EDITORIAL

Role of Electromyography in Assessment of Anorectal Sensorimotor Function

Electromyography (EMG) was first used in the study of anorectal function as a research technique. Early studies showed that the striated muscle of the sphincter was tonically active at rest and during sleep and that reflex contraction occurred in response to coughing, sneezing and lifting heavy weights. The techniques were then applied to the study of clinical conditions. Porter showed low voltage action potentials in the sphincters of patients with rectal prolapse. The turning point in our understanding of the physiology of the sphincters and the continence mechanism came from the study of patients suffering from fecal incontinence. These series of investigations were important in explaining the relationships between innervation, fibre type, architecture and histochemistry of the sphincter musculature. From the histological and histochemical studies of Parks et al., the conclusion that the sphincter musculature was denervated due to proximal nerve damage with reduction in the number of myelinated fibres, muscle fibre atrophy and abnormal fibre type grouping from subsequent reinervation. The application of electrophysiology to the pelvic floor was to confirm these pathological findings and lay the basis for the present techniques of electromyographic assessment of anorectal function.

Before this, the most commonly used objective test of motor function was anal canal manometry. Though manometry is still the most commonly used test, the amount of information to be gained from it is limited. The finding of low resting and low maximum squeeze pressures in the anal canal of a patient complaining of fecal incontinence only confirms weakness of the sphincter musculature but gives no indication of the mechanism responsible for the abnormality. Moreover, there are no generally accepted thresholds for the resting and maximum squeeze pressures below which incontinence will supervene. In other disorders of pelvic floor function, such as obstructive defecation and solitary rectal ulcer syndrome, usually associated with increased anal pressures, there are no thresholds for resting and maximum squeeze pressures above which a particular anorectal syndrome or condition can be diagnosed. The reason for this is the great variability in resting pressures recorded in normal subjects and patients. Although the use of anal manometry to detect reflex relaxation of the internal sphincter in response to rectal distension is an important test for Hirschsprung's disease, there are few conditions where manometry is essential and will alone provide clues to the diagnosis.

Electromyographic assessment of anorectal function offers a variety of objective techniques which can clarify the nature of abnormalities in terms of their etiology and pathophysiology, and can precisely define the site of a neurogenic or muscular lesion.

**Needle Electromyography**

*Single muscle fibre electromyography:* This technique can be considered to be the EMG equivalent of a muscle biopsy in that it can determine the extent of fibre type grouping that occurs in the striated part of partially denervated sphincter musculature. It is a quantitative estimate of the mean number of muscle fibres belonging to a motor unit within the small uptake area of the recording electrode. This so-called fibre density is calculated from 20 different recordings of single muscle fibre action potentials collected from different regions of the external anal sphincter. An increase in the fibre density indicates denervation and subsequent reinervation of those fibres within the sphincter. Naid and Swash confirmed the neurogenic basis of fecal incontinence using this technique. Recently, Rogers et al. have shown single fibre electromyography to be sensitive enough to detect evidence of sub-clinical denervation of the sphincter musculature before any changes in anal manometry occur, and to be a highly reliable test when repeated measurements are required.

*Concentric needle electromyography:* The EMG activity recorded by this technique is not easily quantifiable without electronic integration. However, the technique is excellent for accurate assessment of reflex contraction and relaxation of the musculature which can be helpful in the diagnosis of certain anorectal conditions such as solitary rectal ulcer syndrome and obstructive defecation. In addition, repeated insertions of the needle electrode around the circumference of the anal canal can be used to detect accurately the site of a tear in the sphincter ring, a procedure known as sphincter mapping.

Advances in the research of anorectal function have led to the development of an integrated and dynamic approach to the mechanics of the anorectum. Fine wire electrodes which can be inserted almost painlessly...
through the perianal skin can remain and record for prolonged periods, while radiological and manometric data are synchronously recorded.12

Nerve Conduction Studies

Nerve conduction studies of the central and peripher- al pathways innervating the pelvic floor can permit accurate localization of central and peripheral nerve lesions affecting the sphincter musculature. Indeed, it is theoretically possible to locate the lesion anywhere between the cerebral cortex and the pudendal nerve. Early nerve conduction studies of the anorectum concentrated on the peripheral pelvic floor nerves: the pudendal and perineal nerves. The technique for measuring pudendal nerve latency was developed from Brindley.13 A modified stimulator was developed, which could stimulate the pudendal nerves from within the rectum and record the motor action potential of the external anal sphincter.14 With this device, Kiff and Swash showed that in patients with fecal incontinence the terminal motor latency of conduction was increased, indicating that nerve damage had resulted in loss of the fast conducting myelinated nerve fibres. This technique later showed the relationship between obstetric trauma and the pathogenesis of fecal incontinence.15 To investigate the latency of the perineal nerves supplying the pudorectalis, spinal stimulation was devised from a technique first used by Morton et al.16 This involved stimulation of the spinal roots in the spinal canal by sufficiently high voltage (1,500 volts) of short duration (50 microseconds). Furthermore, stimulation of the spinal cord at the levels of L1 and L4 allowed the measurement of the differential latencies, or spinal latency ratio (SLR).7 This enabled proximal lesions in the spinal cord to be differentiated from distal peripheral nerve lesions. Latencies of conduction from the spinal cord at C8 and the cerebral cortex can also be measured, thus enabling an investigation of location of disease within the spinal cord, lumbosacral plexus, cauda equina, and peripheral pelvic nerves.

Sensation

Electrical stimulation has an important role to play in the assessment of areoanal sensation. Sensory aspects of anorectal function have been previously explored using relatively crude methods.20 These qualitative results were important however in drawing attention to the density and complexity of sensory nerve endings in the region and drawing sharp contrast between the relatively insensitive rectum and highly sensitive anal canal. Dustin and Bennett explored the relationship between sensory and motor function acting as an integrated unit to preserve continence.21 Reliable quantitative sensory testing came with the advent of current mucosal electostimulation. This technique described by Roe et al.22 is adapted from a technique used by urologists in assessing urothelial sensation. They illustrated that the technique could be used in assessing anal sensation in a variety of conditions. Later, using this technique, Rogers et al.23 demonstrated a combined sensory and motor deficit in the anal canals of patients with fecal incontinence. In a further study, they reported that this method could detect even sub-clinical changes in sensory function, demonstrating early neuropathic changes in the pelvic floor of diabetics.24 The technique of mucosal electrosensitivity of the anal canal has been shown to have a high degree of reliability,25 which is generally uncommon in tests of sensory function.

Electromyographic assessment of the pelvic floor provides an objective assessment of anorectal function that can precisely define the site of a neurological or muscular lesion. It serves to characterize the nature of the abnormalities in terms of their etiology and pathophysiological mechanism, and has scope far beyond that of simple manometry.

References


