Table 1. P-values (calculated from paired t-test) for differentiating normal versus obstructed bladders characteristics; δ_{vu}, δ_{VD}, δ_{DU} and δ_{DD} are the retardance of the ventral urethral, ventral dome, dorsal urethral and dorsal dome regions, respectively.

Obstruction study duration	Mass	δ_{VU}	δ_{VD}	δ_{DU}	δ_{DD}
2 weeks	0.04	0.03	0.18	0.92	0.66
6 weeks	0.02	0.03	0.14	0.42	0.39

The following conclusions emerge from the statistical results in Table 1.

1) The retardance of the ventral urethral region can be used to diagnose obstruction (p-value < 0.05).

2) Retardance values in the rest of bladder wall regions are not significantly different between the obstructed and control bladders.

The significant change of retardance in the ventral urethral is reasonable, since the ventral region can anatomically expand more to accommodate a larger volume of urine upon obstruction. In fact, regional differences in response to obstruction have been proposed before by Capelo et al [33] and Schröder et al [34]. For example, Capelo et al showed that the ventral sides of the obstructed bladders become less sensitive to contractile agents (NoRadernaline) [33]. Schröder et al have shown that the serosal layer of the ventral side exhibits greater thickening than that of the dorsal side following obstruction [34]. In another study, Sugimoto et al reported increases of short-length, coiled-shape elastin networks in the bladder neck (the region closer to the urethra) that do not contribute to elasticity; these extracellular matrix changes may be responsible for the anisotropy increase near the urethra that we are observing here [35].

Hence, our results demonstrate relevant significant *regional* anisotropy changes in the obstructed bladder walls, quantified using polarized light imaging and Mueller matrix polar decomposition. Recent studies show that polarized light can be delivered through endoscopic devices for tissue characterization [36,37]. We are currently developing a polarized light probe that can be used through a cystoscope. Having endoscopic polarized light imaging tools, one can potentially identify the regions with maximum retardance changes and then use this information for targeting/ pinpointing / optimizing surgical (augmentation) procedures. As mentioned earlier, currently most augmentation procedures target the dome part of the bladder, whereas our results show that the middle region close to the urethra has the most impaired tissue.

4. Conclusion

Polarized light imaging in combination with Mueller matrix decomposition was used to characterize local structural abnormalities of bladder walls after partial bladder outlet obstruction. A rat model was used for partial bladder outlet obstruction. 2 weeks obstructed (+ control) and 6 weeks obstructed (+ control) *ex vivo* bladders were harvested and distended to the same high (physiologic-level) pressures. Regional maximum retardance values were measured for each bladder wall in the retro-reflection geometry. As suggested by previous studies, the ventral region of the obstructed bladder behaves differently than the control bladders. Our results demonstrate that the retardance (anisotropy) of the ventral urethral regions increases significantly due to obstruction, and the increase follows a similar trend to the bladder mass increase. The increased anisotropy of urethral compared to dome regions may have implications for bladder augmentation surgeries that currently target the dome zones. Interestingly, control bladders of the 6-week study were more anisotropic than control bladders of the 2-week study. These obstructed bladder results are consistent with the presence of fibrosis, muscle hypertrophy and hyperplasia observed previously by other groups. Overall, these findings provide a foundation for investigating *in-vivo* applications of polarimetric imaging for regional pathology detection in urology.

#200672 - $15.00 USD Received 6 Nov 2013; revised 9 Jan 2014; accepted 13 Jan 2014; published 27 Jan 2014