Diagnostic Exam Procedures Used to Study Swallowing Function

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Abstract

Aim: To evaluate the most efficient and valid diagnostic procedures to examine swallowing function.

Materials and methods: Several and various diagnostic procedures for examining swallowing function such as Videofluoroscopy, Ultrasonography and Nuclear Magnetic Resonance have been analyzed in literature using "Pubmed" indexed articles.

Results: Videofluoroscopy was considered to be the gold standard among all the other diagnostic procedures for allows to evaluate better deglutition process from the bolus formation in the oral cavity to the entrance through esophageal sphincter to the stomach.

Conclusions: Videofluoroscopy is considered a valid and excellent diagnostic tool to evaluate swallowing function since it is able to videorecord all the deglutition phases, and, once it has acquired and registered the images, each single frame is examined in real time and also in slow motion. Although these previously outlined advantages, Videofluoroscopy exam has still the limitation that has to be performed with the administration of a iodinated contrast media.

Introduction

Deglutition is a fundamental function and whatsoever pathological condition could interfere into the process, compromising it.

The major purpose of swallowing is to actively transfer liquid and solid compound into the stomach hence activating and starting digestive process.

In an adult healthy patient this process starts with moistening and mastication. The involved anatomical structures in mastication are: mandible, maxilla, tooth, palate, cheeks, floor of mouth and most of all the tongue.

The rhythmic action of mastication has a voluntary and involuntary innervation of muscles. The bolus contact with dental occlusion surfaces and palate give the stimulus that enhance the mastication. The tongue and cheeks contain the bolus between the occlusal surfaces.

Moreover, deglutition is a complex process that needs a high number of involved muscles of the oral cavity (mylohyoid, genioglossus, styloglossus and muscles) and of pharynx, larynx and esophagus in coordinated and stereotyped sequence. most of these group of muscles are striated and have a nervous impulse activated and transmitted by the deglutition centre. Subsequently, a neurophysiological alteration of the mechanism provokes a swallowing dysfunction.

Methods

In our study we have taken in account three type of diagnostic exam that, based on international literatures, are the most used. Among those, Videofluoroscopy (VFS) which is a radiographic deglutition exam with modified barium swallow, analyze specifically the bolus passage through the oral cavity to the stomach entrance. Since this exam need a barium modified compound, it is not performed on pediatric patients and most of all not on infants but in pediatric patient that are at least 10 years old.

A radiographic equipment that can acquire and register radiographic images of high digital and frequency quality signal is required to perform Videofluoroscopy.

The exam starts the analysis without a contrast media:

- in lateral projection of the oropharyngeal region that evaluates soft palate mobility while the patient pronounces the word "candy"
- in anterior-posterior projection of the oropharyngeal region that evaluates vocal folds adduction while the patient articulates the letter "e" extended sound ("eeee....")

Another common diagnostic exam investigated is Ultrasonography. Ultrasonography is a non invasive procedures that has some diagnostic features limits:

It is reported, indeed, that the skin scanning transducer used in performing the exam, produces various artifacts misleading the results and medical reports.

Among the most used techniques, nowadays, nuclear magnetic resonance (MRI) is by far the most efficient and functional exam in studying swallowing process and its related anatomical structures, as pointed out by...
Akin and other authors that agree to consider MRI as the least non-invasive and most effective method.

Indeed Foucart et al. have reported the better possibility of using MRI compared to other diagnostic procedures in studying oropharyngeal apparatus and have highlighted the optimal ability of this diagnostic exam in display and visualize soft tissue without radioactive exposure giving also real time frame pictures of the same quality comparable to those produced by Videofluoroscopy (Illustration 2).

Discussion:

During Videofluoroscopy contrastographic phase it is administered to the patient a barium contrast medium per os and the patient is invited to hold it in the oral cavity and to swallow it when asked to. Boluses barium compound administration with different density and consistency is optimized based on patient’s symptoms and helps to identify the more congruous feeding alimentation for him.

the lateral side projection gives a general view of all swallowing process and permits to evaluate all swallowing phases resulting to be the best diagnostic projection to investigate on breathing function.

Whereas, the anterior-posterior projection results to be useful to evaluate bolus transit symmetry and identify monolateral stagnation that can be noticed after swallowing in the oral cavity , in the valleys glossopalatine epiglottis and in the pyriform sinuses.

All swallowing phases are videorecorded and ,once frame records are acquired, frame images are evaluated and analyzed both in real time and slow motion or each single frame.

Ultrasonography, instead, is limited to the study of the only oral phase of deglutition for skeletal interference do not allow to visualize pharynx and larynx. Radiation emission questions these two techniques (Videofluoroscopy and Ultrasonography) specially if performed in particular patient, as those pediatric patients affected by Pierre Robin sequence.

MRI obviate these difficulties, helping to visualize neat images of the oral cavity and of the larynx as well as of deeper structures. Yasutoshi et al. support the effectiveness of MRI in sitting position, particularly when evaluating the motility of posterior pharyngeal wall during deglutition. The contrast medium used in the study was a liquid bolus (3gr) dissolved in 300ml of water. Swallowing phases were completed successfully in all patients. The chair used had a posterior support that helped to adjust the vertical position and to correctly position the head and neck at the magnet centre.

Images sequence have delineated each single swallowing phases, anatomical swallowing-related structures (id est lips, tongue, soft palate, mandible, pharynx, hyoid bone, larynx, mylohyoid muscle and esophageal wall).

The oral high-intensity contrast medium administration allowed to visualize the oral and pharyngeal phase of the swallowing process.

Conclusions

Swallowing is a very complex essential function that needs oropharyngeal, laryngeal and esophageal muscles coordination and if it is altered can lead to severe consequences such as dehydration and malnutrition.

Therefore it is important that swallowing execution happens correctly and that can be easily and efficiently analyzed: MRI seems to be considered by literature the most indicated diagnostic procedure to assure it.

MRI is also applicable to a larger age range compared to previously exposed diagnostic procedures such as Videofluoroscopy and Ultrasonography.

References

5. Akin E., sayin., Bulakbasi N. Real-time balanced turbo field echo cine-magnetic resonance imagim evaluation of tongure movements during deglution in subject with anterior open bite. Turkey 2004
Illustrations

Illustration 1

anatomical structures visible in MRI image

Illustration 2

Videofluoroscopy exam image