Anourethral reflex. Description of a reflex and its clinical significance: preliminary study

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A new reflex which I call the 'ano-urethral reflex' is described and its clinical significance discussed. It was studied in 16 volunteers with normal vesical and rectal functions.

A concentric needle electrode was introduced into the external anal sphincter (stimulating), and another one into the external urethral sphincter (recording). The reflex response was recorded by EMG apparatus. The external urethral sphincter basal activity was increased with stimulation of the external anal sphincter. This reflex response was absent when the external anal sphincter was anaesthetised. The average latency of the reflex was 129.5 ms.

Reflex urethral sphincter contraction at defecation guards against involuntary micturition which may result from rectal distension and levator contraction. The anourethral reflex can be a valuable diagnostic tool in routine investigations of patients with urological and proctological complaints.

Key words: anal canal; anal sphincters; urethral sphincters; defecation; micturition; reflexes; anourethral reflexes.

Introduction

Mechanisms of defecation, micturition and continence are regulated by reflex actions. Study of the latency, amplitude and duration of these reflexes could play a role in the diagnosis of pathological anorectal and urinary conditions. Examples of these reflexes include the anal, bulbocavernosus and recto-inhibitory reflexes.

Pederson *et al*¹ noted that the latency of the reflex response varied with different stimulus parameters. For the anal reflex, they reported average latencies of 200 ms at a threshold stimulus, and in some cases the latency was as high as 400 ms; the average minimum latency was 50 ms. The latent period in the anal reflex exhibits wide ranges of latency, even within the same subject and may persist for several hundred milliseconds after a stimulus.² Swash,³ and Bartolo, Jarratt and Read⁴ mentioned that the difference in the latency of the reflex is accounted for by the difference in the experimental technique.

External anal and urethral sphincters act as the continent muscles for the rectum and the urinary bladder respectively. During our electrophysiologic study of the relation of the 2 continent muscles to each other, it was found that the external urethral sphincter contracts on stimulation of the external anal sphincter. I call this reflex action the 'ano-urethral reflex'. In the present communication, the reflex is studied aiming at the elucidation of its clinical significance.

Physioanatomical considerations

The puborectalis is a U-shaped sling which embraces the rectal and vesical necks. As it proceeds backwards from its origin in the symphysis pubis, it gives rise to 'individual' sphincters to the anal canal, urethra, vagina or prostate⁵ (Fig 1). The individual sphincters are the external anal and urethral sphincters and the prostatic and vaginal sphincters. The puborectalis is supplied by the pudendal nerve. The external sphincters, anal or urethral, are striped and act voluntarily. They function to oppose, interrupt or terminate the act of evacuation.^{6,7}

The levator ani muscle is a funnel with a

Figure 1 Diagram illustrating the anatomy of the puborectalis and levator ani muscles. (From Shafik⁵).

transverse part called the levator plate and a vertical part called the suspensory sling⁸ (Fig 1). It is a vesical and rectal neck dilator, whereas the puborectalis is a neck constrictor. Levator muscle contraction pulls the hiatal ligament which pulls open the rectal and vesical necks to evacuate their contents.^{7,9} The levator ani is thus a muscle of evacuation.

Material and methods

The study comprised 16 volunteers with no anorectal or urinary complaint. Nine were males varying in age from 23 to 52 years with an average of 44.8 years. The 7 females were aged between 26 and 49 years with an average of 35.3 years. An informed consent was taken from each subject before entering the study. All had normal rectal and urinary functions.

The subject was placed in the left lateral position. A concentric needle electrode was introduced into the external anal sphincter to serve as the stimulating electrode. It was inserted into the perineal skin 1–1½ cm lateral to the anal verge and 1½–2 cm deep. A recording needle electrode was introduced into the external urethral sphincter. In the male, it was inserted into the perineal skin about 1½ cm in front of the anal orifice and directed upward and forward, guided by a finger in the anal canal, until its tip lay just below the prostatic apex where the external urethral sphincter was located.

In the female, the needle electrode was introduced through the vaginal mucosa on one side of the external urethral orifice. The

electrode was pushed upward to a depth of approximately 1½ cm to be in the urethral sphincter. A ground electrode was strapped to the thigh.

The reflex response recorded by the needle electrode was displayed on the oscilloscope of an EMG apparatus. The external anal sphincter was stimulated and the external urethral sphincter myoelectric activity recorded. The latency of the reflex was measured.

In 9 subjects the external anal sphincter was infiltrated with 2 ml of 1% xylocaine to anaesthetise the muscle bundles around the stimulating electrode, and the muscle was stimulated. This procedure was repeated with an injection of normal saline.

Results

The external urethral sphincter showed a basal activity at rest which was augmented with squeezing. When the external anal sphincter was stimulated, the external urethral sphincter basal activity increased (Fig 2). This reflex response was reproducible in all of the subjects examined. It disappeared when the external anal sphincter was anaesthetised, and returned after 45–60 minutes when the anaesthetic effect waned. The reflex action was not affected when the muscle was infiltrated with saline.

The latency of the response was dependent on the intensity of stimulation. On stimulation by a train of 5 square pulses of 1 ms duration and separated by 1 ms, the threshold varied from 40 to 62 mA with an average of 52.2 mA (SD 7.2) and the latency at threshold varied from 128 to 158 ms with an average of 129.5 ms (SD 28.2).

Figure 2 The anourethral reflex. The latency of the reflex response is 134 ms. S = stimulus; r = response.

Discussion

Contraction of the external urethral sphincter upon external anal sphincter stimulation demonstrates a relationship between the 2 sphincters. The reflex action was reproducible in all of the individuals examined. This reproducibility as well as the disappearance of the reflex response on anaesthetising the muscle around the stimulating electrode points to the constancy of the reflex.

Role of the anourethral reflex in the act of defecation and micturition

Rectal distension evokes reflex external anal sphincter contraction which initiates reflex external urethral sphincter contraction. This reflex sphincter contraction is a protective mechanism to guard against involuntary evacuation of the rectum and urinary bladder. It allows time for impulses to achieve the conscious decision as to whether or not to evacuate. If there is no desire to evacuate, reflex contraction of the external anal and urethral sphincters continues voluntarily, allowing time for compliance mechanisms within the urinary bladder or rectum to provide for adjustment to increased volumes. As these organs accommodate to their new volumes, stretch receptors are no longer activated and afferent stimuli disappear along with the sensation of urgency. If circumstances allow for evacuation, the external anal and urethral sphincters relax voluntarily.

Selective 'individual' sphincter action

Both the external anal and urethral sphincters are supplied by the pudendal nerve, but

each has its own separate branch.^{6,7} The 2 muscles arise from the puborectalis.⁵ Though striated, they react both voluntarily and involuntarily. While voluntary action follows a conscious decision, the involuntary action is reflex in nature.

The acts of micturition and defecation either occur simultaneously or separately. The identical innervation of the external anal and urethral sphincters allows the reflex action of both muscles to be simultaneous. Meanwhile, the separate innervation allows each muscle to react, under voluntary control, separately. Accordingly, the acts of micturition and defecation occur simultaneously or separately depending on whether the response is reflex or voluntary. Furthermore, the present discussion shows that the involuntary reflex actions of the striated external urethral and anal sphincters are under voluntary control.

Diagnostic role of the anourethral reflex

Recording of the anourethral reflex in patients with disorders of defecation or micturition or both may prove useful in assessing the function of muscles and the nerves supplying them. Detectable changes in latency of the evoked response may indicate a defect in the reflex pathway that could be a muscle or nerve damage from a disease of the spinal cord, spinal nerve roots or peripheral nerves. The inclusion of this reflex in the diagnostic tools of proctological and urological disorders would thus provide an additional valuable finding.

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