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The association between seminal vesicle size and duration of abstinence from ejaculation

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Abstract

There are few data describing the relationship between seminal vesicle (SV) size and duration of abstinence between ejaculations. This study evaluates the association between SV size and duration of abstinence from ejaculation using pelvic magnetic resonance imaging(MRI). Sexually active men 18–68 years old who underwent pelvic MRI for various medical indications were included. The date of last ejaculation was recorded, and the cross-sectional areas of the right and left seminal vesicles were calculated separately using mediolateral and anteroposterior measurements on T2 weighted MRI images. The association between SV area and duration of abstinence between ejaculations was determined via linear regression analysis. The study cohort consisted of 104 men with a mean age of 46.45 ± 11.4 (range 18–68) years old. Mean right and left SV cross-sectional areas were 744.1 ± 351.1 (range: 149.9–1794.7) mm² and 727.6 ± 359.2 (range 171.4 to 2248.4) mm², respectively. The mean duration of abstinence between ejaculations in the cohort was 3.6 ± 2.6 (range 1–15) days. Although no correlation between age and SV area was observed ($r=0.007$, $p=0.947$), linear regression analysis demonstrated a positive correlation between SV area and the duration of abstinence from ejaculation ($r=0.372$, $p=0.0001$). SV cross-sectional area increases with duration of abstinence from ejaculation and can be assessed using MRI. The use of SV size estimation may be applicable in diagnosis, risk stratification, and treatment of urological diseases.

Keywords

Abstinence; Ejaculation; Magnetic resonance imaging; Seminal vesicle; Size; Volume

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Conflicts of Interest

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Introduction

Ejaculation requires a complex interplay between male reproductive organs. The two phases of ejaculation, seminal emission and expulsion, require coordinated secretion of the components of semen, followed by their expulsion from the urethra (Witt & Grantmyre, 1993; Clement & Giuliano, 2015). The sperm travel from the epididymides through the vasa deferentia, which join with the seminal vesicles (SVs) to form the ejaculatory duct, and then into the urethra. During ejaculation, the SVs contract, secreting approximately 70% of the seminal volume. The seminal fluid contributed by the SVs provides nutrients for sperm and aids the growth of the embryo through expression of embryotrophic cytokines in the periconception environment (Bromfield et al., 2014). Thus, the SVs play a multifaceted and integral role in fertility.

Normal SV width is less than 1.5–2.0 cm in the anteroposterior dimension (Carter et al., 1989; Jarow, 1993; Vicari, 1999). Dilation of the SVs, most commonly visualized using transrectal ultrasound (TRUS), can indicate ejaculatory duct obstruction, and decreased SV size or SV agenesis can be associated with unilateral vasal and renal agenesis such as that found in men with cystic fibrosis (Jarow, 1993). Performing TRUS in men with unilateral vasal agenesis permits visualisation of the SVs, as segmental SV atresia can often occur in these patients and may lead to obstructive azoospermia (Hall and Oates, 1993; Abdulwahed et al., 2013). Serum testosterone and prolactin levels are positively associated with SV size (Lotti et al., 2013; Sasagawa et al., 1989), and men with autosomal dominant polycystic kidney disease often have enlarged SVs as well (Joo et al., 2010).

Imaging the SVs may facilitate both disease diagnosis and management. SV volume can be used in staging prostate cancer or anticipating the efficacy of prostate cancer treatments, including that of 3D conformal or intensity modulated radiotherapy (Cummings et al., 1994; Reddy et al., 2010). The size of the SVs may also be indicative of comorbidity or drug use. In men with autosomal dominant polycystic kidney disease, SV size is larger than that in normal subjects (Mlynarski et al., 2015). Drugs, including silodosin which can cause SV enlargement, may also affect SV size (Bozkurt et al., 2015), and smoking is associated with lower SV and ejaculate volume assessed using ultrasound (Lotti et al., 2015). Magnetic resonance imaging (MRI) is the most accurate imaging modality for SV size determination, and few studies correlating SV and ejaculate volume are available (Sala et al., 2006). Given the potential diagnostic and prognostic roles of SV size, an improved understanding of SV size relative to the contribution of the SVs to seminal volume is desirable. Here we describe the relationship between SV size and duration of abstinence between ejaculations.

We aimed to assess the relationship between SV size and duration of abstinence from ejaculation using pelvic MRI studies. We tested the hypothesis that SV size is directly related to the duration of abstinence between ejaculations.

Materials and Methods

Study Population

After approval by the Institutional Review Board, sexually active men who underwent MRI of the pelvis for non-urologic causes in a single academic medical center and who provided their informed consent were prospectively included in the study. Demographic data including patient age, comorbidities, and duration of abstinence between ejaculations were obtained; the most recent date of ejaculation for each participant was recorded. MRI scans were reviewed and patients were enrolled if both SVs were involved in the pelvic images.

Calculation of SV Cross-Sectional Area

A 1.5 Tesla Achieva MR imaging unit (Philips, Best, The Netherlands) and an eight-channel surface coil were used for imaging. Coronal proton density weighted images were acquired perpendicular to the long axis of the pelvis, with 5mm slice thickness and 1mm gap. All MRI studies were evaluated by a two researchers (EY, AC) who were experienced in prostate imaging studies. Briefly, SV volume was calculated using T2-weighted images first by measurement of the largest mediolateral (ML) and anteroposterior (AP) dimensions of the right and left SVs, followed by multiplication of these measurements (Figure 1). Total SV cross-sectional area for each subject was calculated by summing the areas of the right and left SVs.

Statistical Analysis

Linear regression analysis was used to determine the relationship between combined cross-sectional area of both SVs and duration of abstinence since ejaculation using the Number Cruncher Statistical System (NCSS) 2007 Statistical Software (Kaysville, Utah, USA). Pearson correlations were calculated to determine the association between SV measurements, age and abstinence duration. The relationship between SV size measurements and duration of abstinence since last ejaculation was the main outcome measure.

Results

The study cohort consisted of 104 men with a mean $\pm$ SD age of 46.45 $\pm$ 11.4 (range 18–68) years. Patient characteristics and comorbidities are summarized in Table 1 whereas SV cross-sectional area calculations are shown in Table 2. The mean duration of abstinence since last ejaculation was 3.6 $\pm$ 2.6 (range 1–15) days and linear regression analysis demonstrated a moderate positive correlation between SV area and duration of abstinence ($r^2=0.120$, $p=0.001$) (Figure 2). Pearson correlations were evaluated comparing age with abstinence duration and SV measurements and area calculations. No significant correlations between age and SV measurements or abstinence duration were observed, suggesting that SV size is independent of subject age (Table 3). When correlating SV size measurements with duration of abstinence since last ejaculation, however, significant correlations were observed for all SV size measurements and cross-sectional area calculations, supporting our findings on linear regression analysis (Table 4).

Discussion

We observed a positive correlation between duration of abstinence from ejaculation and SV size measurements determined on T2-weighted MRI imaging. During ejaculation, the SVs contract and contribute approximately 70% of the seminal volume, decreasing in size, but then reaccumulating fluid. A recent study analysing prostate and SV size found that SV volume decreased by approximately 40% immediately after ejaculation. However, this study examined only pre-ejaculation and immediate post-ejaculation SV volume (Medved et al., 2014). In our study, size as a function of abstinence period between ejaculations is examined, which has not previously been reported.

A related recent study evaluating SV size using transrectal ultrasound in 368 men seeking infertility care observed a decrease in SV volume on ejaculation, and found that larger post-ejaculatory SV volumes were associated with a higher prostate volume and more SV abnormalities (Lotti et al., 2012). The study also demonstrated that men with a SV ejection fraction of at least 21.6% were more likely to have normal ejaculate volume and fewer ejaculatory duct abnormalities. Impaired emptying of the SVs is associated with larger post-ejaculatory volumes, suggesting that SV volumes immediately post-ejaculation may be an indicator of ejaculatory duct obstruction. Thus, determination of immediate post-ejaculatory volume may provide an additional metric by which to risk stratify men with suspected ejaculatory duct obstruction.

There are other potential roles for SV size assessment in disease management. Benign prostatic hyperplasia (BPH) can result in compression of the urethra, and may result in compression of the ejaculatory ducts, thus providing a sensitive, objective measure for the physical impact of BPH in individual patients (Hayakawa et al., 1998). SV size can also play a significant role in diagnosis and treatment of prostate cancer. A recent study of markers for aggressive prostate cancer in 406 patients found that SV invasion (SVI) by localized prostate cancer is associated with a worse post-operative recurrence-free survival, a finding corroborated by other studies (Troyer et al., 2015; Ying et al., 2015; Mitchell et al., 2016). However, while MRI is reliable in detecting extracapsular extension of prostate cancer, it remains suboptimal at detecting SVI. In a recent study of 88 men undergoing radical prostatectomy for prostate cancer, SVI was accurately detected in only 16.7% using MRI, although specificity of detection was 100% (Oon et al., 2015). In a similar study, endorectal MRI was used to evaluate for prostate cancer SVI in patients preoperatively, with a sensitivity of 48.6% and a specificity of 97.7% (Roethke et al., 2014). However, the detection of SVI and extracapsular extension using MRI results in alteration of target volumes for radiation therapy (Chang et al., 2014). In one study, combined prostate and SV volumes facilitated selection of conformal (CRT) or intensity modulated radiation therapy (IMRT), with volumes $< 85 \text{ cm}^3$ supporting the use of CRT and volumes $> 85 \text{ cm}^3$ supporting the use of IMRT based on total radiation dose delivered (Reddy et al., 2010). Moreover, in a study by Xin et al, it has been shown that the recommended target distances of 1 and 2cm from the starting point of SVs for definitive radiotherapy are inadequate as the actual anatomical SVs are not covered in 62.3% and 71.0% of cases depending on the guideline preferred (Qi et al., 2014). Thus, consideration of SV volume as a function of

duration of abstinence from ejaculation may be useful in treatment approaches to numerous conditions.

Our study has several limitations that should be discussed. First, MRI was performed in the study population primarily for reasons unrelated to genitourinary complaints. This limited our assessment of SV size to cross-sectional area rather than volume, and limited comparison of SV size with other medical comorbidities. Second, hormonal data were not available in our cohort, limiting our ability to correlate SV size with serum markers. Third, no data on ejaculatory volume or semen parameters were available, limiting our ability to correlate these parameters with SV size as a function of abstinence duration. In addition, the maximum abstinence duration in our cohort was 15 days, limiting our ability to assess SV size beyond that time frame. Finally, correlation analyses of the SV size with other anthropometric measures (e.g. height, weight, pelvis size, prostate size) could have revealed associations between these parameters. Future studies should also record these variables in order to detect possible correlations.

Conclusions

We find an increase in SV cross-sectional area with abstinence duration after ejaculation. Understanding the relationship between SV size and duration of abstinence may facilitate diagnosis and treatment planning approaches for genitourinary conditions such as prostate cancer and autosomal dominant polycystic kidney disease, as well as an improved understanding of the impact of drugs and other external factors that may impact the male genitourinary tract.

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Figure 1.
Representative T2-weighted MRI image of the pelvis

Figure 2.
Linear regression analysis comparing duration of abstinence and SV area

Table 1

Patient demographics and comorbidities (BMI= body mass index, DM= diabetes mellitus, HT=hypertension, CKD= Chronic kidney disease, CAD=coronary artery disease)

Mean patient age (years), mean±SD	46.45±11.4
BMI (kg/m ²), mean±SD	23.88±1.46
Smoking, n(%)	14 (13.46%)
DM, n(%)	21 (20.19%)
HT, n(%)	24 (23.07%)
CKD, n(%)	10 (9.61%)
CAD, n(%)	7 (6.73%)
Bladder cancer, n(%)	8 (7.69%)
Kidney cancer, n(%)	10 (9.61%)
Prostate cancer, n(%)	6 (5.76%)
Testicular cancer, n(%)	7 (6.73%)
Benign anorectal diseases (hemorrhoid or anal fistula), n(%)	21 (20.19%)
Previous pelvic surgery, n(%)	6 (5.76%)
Colorectal tumor	5 (4.8%)
Open prostatectomy	1 (0.96%)

Table 2

Seminal vesicle (SV) cross-sectional area calculations

Variable	Mean±SD	Range
Abstinence duration (days)	3.6±2.6	1–15
<u>SV Measurements</u>		
Right SV Mediolateral (mm)	39.3±7.6	19.3–54.2
Right SV Anteroposterior (mm)	18.3±6.4	7.5–40.5
Left SV Mediolateral (mm)	36.9±7.4	21.1–62.7
Left SV Anteroposterior (mm)	19.1±6.9	8.1–43.9
<u>Cross-Sectional Areas</u>		
Right SV (mm ²)	744.1±351.1	149.9–1794.7
Left SV (mm ²)	727.6±359.2	171.4–2248.4
Total Cross-Sectional Area (mm ²)	1461.8±682.3	321.3–4043.1

Table 3

Pearson correlations comparing subject age and seminal vesicle (SV) measurements

	Subject Age	
Abstinence Duration	r	0.031
	p	0.760
Total SV Area	r	0.007
	p	0.947
Right SV Area	r	-0.032
	p	0.745
Left SV Area	r	0.044
	p	0.657
Right ML Measurement	r	-0.057
	p	0.565
Right AP Measurement	r	0.014
	p	0.887
Left ML Measurement	r	-0.061
	p	0.540
Left AP Measurement	r	0.109
	p	0.271

Table 4

Pearson correlations comparing abstinence duration with seminal vesicle (SV) measurements.

Abstinence Duration		
Abstinence duration	r	0.031
	p	0.760
Total SV Area	r	0.372
	p	0.0001
Right SV Area	r	0.362
	p	0.0001
Left SV Area	r	0.354
	p	0.0001
Right ML Measurement	r	0.468
	p	0.0001
Right AP Measurement	r	0.221
	p	0.029
Left ML Measurement	r	0.492
	p	0.0001
Left AP Measurement	r	0.202
	p	0.046