Report for MR Spectroscopy study of the puborectalis muscle

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Study Title  Tissue strength and characterization of the puborectalis muscle

Ethical approval  Study reference: Q0505/45

Summary of the study

Background
The puborectalis muscle (PRM) is the most medial of the pubovisceral sling muscles; it closes the levator hiatus, maintains the anorectal angle, supports the bladder neck and uterus. Muscular atrophy can occur secondary to obstetric trauma and the progression of age. Atrophy may explain the frequently poor surgical outcome following operations for incontinence and prolapse. We report the use of MRI Spectroscopy (MRS) to quantify PRM atrophy quantification, and compare the results with symptoms and perineal dynamometry - an objective measure of muscle strength.

Methods
50 subjects (18 asymptomatic controls and 32 women with faecal incontinence) underwent MR spectroscopy of the puborectalis. 38 had combined spectroscopy and perineal dynamometry to assess their peak muscle strength during 3 consecutive isometric contractions for 5 seconds. The % decline of strength over 4.5 seconds of each contraction was used as a marker of endurance. Conventional MRI of the puborectalis and MR spectroscopy using Single Voxel Spectra were acquired using PRESS with a repetition time of 1150ms and an echo time of 30ms. Apparent water and apparent fat are respectively the areas of the resonance peaks of water (W)(at 4.7ppm) and lipid (L)(at ~1.3ppm) in spectra acquired from voxels of interests positioned on the PRM. An experienced gastrointestinal radiologist graded puborectalis atrophy on a scale from 1 to 3 (1- mild, 2- moderate, 3- severe).

Results
There was a significant difference in spectroscopic lipid content between those patients where muscle atrophy was subjectively scored as absent (mean apparent lipid content 11%), moderate (mean apparent lipid content 13.3%) and severe (mean apparent lipid content 27.5%) (ANOVA, P<0.001). Apparent lipid content in the right limb of the PRM significantly correlated with that in the left limb(Kendall's rank correlation, tau=0.36,p=0.001).Those patients with an average mean apparent lipid content of more than 10% had significantly (p=0.01) less endurance over 4.5 seconds on the third isometric contraction (% decline over 4.5 seconds mean 29. 5%) compared those with mean <10% lipid content (% decline 15.8%). Indices of structure (mean subjective atrophy scores and mean objective apparent lipid content, both p<0.001) and fatigability (p =0.04) correlated with age. No significant difference between the apparent lipid content of healthy controls and the patients was identified (p=0.5).

Conclusion
MR Spectroscopy is a promising objective measure of tissue atrophy of puborectalis muscle. In patients with faecal incontinence, greater fatty atrophy of the puborectalis was associated with greater muscular fatigability. Atrophy is a global process, with high degree of agreement of the degree of atrophy on both sides of the sphincter.
Preliminary results presented

Association of Coloproctology of Great Britain and Ireland – Birmingham 2008

Oral Presentations

1. Digestive disease week – Chicago May 2009

Poster presentations

1. European society of Coloproctology – Prague September 2009

Future work

We plan to do further detailed analyses on this large data set to determine the role of obstetric sphincter and puborectalis injuries on the development of atrophy. We hope to publish this work in the forthcoming months. We also hope to build on this work of quantifying atrophy as a marker for therapeutic outcome for both conservative and surgical treatment modalities.

Published abstracts from this study


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Dave Chatoor