

# Nutcracker upper esophageal sphincter

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**Background:** Different manometric patterns characterize named well-defined motility disorders of the esophageal body. The detailed study of the upper esophageal sphincter (UES); however, has been neglected. It is elusive whether a similar condition as the nutcracker esophagus exists in the UES. This study aims to evaluate the prevalence and characteristics of patients with “nutcracker UES”.

**Methods:** We retrospectively reviewed 1,000 esophageal function tests to identify patients with UES basal pressure above 190 mmHg (2 standard deviation above the average in volunteers studied in our laboratory). Demographic data and manometric parameters for the lower esophageal sphincter (LES), esophageal body and UES were recorded as well as pH monitoring variables.

**Results:** Thirty-one patients were selected (prevalence 0.3%). There were 9 (29%) males, mean age 40±11 (range, 15–60) years. LES basal pressure was 16±15 mmHg (52% were hypotonic and 3% hypertonic). Two (6%) had a nutcracker esophagus. UES basal pressure was 235±89 mmHg. Ten (32%) had pathologic reflux with equal distribution of reflux pattern (supine *vs.* orthostatic). Six (19%) had extra-esophageal symptoms.

**Conclusions:** In conclusion, nutcracker UES has a low prevalence in patients that undergo esophageal manometry. There is not a specific demographic group at risk for this manometric condition. Manometric parameters of the LES and esophageal body are not specific for this condition.

**Keywords:** Upper esophageal sphincter (UES); esophageal manometry; nutcracker esophagus; esophageal motility disorders; gastroesophageal reflux

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## Introduction

Some specific manometric patterns characterize well-defined motility disorders of the esophageal body (1). These named motility disorders changed in nomenclature and definition when high-resolution manometry replaced conventional manometry and the Chicago classification was introduced. Conventional manometry defined hypertensive peristalsis as a “nutcracker esophagus” (2) that corresponds to the “jackhammer esophagus” described in the high resolution classification (3). It is elusive whether a similar condition as the nutcracker esophagus exists in the upper esophageal sphincter (UES).

The UES was neglected during the era of conventional manometry. Some inherent technical limitations of the past technology due to artifacts of movement and the low frequency response of water perfused systems precluded an accurate study of the UES (4). The analysis of the relaxation of the sphincter and coordination with pharyngeal contraction and relaxation was certainly jeopardized by these limitations. UES basal pressure was probably the most reliable parameter measured by conventional manometry.

This study aims to evaluate the prevalence and characteristics of patients with nutcracker UES.

## Methods

### Population

We retrospectively reviewed 1,000 consecutive unselected esophageal function tests. Patients with previous foregut surgery were excluded from the study.

### Esophageal function tests

All patients underwent esophageal manometry (Multiplex, 8-channels, water-perfused, Alacer Biomedica, Sao Paulo) to evaluate esophageal motility and to locate the upper border of the lower esophageal sphincter (LES). Position, pressure, length, and relaxation of the LES were measured using the station pull through technique, with 1-cm increments. Esophageal body wave's amplitudes were recorded 3, 8, 13, and 18 cm above the upper border of the LES by giving 10 swallows of 5 mL of water at 30-second intervals. Position, pressure and relaxation of the UES were recorded. UES basal pressure was measured at the point of highest pressure at least 2 seconds prior or after swallows to avoid pre and post relaxation increases. UES residual pressure <1 mmHg zeroed at atmospheric pressure was considered normal.

Esophageal pH monitoring (AL-3, Alacer Biomedica, Sao Paulo) was performed in all patients. Acid reducing medications and medications that interfere with esophageal and gastric motility were discontinued before the tests.

Nutcracker UES was defined by UES basal pressure above 190 mmHg [2 standard deviation above the average in volunteers studied in our laboratory (5)]. Gastroesophageal reflux disease (GERD) was defined by a composite score (DeMeester score) greater than 14.7. Other motility disorders were classified according to Richter's classification (2).

### Symptoms

Symptoms were grouped in esophageal (heartburn, regurgitation) and extra-esophageal (hoarseness, throat clearing, cough, chest discomfort).

### Ethics

The study protocol was approved by the local Ethics Committee. There are no conflicts of interest. There is no funding. The authors are responsible for the manuscript and no professional writers were hired. Informed consent was waived due to the retrospective format of the study.

## Results

Thirty-one patients met the criteria for Nutcracker UES (prevalence 0.3%). There were 9 (29%) males, mean age  $40 \pm 11$  (range, 15–60) years.

Manometric data showed a mean LES basal pressure  $16 \pm 15$  (range, 2–82) mmHg (52% were hypotonic and 3% hypertonic). Two (6%) had a concomitant nutcracker esophagus. No other named motility disorders were diagnosed. UES basal pressure was  $235 \pm 89$  (range 190–699) mmHg. Residual pressure was normal in all patients.

Mean DeMeester score was  $13.0 \pm 16$  range 0–29. Ten (32%) patients had pathologic reflux with equal distribution of reflux pattern (50% supine *vs.* 50% upright). Six (19%) had extra-esophageal symptoms (throat secretion  $n=2$ , throat clearing  $n=2$ , hoarseness  $n=1$ , cough  $n=1$ ). No patient was referred due to dysphagia or globus).

## Discussion

Our results showed that: (I) the prevalence of nutcracker UES is low, (II) specific demographic group at risk for this manometric condition was not determined; (III) specific manometric characteristics apart from the UES at risk for this manometric condition were not determined, and (IV) this manometric pattern seems an incidental finding not causative of symptoms.

### Clinical usefulness of UES basal pressure

UES disorders are present in only 3% of routine manometries (6). This fact led some authors to disregard the study of the UES in routine manometric studies and value it only in patients with oropharyngeal dysphagia (7,8) in as much that the current classification for motility disorders ignores the UES (9). In addition, previous studies showed that the UES basal (resting) pressure has reference values for normality that vary wildly (4,10) and that the pressure is not constant during the test (5). This wide range of variance among normal individuals may be linked to certain voluntary control of the striated muscle that constitute the UES and consequent influence of emotional status and the effect of aging since lower UES pressures are found in individuals older than 60 years (11,12). Although a wide range of ages were found in our patients with nutcracker UES, the condition was not found in patients older than 60 years.

UES is certainly altered in oropharyngeal dysphagia (13). Dysphagia; however, is associated to low UES basal

pressure (13,14) different from nutcracker esophagus that is a frequent cause for dysphagia (15). In fact, no patient present with dysphagia in our series.

UES hypercontractility was not linked to GERD in our series. UES is intuitively expected to act as a last barrier to prevent supra-glottic reflux of gastric contents but we have demonstrated previously that there is a predominance of hypotonic UES in GERD patients that may suffer from a panesophageal motor disorder (9). A pan-hypercontractile pattern was also not found as only 1 patient had a hypertonic LES and only 2 different individuals a concomitant nutcracker esophagus.

## Conclusions

Our study has some limitations. This series encompasses a large number of esophageal function tests performed in a single center by a single experienced investigator. The final number of patients identified with the condition to be studied is; however, small. This must be added to the retrospective design of the study. Finally, patients were not studied by high resolution manometry precluding the use of more complex manometric parameters especially for the evaluation of UES relaxation and the coordination between oropharynx and UES. There are; however, no widely accepted parameters to evaluate the UES by high resolution manometry yet. This motivated us to query our large database of conventional manometry. It was not possible as well to determine if nutcracker UES is secondary to GERD in the small percentage of patients with both conditions. The answer to this question would demand repetition of the test after GERD treatment.

Our results showed that nutcracker UES is a rare condition and it probably does not constitute a defined manometric pattern with clinical significance.

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## Footnote

*Conflicts of Interest:* All authors have completed the ICMJE uniform disclosure form (available at <http://dx.doi.org/10.21037/aoe.2019.02.02>). The authors have no conflicts of interest to declare.

*Ethical Statement:* The authors are accountable for all

aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study protocol was approved by the local Ethics Committee. Informed consent was waived due to the retrospective format of the study.

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