Acoustic Manometry

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Introduction:

Acoustic manometry determines the cross sectional area of the nasal cavity as a function of distance into the nasal cavity. This provides a two dimensional picture of nasal cavity. These measurements help in objective assessment of nasal patency. Nasal patency is actually a complex issue which can involve mucosal, structural and psychological factors. It should always be borne in mind that the sensation of nasal obstruction is purely subjective and does not correlate `100% always with clinical examination findings [3]. This test has been intended as an objective quantification of nasal patency.

Acoustic Rhinomanometry:

Rhinomanometry [8] is a measurement of pressure encountered by air passing through the nasal cavity [1]. This procedure was first introduced by Hilberg [7] as an objective method in assessing the nasal cavity. It uses the reflected sound signal to measure the cross sectional area of nasal cavity. This is painless, non invasive, fairly rapid and easily tolerated even by children [6]. The sound frequency used should be above 250 Hz. The equipment used for this purpose is odisoft rhino. It has also been borne out in various studies that there are many objective test values where some patients will complain of nasal obstruction while others may not.

Odiosoft rhino is an equipment used to measure the sound produced by nasal airflow. Measurement of nasal airflow sounds helps us to indirectly assess the presence / absence of nasal block as well as accurately identifying the site of the block. Normal nasal airflow in humans is neither laminar nor turbulent, but a mixture of both. Hence the term transitional is used to describe nasal airflow. Simple mathematical formulae cannot be used to study nasal air flow dynamics. At higer velocities of nasal airflow turbulence also increases. This turbulence creates sound which can be recorded by recording devices such as odisoft rhino [2]. A review of literature suggests that the findings of acoustic rhinomanometry does not correlate well with adenoid hypertrophy in children [4]. These measurements do not take into account tip ptosis / alar collapse as these areas are byepassed during the acoustic rhinomanometry studies, hence should be used with caution in patients with these problems.

Airflow within the nasal cavity is regulated by 4 valves:

1.External nasal valve

2.Internal nasal valve

3.Nasal turbiantes

4.Nasal septum

Role of Fourier analysis in the study of nasal airflow:

According to Fourier the French scientist any complicated wave form can be expressed as a series of two or more simple sine waves and cosine waves.

Sound generated by air passing through nasal cavity can be recorded by placing probes containing microphone in the anterior nasal cavity. These recorded sounds are subjected to fast fourier transformation using the software called Odisoft rhino.

The recorded frequency spectrum could be classified into:

1.Low frequency (500 – 1000Hz)

2.Medium frequency (1-2KHz)

3.High frequency (3-6 Khz)

Procedure:

Before emarking on recording nasal sounds, the following things should be ensured:

1.The patient should be completely relaxed

2.Crusts and mucous secretions from the nasal cavity should be removed

3.While testing the right nasal cavity the probe is held in the right hand and parallel to the right nasal cavity, while the left hand is used to close the left nasal cavity.

4.The probe should not be inserted into the nasal cavity and atleast 1 cm space should be there between the probe and the nares.

5.Recording usually starts during non forced expiration.

6.Recording should ideally be performed in quiet environment and acoustic artifacts like noise caused by rubbing of wires should be avoided.

Nasal sound analysis:

The frequency and amplitude of the recorded sounds should be taken into consideration. Nasal sound frequency and amplitude increases as the turbulence inside the nasal cavity increases. Nasal sound recordings in patients with deviated nasal septum have shown that the intensity of sound in lower and mid frequencies are not raised that much while the intensity of sound in high frequency was significanty elevated.
Obstruction in nasal valve area can be assessed by performing the Cottles Maneuver. Before cottle's maneuver the intensitey of sound in high frequency is elevated, while recordings performed during cottle's maneuver shows a reduction in the intensity of sound at high frequencies as the nasal air flow assumes a laminar pattern.

This whole system can also be used as a web based diagnostic service, where a patient can be asked to use the probe and the recorded sound is transmitted through internet to the diagnostic server where these sounds can be analysed and diagnosis can be made.

Uses for acoustic rhinomanometry:

1. To assess the post operative nasal function objectively

2. It gives anatomical description of nasal cavity and probable anatomic area of nasal obstruction

3. Can be used to identify the site of upper airway obstruction in patients with obstructive sleep apnoea [5]

Factors that can affect acoustic rhinomanometry:

1. Vasoconstrictors

2. Drugs

3. Surgery

4. Nasal cycle

Conclusion:

Eventhough this is a promising tool in rhinology lab analysis, a lot of work needs to be done before acoustic rhinomanometry could be used with reasonable degree of accuracy in estimating nasal cavity dimensions in the dynamic clinical scenario.

References:

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