authors are responsible for the manuscript, no professional or ghost writers were hired.

Were studied 36 healthy volunteers (mean age  $31 \pm 10$  [18-63] years, 55% females). Individuals with previous esophageal operations, digestive symptoms more than once a month or refusal to participate were excluded.

### Esophageal manometry

All patients underwent HRM (Given Imaging, Los Angeles, USA) after fasting for eight hours. Medications that could interfere with esophageal motility were discontinued at least

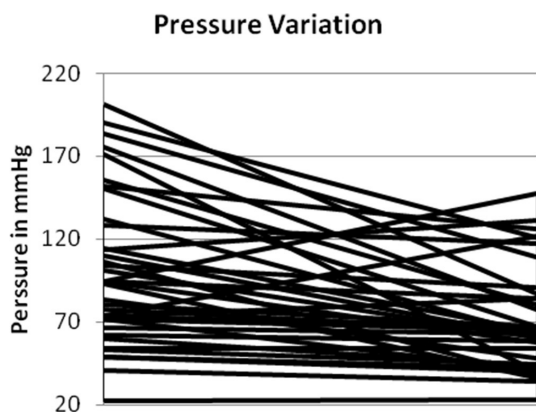
72 hours prior to the test. Acquisition and data analysis were obtained via the dedicated commercial software (ManoScan and Manoview, Given Imaging, Los Angeles, USA). The manometric protocol included an initial period of adaptation to allow individuals adjust to the presence of the trans-nasal catheter, followed by a 30-second period for landmark recording and 10 wet swallows (5 ml of water) spaced by a 30-second interval<sup>8</sup>. The manometric parameters evaluated were: a) UES resting pressure (normal value 34-104 mmHg<sup>5</sup>) at the beginning of the test, and b) UES resting pressure at the last swallow.

#### Statistics

Student t test was used to compare pressures. The value of  $p < 0.05$  was considered significant. The variables are expressed as mean  $\pm$  standard deviation [range]

## RESULTS

The mean time of the test was  $8 \pm 0.2$  [6-16] minutes. The resting pressure of the UES was  $100.6 \pm 45.6$  [22.0-201.1] mmHg at the beginning of the test and  $70.7 \pm 31.2$  [23-147.3] mmHg at the end ( $p < 0.001$ ) (Figure 1).



**FIGURE 1** - Upper esophageal sphincter pressure variation at the beginning and at the end of the esophageal manometry

At the beginning of the test, one (3%) individual had hypotonic UES and 14 (39%) hypertonic. At the end of the test, one (3%) had hypotonic UES (same patient as the beginning) and seven (19%) hypertonic (five of them initially with a hypertonic UES).

## DISCUSSION

These results show that a significant variation of the resting pressure of the UES occurs during the performance of HRM.

Conventional manometry may be an inadequate technology for the study of the UES. First, it is based on a water perfused system with a response rate to the pressure variations around 300-400 mmHg/s, insufficient to properly analyze striated muscle contraction<sup>1</sup> and leading to a constant dripping of water that stimulates the UES<sup>2</sup>. Second, the elevation of the hypolaryngeal complex during swallowing causes motion artifacts<sup>5</sup>. Last, the UES has a radial and longitudinal asymmetry<sup>2</sup> and only four radial sensors may be inappropriate.

These disadvantages of the system lead some authors in the past to not recommend the routine study of the UES, since abnormalities were frequently found, but changes in therapy were rarely related to manometric findings<sup>6</sup>. On the other hand, HRM provides an embracing presentation of the pressure of the pharynx and esophagus by increasing the number of sensors and reducing the distance between them, eliminating the disadvantages of the conventional equipment. In addition, a solid state catheter is

used, therefore avoiding the continuous dripping of water in the pharynx. A renewed interest for the UES brought to the literature a few studies published in the last years. However, there are still some aspects of the UES function that need further clarification.

Normal values for UES basal pressure has a noteworthy variance among different series but also within the same group of volunteers. Thus, extreme values as 19 and 165 may be considered normal<sup>3</sup>. Other groups showed a normal range varying from 35 to 113<sup>9,10</sup>. The wide variation in results can be partly explained by the influence of factors affecting the measurement of the pressure of UES such as the head position<sup>7</sup> or age of the patients<sup>4</sup>. These results also showed a significant variation of the basal pressure of the UES in the course of HRM. The stress of intubation and the need to inhibit dry swallows during an esophageal manometry test may lead to partial voluntary increase in the basal pressure of the UES at the beginning of the test. Moreover, the striated muscle is susceptible to fatigue.

## CONCLUSION

Even though the current study has small number of individuals as its main limitation, all subjects evaluated were healthy volunteers and it was able to show a significant variation of the basal pressure of the UES, observed in the course of HRM. Probably, the value obtained at the end of the test may reflect a more clinically important value.

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