

DYNAMIC CONTRAST ENHANCED MAGNETIC RESONANCE IMAGING OF PELVIC BLOOD FLOW CORRELATES WITH ERECTILE DYSFUNCTION AND LOWER URINARY TRACT SYMPTOMS

Hypothesis / aims of study

The project hypothesis is that lower urinary tract symptoms and erectile dysfunction are related to pelvic ischemia, which can be demonstrated by dynamic contrast-enhanced magnetic resonance (DCE-MR) image values for pelvic perfusion. Two aims stem from the hypothesis: to show that patients with known coronary artery disease (CAD) will differ from controls with respect to 1) pelvic perfusion and 2) pelvic symptoms (erectile dysfunction and lower urinary tract symptoms).

Study design, materials and methods

Institutional approval for the prospective observational study was obtained. Men with known CAD as documented by prior coronary artery bypass grafting without concurrent procedures were identified from the Department of Cardiovascular Surgery Database. Comparison group patients were selected from the Cardiac Catheterization Lab records of normal studies within 18 months. Participants responded to our letter of invitation.

Each participant detailed his medical history and completed:

- 1) The International Index of Erectile Function (IIEF) [1]
- 2) The International Prostate Symptom Score (IPSS) [2]
- 3) MR Imaging of the pelvis, including phase-contrast quantitative flow analysis of the distal aorta, dynamic contrast-enhanced perfusion of the prostate, corporal, and spongiosal tissue, and MR Angiogram, using injection of the gadolinium complex Gadodiamide™.

Patients with a history of diabetes, stroke, prostate cancer, renal failure, urinary tract infection, and trauma to the phallus, cortex, spinal cord, or peripheral nerves (e.g. abdominal-perineal resection) were excluded. Pearson's correlation coefficient was used to compare perfusion with symptom scores. Two-tailed t-tests were used to compare the CAD group to controls.

Results

Twelve patients (six in each group) met criteria and completed the study. The two groups did not differ with respect to age, ethnicity, body mass index, presence of hypertension, family history, exercise, depression, anxiety, sleep apnea, tobacco use, or a history of alcoholism. Hypercholesterolemia was more likely in the CAD group [$t = -3.162$, d.f. = 5, $p = 0.025$]. None had large-vessel stenosis on MR angiogram.

All twelve patients were then analyzed for symptom scores versus pelvic perfusion using Pearson's correlation coefficient. IPSS score correlated with time to 90% peak enhancement in the prostate ($r = 0.735$, $p = 0.006$) and trended with slope of rise ($r = -0.521$, $p = 0.082$). IIEF erectile function scale score ($r = 0.722$, $p = 0.018$) and total score ($r = 0.636$, $p = 0.048$) correlated with maximum differential in corporal tissue. There were similar trends for the spongiosal tissue.

The cardiac patients were then compared to controls using two-tailed t-tests. Equal variance was not assumed.

Phase contrast quantitative flow analysis of the distal aorta was not different between groups, implying similar cardiac output at this level.

IPSS and IIEF results trended to difference between the two groups. Total IPSS was 12 in those with CAD and 6 in those without ($t=-1.58$, d.f. = 6.63, $p = 0.16$, CI = -15.1 to 3.08). Total IIEF was 39.5 in those with CAD and 61 in those without ($t = 1.90$, d.f. = 9.249, $p = 0.089$, CI = -4.001 to 47.001).

Measures of pelvic perfusion were different between the two groups. For the prostate, mean slope of rise was 0.498 in the CAD group and 1.20 in controls ($t = 4.80$, d.f. = 7.98, $p = 0.001$, CI = 0.36 to 1.03). Time to 90% peak was 106 seconds in the CAD group and 64 seconds in controls ($t = -3.56$, d.f. 7.191, $p=0.009$, CI = -69.9 to -14.3). Maximum differential was 143% baseline in the CAD group and 155 in controls ($t = 1.49$, d.f. = 9.9, $p = 0.168$, CI = -5.5 to 27.5).

Corporal cavernosal tissue showed slope of rise of 0.121 in CAD patients versus 0.580 in controls ($t=2.001$, d.f. = 5.42, $p = 0.097$, CI = -0.12 to 1.04), and maximum differential of 124% baseline in CAD patients versus 147 in controls ($t=2.39$, d.f. = 3.76, $p = 0.079$, CI = -4.261 to 48.9). Spongiosal tissue demonstrated a maximum differential of 139% baseline in CAD patients versus 173 in controls ($t = 2.85$, d.f. = 3.49, $p = 0.055$, CI = -1.16 to 69.5).

Interpretation of results

This pilot study suggests two main findings. 1) Pelvic symptomatology correlates with pelvic perfusion by DCE-MRI, and 2) Both symptoms and perfusion differ in cardiac patients versus controls.

Concluding message

The initial data in this pilot study suggests that pelvic perfusion can be measured, and that perfusion correlates with LUTS as well as erectile dysfunction. These parameters are different in cardiac versus non-cardiac patients. The results from this data will be used to perform a power analysis to determine the sample size for the full extension of this project.

[1] The international index of erectile function (IIEF): a multidimensional scale for assessment of erectile function. *Urology*, 1997; 49(6):822-30.

[2] The American Urological Association symptom index for benign prostatic hyperplasia. *J. Urol.*, 148: 1549, 1992.

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