Contractile Properties of Rat Fascia

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BACKGROUND: Myofibroblasts have recently been discovered in human and rat lumbodorsal fascia [1]. Their contractile responsiveness to mechanical and pharmacological stimuli is insufficiently understood.

METHODS: Fresh strips lumbodorsal fascia profunda from rats (age 8-33 wks) were vertically suspended in an organ bath setting. Force responses were measured while tissues were treated with the myofibroblast contractile agent mepyramine, with the thromboxane analogue substance U46619, or with fetal calf serum (CS). Alternatively tissue responses were examined in response to pure mechanical stimulation (a sustained 5% strain application). Control tissues which were pre-incubated with the cell disrupting substance cytochalasin-D or with the thromboxane receptor antagonist SQ29548 were exposed to the same protocols in order to clarify the cellular component of responses. Additionally we stained tissues which showed clear contractile responses for their density of alpha smooth muscle actin (ASMA) stress fiber bundles and compared their density with tissues that failed to show any responsiveness. We performed Wilcoxon signed rank test with a significance level of 0.05.

RESULTS: Addition of mepyramine 10mM elicited contractile responses in 13 of 24 samples. U46619 at 100 µM triggered contractions in 9 of 22 samples, and 30% CS solution in 7 of 12 samples. Pure mechanostimulation also resulted in a clear force increase (after the usual initial tissue relaxation response) in 18 of 38 samples. The contraction forces ranged between 0.2 and 1.2 mN per mm^2 cross sectional area. In contrast, samples pretreated with cytochalasin-D showed insignificant responses (<20 nN/mm^2) to mechanostimulation (n=6), to mepyramine (n=8) and to U46619 (n=6). Samples pretreated with SQ29548 showed no response to U46619 (n=10). Retrospect immunohistological analysis of non pretreated samples revealed a significantly higher density of ASMA stress fiber bundles in responder tissues compared with non responding bundles (2.62% versus 0.37%, , n=8).

CONCLUSION: Clear force increases can be elicited in approximately half of the tissue samples from rat lumbodorsal fascia in vitro. Responsiveness is dependent on the local density of ASMA stress fiber bundles, indicative of the cellular density of myofibroblasts in a given tissue bundle. The contractile responses can be elicited with appropriate pharmacological stimulation, yet also via pure mechanostimulation. Control tests with agents that inhibit cellular responsiveness suggest that the previously described fascial contractions are indeed generated by resident myofibroblasts.

REFERENCES [1] Schleip R et al.. In Findley TW, Schleip R, eds. Fascia Research – Basic Research and Implications for Conventional and Complementary Health Care. Munich: Elsevier , 2007, p 76-77.