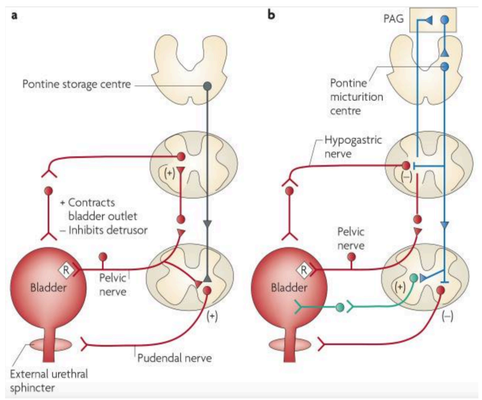
Preliminary Results of Baseline Cortical Neural Activity in Men with Benign Prostatic Hyperplasia and Bladder Outlet Obstruction

Logan C. Hubbard[1], Ricardo R. Gonzalez[1] ,Tran A.M. Khue[1], Natalia Hernandez[1], Christof Karmoni[2], Shi Zhaoyue[2], Rose Khavari[1]

[1]Department of Urology, Houston Methodist Hospital, Houston, Texas, USA. [2]MRI Core, Houston Methodist Research Institute, Houston, Texas, USA

This is the first study evaluating cortical activity in men with benign prostatic hyperplasia (BPH) and bladder outlet obstruction (BOO). This human trial offers the first concurrent urodynamic (UDS) and functional MRI (fMRI) evaluation on alteration in cortical function during bladder filling and emptying cycles in men with BPH and bladder outlet obstruction.

Introduction



Fowler et al. Neural control of Micturition. Nature Reviews Neuroscience. 2008 Jun;9(6) 453-456

- Benign prostatic hyperplasia (BPH) affects the entire micturition cycle including filling and storage phases, often creating bothersome lower urinary tract symptoms (LUTS).
- Persistent bladder outlet obstruction (BOO) is known to remodel the bladder's smooth muscle, connective tissue and local neural network; however, the extent to which it alters the central nervous system (CNS) in BPH patients is unknown.[1]

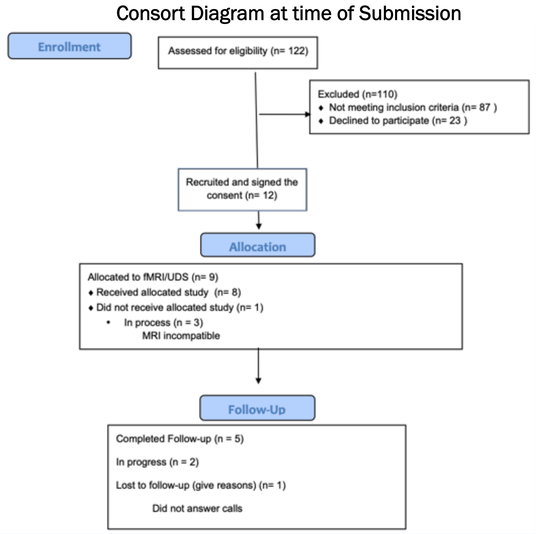
Objectives

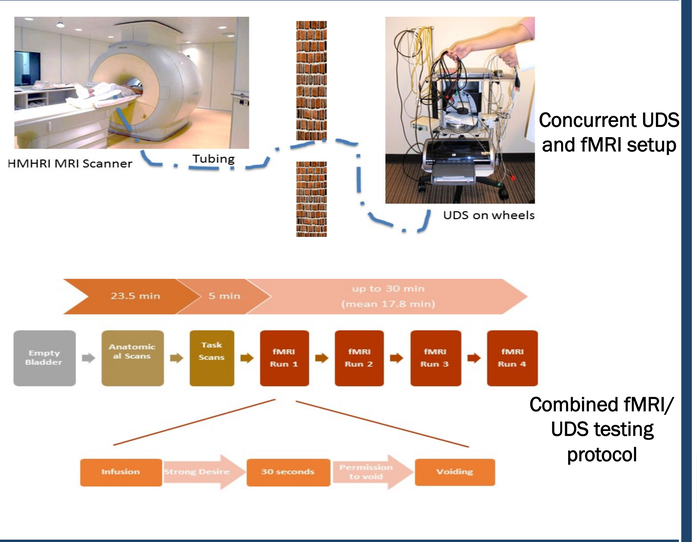
- Utilization of fMRI to:
  - Identify baseline brain activation patterns in men with BPH and BOO.
  - Compare areas of cortical activity to predetermined regions of interest in healthy adult men from the literature.

Subjects

- Men ≥ 45 years old who failed conservative BPH therapy planning to undergo BOO procedure.
  - After exclusion 7 men were evaluated.
- All subjects underwent concurrent fMRI/ urodynamics (fMRI/UDS) testing platform.

Methods





Results

Brain Activation Pattern in Seven Men with BPH

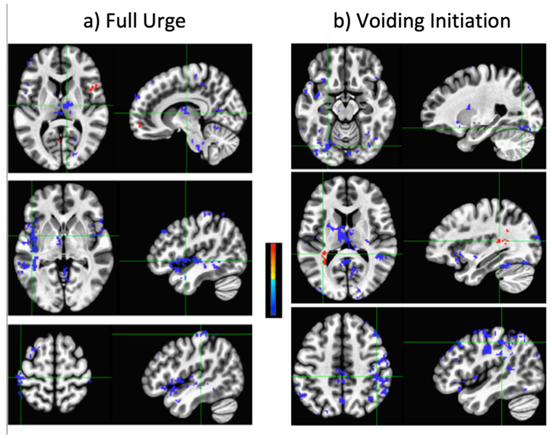


Figure 1. Brain activation of seven BPH men prior to BOO procedure, at a) Full urge, and b) Voiding initiation. Blue markings represent areas of deactivation, while red marks indicate areas of activation. Green crosshairs are used to indicate brain regions associated with activation and deactivation.

Table 1. Baseline Demographics

Baseline Demographics n =7	Mean (range)
Age (years)	61 (48-71)
Prostate Volume (mL)	47 (29-69)
IPSS	18.5 (12-27)
SHIM	18.2 (9-24)
ASA	2 (2-2)
Liverpool Percentile	16.6 (2.5-40)
Free Flow Data	
Functional bladder capacity (PVR + Voided volume in mL)	300
Qmax (mL/s)	8.4 (4.6-14)
Mean Voided Volume (mL)	210 (47-381)
PVR (mL)	90 (0-167)
Voiding Time (s)	29 (13-60)
Mean Flow (mL/s)	4.6 (3-6)
fMRI-UDS Characteristics	
Baseline PVR (mL)	227 (15-900)
End PVR (mL)	267 (0-470)
Ability to Void (# patients)	4
Presence of DO (# patients)	1
Total Time in Scanner (min)	49 (36-61)

Qmax: maximum flow rate, ASA: American Society of Anesthesiologists' classification of Physical Health
Pdet: Detrusor pressure PVR: Post void residual,
IPSS: International Prostate Symptom Score SHIM: Sexual Health Inventory For Men. DO: Detrusor overactivity

Summary of Results

- Baseline demographics represented in Table 1.
- At strong urge to void there was neural activation in the right inferior frontal gyrus (IFG) ($p<0.05$), fig. 1.
- At Strong urge to void, there was deactivation noted bilaterally in the:
  - Thalamus
  - Middle Frontal Gyrus
  - Insula
  - Parahippocampal gyrus
  - L middle and superior temporal gyrus
- During voiding initiation, activity was seen in the:
  - Left angular gyrus
  - Superior temporal gyrus
  - IFG

Conclusions

- Activation of IFG at full urge is consistent with prior studies and their significance during voiding phase[2]
- Deactivation in bilateral thalamus, insula, and IFG during initiation and voiding attempts reflect diminished activity in areas of normal micturition in healthy adults.
- Further studies should evaluate whether deactivation in these regions reflect the inability to void of multiple subjects and/or represent neuroplastic changes of supraspinal micturition control in response to chronic bladder outlet obstruction in men with BPH.

Acknowledgements

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