Leading article

Anal endosonography in faecal incontinence

The application of neurophysiological techniques to the pelvic floor highlighted the role of nerve damage in idiopathic faecal incontinence, and electromyographic needle mapping provided a means of defining traumatic defects in the external sphincter.[1] Internal sphincter damage could be inferred only from manometric assessment, as prior to endosonography there was no means to assess this part of the sphincter directly. The technical advantage of endosonography is that it places the probe within the anal canal, very close to the target structures. High frequency transducers may then be used with the benefit of improved tissue resolution and detail in the near field. Endosonography overcomes the inherent sonographic trade off between high frequency and poor tissue penetration.

The technique of anal endosonography

Endosonography within the anal canal was developed by adapting an endoprobe system designed for rectal examination. Replacing the balloon system for the rectum with a hard cone to cover the rotating probe, was all that was required to obtain highly detailed images of the sphincters.[2] The cone has parallel walls so that the anatomical configuration of the anus is not distorted, and is only 1·7 cm in diameter. An endosonographic examination is easy to perform, requires no preparation of the patient and causes minimal discomfort.

Interpreting the image

A sonographic image is based on acoustic reflections from interfaces of different impedance. The echogenicity of any tissue structure is usually expressed in terms of its overall echogenicity, homogeneity, and textural pattern. Our understanding of the normal sonographic anatomy of the anal canal has been acquired over the past few years.[3–5] Although this may still be incomplete, a working pattern of the sphincter anatomy has emerged.

The internal sphincter is a clearly defined inner hypoechoic ring, 1–3 mm in thickness. This specialised expansion of smooth muscle can be traced up into the circular muscle of the rectum. It ends at the junction of the superficial and subcutaneous external sphincters, and is usually thickest just before it terminates. There is no sex difference, but it does increase in thickness with age[5 6] caused by connective tissue replacement of smooth muscle. Electron microscopy has shown a less compacted arrangement of muscle fibres in the elderly, with increased collagen in the interstices between smooth muscle and stretching of elastic tissue strands.[7]

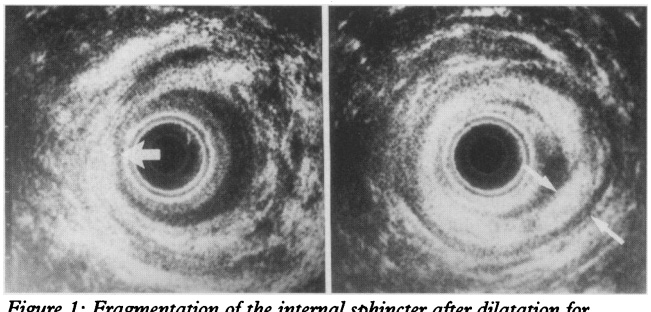

Figure 1: Fragmentation of the internal sphincter after dilatation for fissure. The view on the left is high in the canal and shows significant thinning of the internal sphincter posteriorly (arrow). The film on the right is lower in the canal. The internal sphincter is fragmented with only a few remnants left just medial to the inner arrow. The longitudinal muscle and external sphincter lie between the arrows. The longitudinal muscle is hyperechoic relative to the outer ring of hypoechoic external sphincter in this male patient. The images are orientated in the same plane as they were acquired, so that the patient's anterior is to the right of the film, posterior to the left, right uppermost, and left lowermost.

The external sphincter varies in echogenicity and configuration between the sexes. In most women the longitudinal muscle and external sphincter are isoechoic and difficult to distinguish, whereas in men the external sphincter is hypoechoic compared with the longitudinal muscle, so that both are clearly defined. Most anatomical diagrams display a coronal view, where there is little difference in the sphincter anatomy between the sexes. This is not true anteriorly where the configuration is quite different. The external sphincter forms a symmetrical cylinder around the longitudinal muscle in men, whereas in women the lateral aspects of the deep and superficial parts slope downwards as they run forwards to fuse together into an intact anterior muscle bundle lower in the canal.[8] As a result cross sectional images high in the female canal will suggest loss of structural integrity of the external sphincter anteriorly. This reflects not only a real difference in sphincter anatomy, but also the lack of acoustic definition of the decussating fibres within the perineal body, so that there is no clear landmark in the paravaginal tissue. As the probe is withdrawn down the canal, the intact anterior muscle ring of the external sphincter becomes visible. It is only in this part of the anterior external sphincter that tears should be diagnosed in women.

Endosonographic morphology of the intact sphincter and manometry

It might be reasonable to assume that there is a direct relation between the muscle bulk of a sphincter and the pressure it exerts. In the intact internal sphincter such a positive linear relation has been suggested in one study,[9] though refuted in others.[10 11] An inverse relation has been reported,[12] which is not unreasonable as the increase in thickness with age is not caused by an increase in muscle, but of collagen. Sphincter thickness therefore may not relate directly to smooth muscle content. A thin internal sphincter of pure smooth muscle in a young patient functions well, whereas in an older patient, a thicker sphincter with less smooth muscle shows impaired function.

No correlation has been shown between the maximum squeeze pressure and external sphincter thickness, although this is related to body mass and tends therefore to be thicker in men.[4] Emblem *et al*[12] found a negative correlation between external sphincter thickness, muscle fibre density, and pudendal nerve terminal motor nerve latency,

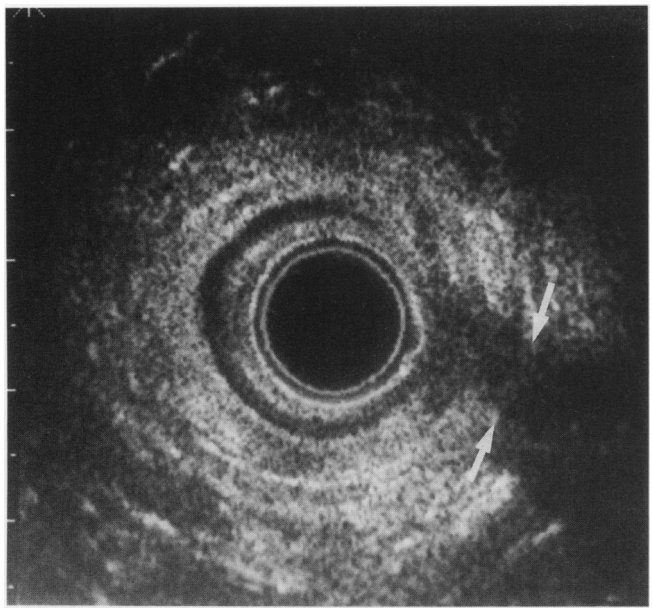

Figure 2: There is a well defined anterior defect in the external sphincter (arrows) after a penetrating injury during a road traffic accident.

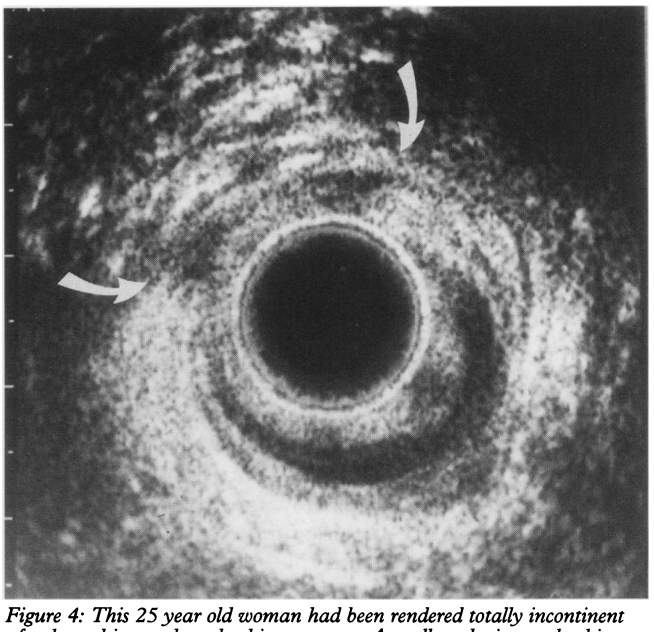

Figure 4: This 25 year old woman had been rendered totally incontinent after lateral internal anal sphincterotomy. As well as the internal sphincter being cut throughout its length, the external sphincter was also divided (arrows).

and suggested that the ratio between the thickness of the external and internal sphincters was significantly reduced in patients with neurogenic incontinence.

Endosonography of sphincter disruption

Any break in the ring of the internal sphincter is abnormal, and easily recognised on endosonography. Examination of patients after lateral internal anal sphincterotomy has confirmed that sonographic defects correspond to the site of surgical division.[13] After anal dilatation or stretch procedures there may be multiple defects or fragmentation of the sphincter[14] (Fig 1). A number of studies have confirmed a fall in resting pressure with internal sphincter disruption.[15 16]

External sphincter defects (Fig 2) are more difficult to recognise. Traumatic tearing of striated muscle heals by granulation tissue and fibrosis leaving a scar. Acoustically such scars tend to be comparatively homogeneous and of lower echogenicity than the longitudinal muscle and female external sphincter. Such endosonographic lesions have been correlated with electromyographic defects,[17–19] and with surgically confirmed muscle tears,[20] confirming that these sonographic defects are true scars. A linear relation has been shown between the circumferential length of the defect and the reduction in squeeze pressure.[15]

Endosonography in faecal incontinence

Childbirth is the commonest cause of damage to the anal sphincters (Fig 3). Clinically recognised tears of the external sphincter, by definition third degree, are uncommon with an incidence of <1%. However, endosonography has shown a much higher incidence of sphincter damage. In a prospective study with pre and post-partum scanning, 35% of primiparous women were found to have developed sphincter defects after vaginal delivery.[21] In 16% the internal sphincter only was affected, in 6% the external, and in 13% both sphincters were affected. These 'occult' defects were not entirely asymptomatic, as on

Figure 3: Internal and external sphincter defects in the right anterior quadrant (arrows) after obstetric trauma with forceps delivery.

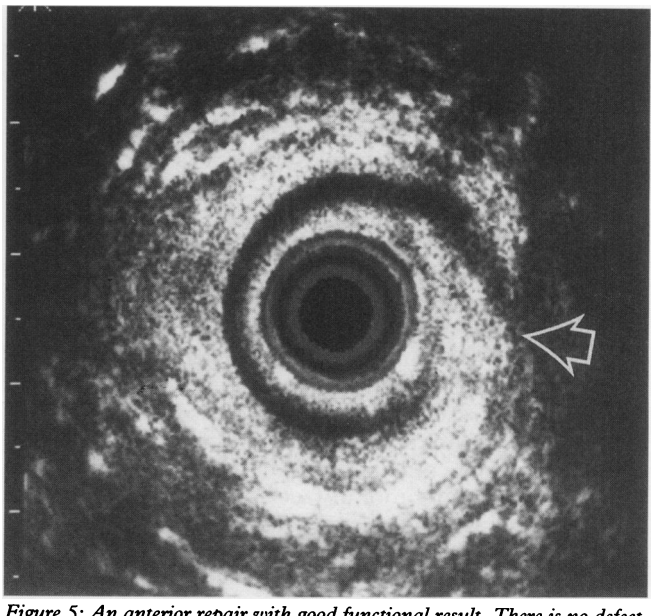

Figure 5: An anterior repair with good functional result. There is no defect between the overlapped ends (arrow).

direct questioning 10% admitted to some disturbance of anal continence. This was associated with sphincter damage, and not with any prolongation of the pudendal nerve motor terminal latency.

A damaged sphincter may precipitate overt symptoms later in middle age when the cumulative effects of the menopause, neuropathy, and muscle loss lead to overt decompensation of the continence mechanism. Several studies support this view. In one review of 62 women with faecal incontinence, whose only common history was obstetric trauma, 90% had external and 65% had internal sphincter defects.[22] Another study found that 87% of women with faecal incontinence had a sphincter defect on endosonography.[23] Another report[24] highlighted the significance of childbirth in the aetiology of faecal incontinence, and made a plea for prevention.

Endosonography has made a contribution to the prevention of incontinence by showing exactly what procedures are associated with sphincter damage. Manual dilatation of the anus during anaesthesia is comparatively uncontrolled, and the internal sphincter may be damaged[14] in more than half the patients undergoing such stretch procedures. In 32 consecutive cases sphincter defects were found in 65% with some degree of anal incontinence in 12·5%.[25] The alternative procedure of lateral internal anal sphincterotomy, though more precise is not without risk (Fig 4). The operative objective is to divide the distal third of the internal sphincter up to the level of the dentate line. Endosonography has shown that this is achieved in men, but in women the shorter anal canal may result in a more extensive sphincterotomy than intended. In nine of 10 women it was found that the entire length of the internal sphincter has been divided,[13] and three of these patients were incontinent to flatus. Endosonography has shown that vacuum extraction is safer than forceps with regard to sphincter damage.[26] Examination after primary repair of third degree tears suggests that many have residual sphincter defects,[27 28] which are associated with low anal resting pressures, and symptoms when both internal and external sphincter defects are present. Good functional outcome from a surgical repair correlates with restoration of an intact external sphincter ring (Fig 5), and conversely poor function with persisting defect.[29 30]

Conclusion

Many studies have confirmed the value of endosonography for detecting sphincter damage in faecal incontinence.[8 15 16 19 31] It has been suggested[18] that endosonography replaces electromyographic mapping of external sphincter defects. With experience this is possible, though a combined approach is recommended during any learning curve.

Magnetic resonance imaging has been compared with endosonography. Although a linear correlation was found between the internal sphincter measurements, the anatomical resolution was inferior to endosonography.[32] This situation may change with the development of internal coils for anal magnetic resonance imaging.[33] However, endosonography is much quicker and cheaper than magnetic resonance imaging. It has proved a simple but elegant technique to portray sphincter anatomy. Endosonography complements physiological studies, and is an ideal screening tool in faecal incontinence to select those patients with sphincter damage, who might benefit from surgical repair.

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