(Thermal) Quantitative Sensory Testing—tQST

Description

Quantitative sensory testing (QST) is a collection of individual tests designed to assess the somatosensory system, particularly of patients with neuropathic pain or suspected neurologic disease (Rolke et al 2006b, Shy et al 2003). Pressure algometry, one of the individual QST tests, has previously been discussed in Clinimetrics (Ylinen 2007); this article focuses on the thermal component of the QST protocol (tQST), which requires the use of a Thermal Sensory Analysera (TSA) or an Modular Sensory Analyserb (MSA) (Rolke et al 2006a).

The tQST protocol is used to detect cold and warm thresholds, paradoxical heat sensations, and cold and heat pain thresholds (Rolke et al 2006a, Rolke et al 2006b). The most common method for threshold determination is the 'method of limits.' This involves the patient indicating as soon as he or she detects either a hot or cold stimulus as the strength of the signal gradually increases. Alternatively, depending on the particular test, the patient may indicate when the stimulus is no longer detected as its strength is gradually decreased (Rolke et al 2006a, Shy et al 2003).

Clinimetrics: The tQST protocol described by Rolke and colleagues comprises a series of tests primarily intended to assist with the diagnosis of pain mechanisms, for example central sensitisation (Rolke et al 2006b). Although the individual component tests of the protocol have been previously validated, further studies are needed to evaluate the validity of the complete QST battery (Rolke et al 2006b). There is also a lack of data on the validity of the tQST protocol to diagnose specific neurologic conditions, the absence of which has probably limited the acceptance of tQST in the clinical management of painful conditions (Backonja et al 2009, Shy et al 2003).

tQST has been found to demonstrate good reproducibility, performed with the method of limits at different test intervals (Heldestad et al 2010). For example coefficients of repeatability (the minimal detectable change between measurements, expressed in C°) between testing on Days 1, 2, and 7 ranged from 0.62 to 1.35 for both warm and cold thresholds. However, as values ranged from 1.64 to 3.14 when heat and cold pain thresholds preceded threshold testing, Heldestad et al (2010) have stressed the importance of conducting thermal threshold testing prior to pain thresholds so that reproducibility is optimised. Significant correlations in tQST results have been found over two days in a sample of chronic pain sufferers and healthy subjects (range r = 0.41 to 0.62) (Agostinho et al 2009).

Commentary

tQST is best suited to quantifying positive sensory phenomena, such as allodynia and hyperalgesia; it is most suitable as a within-patient outcome measure of pharmacological and non-pharmacological treatment effect on somatosensory function in those with neuropathic pain (Backonja et al 2009, Cruccu et al 2010, Rolke et al 2006a). QST normative values have been published and serve as a reference against which patients’ results can be evaluated (Rolke et al 2006a). However, as many variables can affect the results of an assessment comparing scores from different subjects, examiners, settings or, perhaps most significantly, testing apparatus, can be difficult (Shy et al 2003).

As with any psychophysical test (i.e., a test requiring cooperation from the patient) care must be taken in the interpretation of results. This is particularly relevant with the interpretation of tQST scores since the tests rely heavily on patient perceptions and responses (Backonja et al 2009, Shy et al 2003). In order to optimise the reliability of the measure, there is a critical need for standardised physical properties of the stimulus, closely standardised instruction, and investigator training (Backonja et al 2009).

The lack of evidence-based diagnostic criteria for tQST for neurological conditions is a likely explanation of why tQST is more common in the neuroscience research setting than in clinics. Practical considerations and cost are likely to also play a significant role (the tQST assessment takes around 45 minutes to set up, perform, and record, and tQST units can cost around AU$40 000). However the study of neuropathic pain is a rapidly developing area of clinical research in which tQST is likely to play an increasingly significant role. With appropriate application and interpretation the tool will likely be utilised more in clinical practice (Backonja et al 2009). tQST robustness will ultimately depend on investigator training and method, and its results are likely best interpreted in light of the broader clinical picture.

Flavia Di Pietro and James H McAuley
Neuroscience Research Australia (NeuRA); The University of New South Wales, Sydney

References


Websites

http://www.medoc-web.com/
http://www.somedic.com
2D real time ultrasound for pelvic floor muscle assessment

Description

2D realtime ultrasound can be used for non invasive assessment of pelvic floor muscle (PFM) function with standardised protocols described for both transabdominal (TA) (Sherburn et al 2005, Thompson and O’Sullivan 2003) and transperineal (TP) approaches (Dietz 2004). The TA approach requires a moderately full bladder; the probe is placed over the supra-pubic region to visualise the bladder and the bladder base. The sound head is angled caudally to obtain a clear image of the bladder wall. The TP approach is undertaken without a full bladder; the probe is placed directly on the perineum, and allows direct visualisation of the ano-rectum, urethra, and bladder neck. In neither approach are the PFMs visualised directly. Movement of the bladder base (TA), and bladder neck or ano-rectal angle (TP) are the surrogate markers for PFM action. Movement of the pelvic floor, during voluntary PFM contractions, and automatic activity in functional tasks are visualised and linear displacement (mm) is measured (Peng et al 2007). Using the TA approach, a marker is placed in the mid-line of the inferior bladder (transverse plane) and at the point of greatest displacement of the bladder base (sagittal plane). The linear displacement from the resting position to final position is measured using online callipers. Using the TP approach measurements of the movement of the bladder neck are relative to the pubic symphysis, whereas in the TA approach displacements are absolute values, as there are no fixed bony landmarks in view. More detailed information regarding pelvic organ prolapse can therefore be obtained in the TP approach (Dietz 2004).

Reliability: Good intra- and inter-rater reliability has been shown for both methods during PFM contraction (ICC 0.81 to 0.93). TP (ICC 0.87) is more reliable than TA (ICC 0.51 to 0.86) during functional manoeuvres which may reflect the difficulty in maintaining firm probe placement on the abdominal wall (Dietz 2004, Thompson et al 2007).

Validity: Movement of the bladder base/neck reflects PFM contraction confirmed by digital palpation (Sherburn et al 2005) and correlates only moderately to PFM strength measured by manual muscle testing (r = 0.58) and vaginal pressure measurements (r = 0.43). This suggests each tool assesses different aspects of PFM action, viz occlusion versus lift.

Sensitivity: TA ultrasound is more sensitive than digital palpation to assess the lifting action of the PFM (Frawley et al, 2006). Incontinent women showed more bladder neck movement on TP ultrasound during Valsalva, head lift, and cough than continent women (Thompson et al 2007, Lovegrove Jones et al 2009), and on TA ultrasound more bladder base movement during Valsalva (Thompson et al 2007), however cut-off values have not been determined.

Commentary

2D realtime ultrasound assessment of PFM function allows direct assessment of the ‘lifting’ action of the PFM not previously available using digital palpation. The TP technique is more difficult to learn, is more personally invasive, and the perineal placement of the probe limits some functional manoeuvres. The TA approach has several advantages for physiotherapists in a clinical setting as it is totally non-invasive and it may be used in populations where PFM digital palpation may not be appropriate, eg, children, adolescent women, women with vaginal pain, elderly women and men. It may also be a useful tool for screening musculoskeletal and sports clients for pelvic floor dysfunction.

Ultrasound also allows visualisation of the PFMs during voluntary contraction and relaxation and reflex activity. Many people with pelvic floor dysfunction have difficulty relaxing the PFMs (Voorham-van der Zalm et al 2008) and ultrasound can be useful biofeedback to improve both relaxation and performance. For example, small bladder displacement visualised could be interpreted as weak PFMs. However, the converse may exist in that the PFMs are overactive, and therefore show minimal displacement. If this overactivity is not confirmed by vaginal palpation, an inappropriate muscle strengthening protocol may be given. Being able to contract the PFM voluntarily does not always correlate with reflex activity during functional activities (Devereese et al 2004) and therefore both should be assessed. Ultrasound can be used to train ‘the knack’ (Miller et al 2006) of pre-contracting the PFM before set tasks.

The disadvantages are that 2D realtime ultrasound assesses only some aspects of PFM function and does not assess occlusion, which has until now been the standard measure of PFM strength, or other important aspects such as resting tone, specific morphological defects or for the presence of pain, and therefore where possible 2D ultrasound is best done in conjunction with digital assessment.

Judith Thompson
Curtin University, Perth
Margaret Sherburn
The University of Melbourne, Melbourne

References