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[Instrument Review]

MicroRPM: Instrument Review

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Introduction :

Respiratory muscle weakness is observed in number of patients suffering with several neuromuscular diseases and is commonly associated with a higher morbidity and mortality.

Nevertheless, it is one of the compounding factor in conditions such as malnutrition, chronic obstructive pulmonary disease, congestive heart failure, sepsis and could be a possible complication of many metabolic diseases, endocrine disorders, and steroid therapy.

Hence, making it important to assess respiratory muscle strength not only to detect but to quantify its severity of weakness. Respiratory muscle assessment is helpful in finding the causes of unexplained dyspnoea, bulbar problems, and impaired cough, and is also important for the follow-up assessment of progress of patients on respiratory muscle training programmes and is being used in ventilator weaning protocols as well.

Clinical assessment of respiratory muscle strength is difficult and hence justifies the need for objective assessment.

There are many respiratory assessment methods in use, those can be classified as Volitional and Non-volitional. Phrenic nerve electrical stimulation, Magnetic phrenic nerve stimulation, Magnetic stimulation of the cortex, Phonomyography, Transdiaphragmatic pressure assessment, Radiological or Ultrasonographic assessment of diaphragmatic position etc. are the non-invasive methods which detect the strength of diaphragm wherein no requirement of voluntary effort from patient. Moreover, these are non-Invasive tests wherein, Oesophageal, gastric, and transdiaphragmatic pressure assessment needs invasion. Arterial blood gas analysis, Polysomnography are the indirect methods to detect affection of respiratory muscles.

Pulmonary function tests using Spirometry and assessment of Mouth pressures and Sniff pressures using Respiratory Pressure Meter, are the tests that require voluntary efforts from patients and hence results could be influenced by the patient's effort and co-operation while performing these test.

The MicroRPM™ (Respiratory Pressure Meter) is a hand-held instrument designed for rapid, non-invasive assessment of inspiratory and expiratory muscle strength. The unit can measure the maximum inspiratory (MIP) and expiratory mouth pressures (MEP), and the Sniff Nasal Inspiratory Pressure (SNIP). A liquid crystal display screen presents the results of each measurement in units of cmH2O. Maximal Rate of Pressure Development (MRPD) and Maximal Rate of Relaxation (MRR) also can be measured using this device. Both Adult and Pediatric patients over the age of 3 years can be assessed using this in different testing environments such as hospitals, Outpatient Departments, laboratories, community setting etc.

The MicroRPM device comes with the advanced software PUMA™. It has a user friendly, modern, multi-window visual interface that displays and stores the real-time pressure curves obtained from the assessments of both mouth and nasal pressures.

Maximal cooperation from children can be ascertained as it includes an animated incentive display ensuring the test quality and encourages correct test technique.

Printout of results can be obtained which is selectable and previous pressure curves can be overlayed. These results can be exported and stored

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electronically in patents records.

The MicroRPM is comprised of following:

1. MicroRPM microcomputer unit
2. Inspiratory pressure valve, filter and mouthpiece
3. Expiratory pressure valve, filter and mouthpiece
4. Battery
5. Calibration screwdriver
6. Nasal probe (Size 1-4)
7. Nasal probe adapter

Image 1: MicroRPM Unit

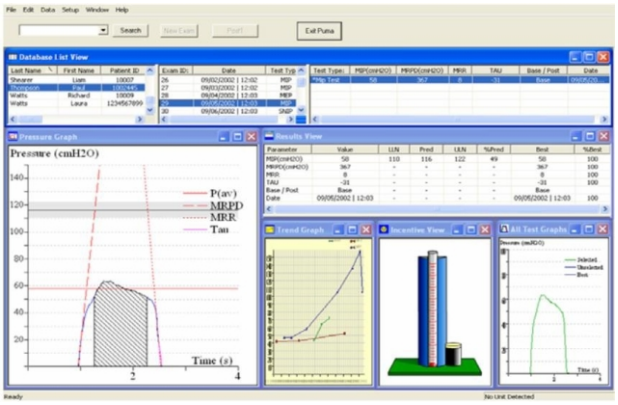

Image 2: PUMA software display

MIP: Maximal inspiratory pressure (MIP) is determined by measuring upper airway pressure (mouth for outpatients and trachea for intubated or tracheostomized patients) during a maximal voluntary inspiratory effort. The measured pressure is a composite of the pressure generated by the inspiratory muscles and the elastic recoil pressure of the lungs and chest wall.

To perform the test, instruct the subject to insert the mouthpiece into the mouth, ensuring the flange is positioned over the gums and inside the lips, whilst the 'bite blocks' are between the teeth.

The subject should then exhale to RV (Residual Volume), lungs empty, then perform a 'Mueller' manoeuvre, a forced inhalation against the MicroRPM with as much effort as possible for as long as possible (minimum 2 seconds).

The display will report the result, the maximum average inspiratory pressure sustained over a 1 second period of the test, in centimetres of water (cmH20). Ideally, the subject should repeat this test 3 times to ascertain a best value.

MEP: Maximum Expiratory Pressure is used for assessment of cough strength, given that one of the phases of cough is explosive expiration and expiratory muscle weakness correlates with respiratory infections and extubation failure.

To perform the test, instruct the subject to insert the mouthpiece into the mouth, ensuring the flange is positioned over the gums and inside the lips, whilst the 'bite blocks' are between the teeth.

The subject should then inhale to TLC (Total Lung Capacity), lungs full, then perform a 'Valsalva' manoeuvre, a forced exhalation against the MicroRPM with as much effort as possible for as long as possible (minimum 2 seconds).

The display will report the result, the maximum average expiratory pressure sustained over a 1 second period of the test, in cmH20. Ideally, the subject should repeat this test 3 times to ascertain a best value.

SNIP: Sniff Nasal Inspiratory Pressure measures the joint activity of the diaphragm and other inspiratory muscles as inferred from electromyographic studies that have shown a selective contraction of the muscles involved in breathing, especially the inspiratory accessory muscles, hence proving the specificity of the test.

To perform the test, instruct the subject to insert the chosen Nasal Probe firmly into a nostril, whilst ensuring the other nostril remains open throughout the test.

The subject should then breathe normally and at the end of a normal tidal expiration, FRC (Functional Residual Capacity), be instructed to perform a short, sharp voluntary sniffing manoeuvre with as much effort as possible.

The display will report the result, the peak inspiratory nasal pressure, in cmH20.

On subsequent tests the MicroRPM will continue to display the highest SNIP value, overwriting previous

values. Ideally, the subject should repeat this test 10-15 times to ascertain the highest value.

Advantages:

Simple and easy to operate,

Pocket-sized,

Battery Powered,

Easy to assemble accessories,

Clear digital display of the results in cm H2O,

PUMA software,

Can be used for adults and children.

Disadvantages:

Used mouthpieces and nasal probes need to be disposed off immediately after each use which incurs additional cost.

Indications:

MicroRPM can be used for

diagnosis of respiratory muscle weakness in patients with pulmonary, cardiac, and neuromuscular diseases, the differential diagnosis of dyspnoea, the assessment of response to cardiopulmonary physiotherapy and rehabilitation, the prescription and monitoring respiratory muscle training and, deciding the possibility and success of weaning from mechanical ventilation in critically ill patients.

Contraindication:

MicroRPM cannot be used in Pathological conditions resulting in large pressure swings in abdomen or thorax, Aneurisms, Uncontrolled Hypertension, Urinary Incontinence.

References:

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