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ORIGINAL RESEARCH

Prevalence of spinal meningeal diverticula in autosomal dominant polycystic kidney disease

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ABSTRACT

BACKGROUND AND PURPOSE: Autosomal dominant polycystic kidney disease (ADPKD) patients develop cysts in the kidneys, liver, spleen, pancreas, prostate and arachnoid spaces. In addition, spinal meningeal diverticula have been reported. To determine whether spinal meningeal diverticula are associated with ADPKD, we compare their prevalence in ADPKD subjects to a control cohort without ADPKD.

MATERIALS AND METHODS: ADPKD subjects and age- and gender-matched controls without ADPKD undergoing abdominal MRI from mid-thorax to the pelvis from 2003 to 2023 were retrospectively evaluated for spinal meningeal diverticula by 4 blinded observers. Prevalence of spinal meningeal diverticula in ADPKD was compared to control subjects, using t-test and correlated with clinical and laboratory data, and magnetic resonance imaging (MRI) features, including cyst volumes and cyst counts.

RESULTS: Identification of spinal meningeal diverticula in ADPKD (n=285, median age, 47 [37,56]; 54% female) and control (n=285, median age, 47 [37,57]; 54% female) subjects had high inter-observer agreement (Pairwise Cohen kappa=0.74). Spinal meningeal diverticula were observed in 145 of 285 (51%) ADPKD subjects compared with 66 of 285 (23%) control subjects without ADPKD ($p<0.001$). Spinal meningeal diverticula in ADPKD were more prevalent in women (98 of 153 [64%]) than men (47 of 132 [36%], $p<0.001$). The mean number of spinal meningeal diverticula per affected ADPKD subject was 3.6 + 2.9 compared to 2.4 + 1.9 in controls with cysts ($p<0.001$). The median volume/interquartile range (IQR, 25%/75%) of spinal meningeal diverticula was 400 mm3 (210, 740) in ADPKD compared to 250 mm3 (180, 440) in controls ($p<0.001$). Mean/SD spinal meningeal diverticulum diameter was greater in the sacrum (7.3 + 4.1 mm) compared to thoracic (5.4 + 1.8 mm) and lumbar spine (5.8 + 2.0 mm), $p<0.001$, suggesting that that hydrostatic pressure contributed to enlargement.

CONCLUSIONS: ADPKD has a high prevalence of spinal meningeal diverticula, particularly in women.

ABBREVIATIONS: ADPKD = Autosomal dominant polycystic kidney disease.

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SUMMARY SECTION

PREVIOUS LITERATURE: Schievink and Torres first reported spinal meningeal diverticula in 3 women with ADPKD being evaluated for headache, visual blurring aggravated by upright positioning, and low cerebrospinal fluid pressure. Since then, there has been additional reports of spinal CSF leaks related to spinal meningeal diverticula in ADPKD subjects. Asymptomatic spinal meningeal diverticula have also been reported in ADPKD patients, all of whom were female. Asik et al., reported more and larger cysts in 50 ADPKD subjects compared to 37 controls without ADPKD and correlated the number and size of spinal meningeal diverticula with a headache severity score.

KEY FINDINGS: Spinal meningeal diverticula are observed in 51% of autosomal dominant polycystic kidney disease (ADPKD) patients on abdominal MRI which is 2.2 time greater than in a control population without ADPKD, ($p<0.001$) and are 1.8 times more common in women (98 of 153 [64%]) than men (47 of 132 [36%], $p<0.001$).

KNOWLEDGE ADVANCEMENT: Spinal meningeal diverticula are prevalent in ADPKD subjects and should be included in the differential diagnosis of headache in ADPKD, especially when the headache is exacerbated or provoked by upright posture.

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INTRODUCTION

Autosomal dominant polycystic kidney disease (ADPKD) is characterized by multi-organ cystic (e.g., kidney, liver) and non-cystic (e.g., pericardial, pleural) fluid accumulations[1-7]. Although most ADPKD imaging focuses on the kidneys, the spine is within the abdominal field of view, enabling the evaluation of nerve roots. ADPKD patients are known to develop intracranial arachnoid cysts[8-11]. We have also noticed that spinal meningeal diverticula appear to be more prevalent in ADPKD patients and there have been multiple case reports[12-18].

Spinal meningeal diverticula, also known as nerve root cyst or perineural cyst, are focal fluid-filled outpouchings along the nerve root that directly communicate with the subarachnoid space and are covered with arachnoid and dura mater. The etiology is unknown, but increased prevalence in connective tissue disorders and spinal injuries has been reported[19-21]. One hypothesis is that inflammation and a ball-valve mechanism between the nerve root sheath and subarachnoid space results from pulsatile hydrodynamic forces on CSF [21]. Most spinal meningeal diverticula are asymptomatic, although the clinical presentation can include headache exacerbated by upright posture[12,14,16,17], low back pain[22-25], sciatic pain[23-25], leg weakness[23-25], bowel and bladder dysfunction[23-25], claudication[23,24] and sacral insufficiency fractures[26]. Spinal meningeal diverticulum formation may also be associated with idiopathic intracranial hypertension[27], where there is elevated intracranial pressure in the absence of hydrocephalus or mass lesions. Additionally, spinal meningeal diverticula can also be associated with spontaneous spinal CSF leaks with CSF flowing directly into the surrounding epidural space (Type 2 CSF leak) or flowing into an aberrant connection between the subarachnoid space and an adjacent paraspinal vein (Type 3 CSF leak) resulting in spontaneous intracranial hypotension (SIH)[28-30].

In this STROBE checklist guided study, we identified the prevalence of spinal meningeal diverticula in ADPKD subjects compared to age/gender-matched control subjects without ADPKD to determine whether these spinal meningeal diverticula are also associated with ADPKD.

MATERIALS AND METHODS

Study Design and Populations

This retrospective, cross-sectional study of existing data and images acquired from 2003 to 2023 is compliant with the Health Insurance Portability and Accountability Act (HIPAA) and was approved by the Weill Cornell Medicine Institutional Review Board. We retrospectively analyzed 285 ADPKD patients and 285 age/sex-matched control subjects without ADPKD. All ADPKD subjects were enrolled in Rogosin PKD Repository, signed informed consent, and underwent MR imaging as outpatients. The requirement for informed consent was waived for analysis of existing data from control patients.

Inclusion criteria for ADPKD subjects were (1) diagnosis of ADPKD based upon Pei-Ravine criteria [31] and (2) MRI with T2-weighted images covering from mid-thorax extending below the kidneys. Exclusion criteria were (1) medical conditions associated with spinal meningeal diverticula, including connective tissue disorder or spinal deformity, (2) incomplete T2 MRI and (3) laboratory data unavailable within 12 months of the MRI (FIG 1). For each ADPKD patient, we identified age- (within 2.5 years) and sex-matched control patients without ADPKD, connective tissue disorder nor spinal deformity were identified from the picture archival computer system (PACS) with contemporaneous exam dates.

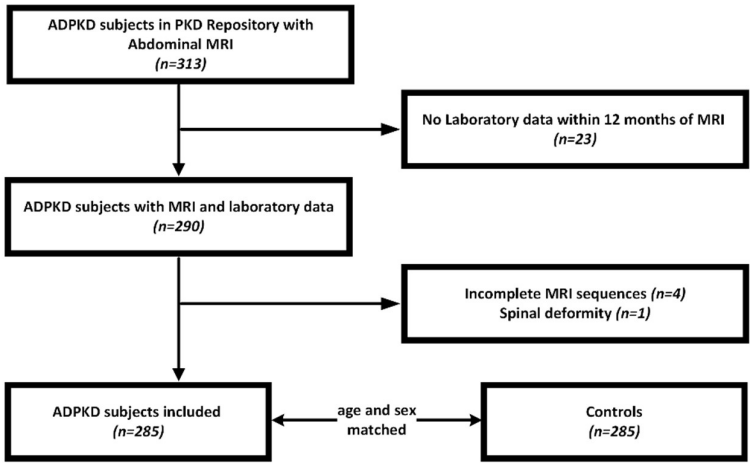

FIG 1. Patient Flow Chart.

Data Extraction

ADPKD and control subject demographic information, clinical data, laboratory data and genetic data were extracted from the PKD Repository and the electronic medical records for the date closest to the MRI date. We analyzed MRI reports, prepared prospectively at the time of imaging, to obtain data on kidney, liver and spleen volumes, cyst counts/fractions, pancreatic cysts, prostate cysts, seminal megavesicles and pleural effusions.

Image Acquisition

MRI exams without contrast enhancement were obtained at 1.5T or 3T using a body array coil with the parameters shown in **Supplemental** Table 1. Pulse sequences used for this analysis were coronal and axial T2-weighted SSFSE (Signa family, GE Waukesha, WI) or HASTE (Skyra, Siemens AG, Erlangen, Germany).

Image Analysis

Axial and coronal T2 MR images were analyzed by 4 independent, experienced observers (US, XY, XL, MRP) blinded to the patient information. Observers independently counted the number of spinal meningeal diverticula present in each subject. Disagreements were resolved by consensus. Spinal meningeal diverticula were defined as present when there was a well-defined T2 bright signal corresponding to fluid intensity along the course of the normal nerve root on T2-weighted images at least doubling the normal nerve root diameter. For size measurement and region distribution, one of the observers (US) annotated spinal meningeal diverticula on coronal images using ITK SNAP software version 3.8.0.(FIG 2)

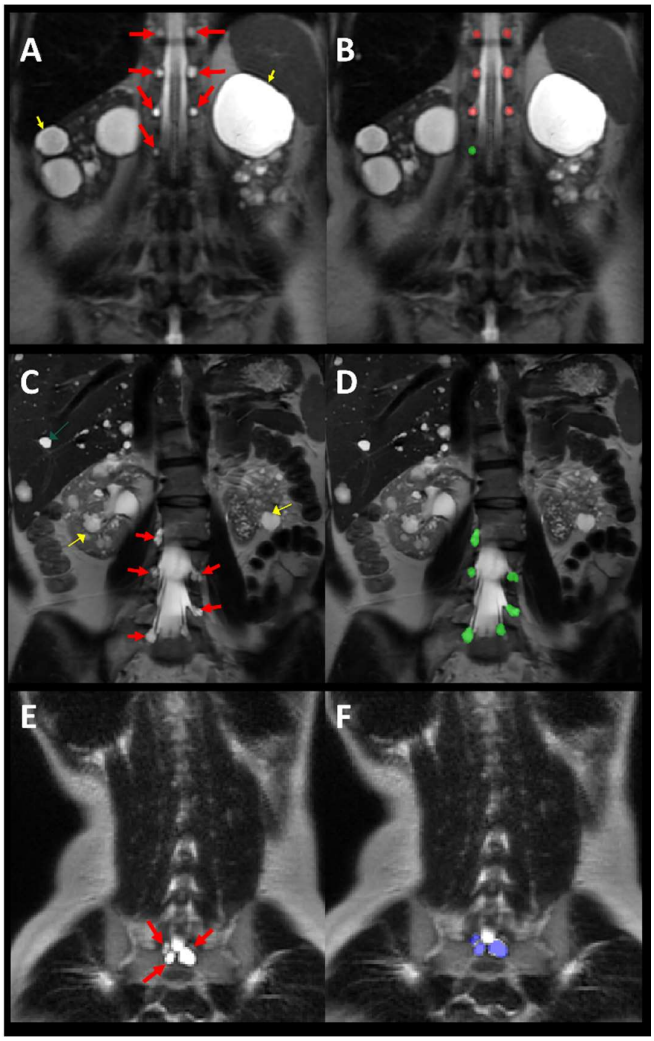

FIG 2. Coronal T2-Weighted SSFSE (single shot fast spin echo) images in 3 typical ADPKD patients including A) a 60-year-old female with T10-12 spinal meningeal diverticula bilaterally (red arrows) and an L1 spinal meningeal diverticulum on the right annotated B) in red (thoracic) and green (lumbar); C) a 46-year-old female with lumbar spinal meningeal diverticula (red arrows) C) with corresponding annotation D) in green for L2 (right), L3 (bilateral) L4 (left) and L5 (bilateral); E) a 28-year-old female with sacral spinal meningeal diverticula (red arrows) annotated F) in blue. Also, note renal cysts (yellow arrows) and liver with multiple cysts (green arrow).

Descriptive Statistics

For normally distributed continuous variables (assessed by Shapiro-Wilk Test), mean and standard deviation (SD) were reported. For non-normal distributions, median and interquartile range were reported. Frequency and percentage were calculated for categorical variables.

For two-group matched continuous variables, a paired t-test was used to assess the statistical significance. For multi-group continuous variables, ANOVA was used to assess statistical significance. For categorical variables, Chi-square or Fisher's Exact test was used to assess statistical significance depending on sample size. Inter-observer agreement for identifying spinal meningeal diverticula and the number of spinal meningeal diverticula was assessed using Pairwise Cohen Kappa and intraclass correlation coefficient (ICC), respectively.

Regression Models

Bivariate analysis was used to estimate the correlation between the presence of spinal meningeal diverticula and age, gender, height, weight, body mass index, body surface area, blood pressure, blood urea nitrogen, creatinine, estimated glomerular filtration rate, albumin, aspartate transaminase, alanine transaminase, height-adjusted total kidney volume, height-adjusted total liver volume, height-adjusted total spleen volume, number of renal cysts, number of hemorrhagic renal cysts, number of liver cysts, number of pancreatic cysts, pleural effusion, severe headache and PKD genotype. The variables that had significance (i.e., $p<0.05$) were used in a multivariable linear regression analysis to assess their effect after adjusting for the other variables. The analysis was performed using GraphPad Prism software version 10.2.0(392).

RESULTS

Abdominal MRI results were available in 285 ADPKD subjects (Median age 47 [37,56], Female 54%, White 84%) and a control group without ADPKD controlled for age and sex (FIG 1, **Online Supplemental Data**).

As expected, the ADPKD group had higher diastolic blood pressure, blood urea nitrogen and creatinine, lower estimated glomerular filtration rate and higher height-adjusted total kidney volume, height-adjusted total liver volume, height-adjusted total spleen volume, number of liver cysts and number of kidney cysts **(Online Supplemental Data)**. Information on race was available for more ADPKD patients compared to control patients, reflecting willingness of ADPKD subjects to provide this information when enrolling in the Rogosin PKD repository. This resulted a significantly higher number of subjects with unknown race in the control population, (Supplemental Table 2).

Indications for MRI in the control subjects included inflammatory bowel disease follow-up (n=99), indeterminate lesion (n=82), pain (n=51), cancer follow-up (n=23), liver disease (n=15), pancreatitis (n=7), hematuria (n=4), small bowel obstruction follow-up (n=2), endometriosis (n=1) and uterine leiomyomas (n=1).

Prevalence of Spinal meningeal diverticula in ADPKD

Spinal meningeal diverticula were identified in 51% of ADPKD subjects compared with 23% of controls (**Online Supplemental Data**; $p<0.001$). In the ADPKD group, 64% of all females had spinal meningeal diverticula compared to 36% of males ($p< 0.001$). In the control subjects, 31% of females had spinal meningeal diverticula compared to 14% of males ($p=0.001$). (Supplemental Table 3)

In the ADPKD group, subjects with cysts had a mean of 3.6 ± 2.9 cysts per subject, which was 50% greater than controls, (2.4 ± 1.9, $p<0.001$). The median spinal meningeal diverticulum volume was 400 mm^3 (210,740) in ADPKD subjects with spinal meningeal diverticula compared to 250 mm^3 (180,440) in controls ($p<0.001$). The mean spinal meningeal diverticulum diameter was 6.6 ± 3.4 mm in ADPKD subjects compared to 6.1 ± 2.6 mm in the control subjects ($p=0.06$). Spinal meningeal diverticula were more prevalent in the sacrum compared to lumbar or thoracic spine locations, $p<0.001$, Supplemental Table 4. Large cysts (>10mm) were more prevalent in the ADPKD group than the control group (35/285 [12.3%] vs 6/285 [2.1%], $p<0.001$, Supplemental Table 5). Mean diameter of spinal meningeal diverticula was largest in the sacrum, (7.3 ± 4.1), compared to lumbar (5.8 ± 2.0 mm) and thoracic (5.4 ± 1.8) spine, $p<0.001$; FIG3, Supplemental Table 6).

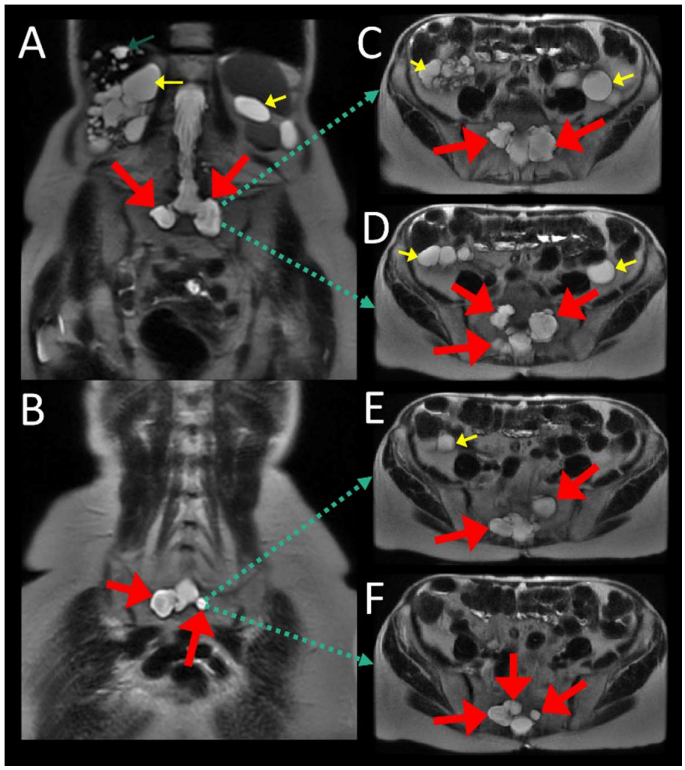

FIG 3. A 73-year-old female with ADPKD reporting a remote history of severe headache lasting 2 weeks with A, B) coronal and C,D,E,F) sequential axial T2-weighted SSFSE (single shot fast spin echo) images showing multiple large sacral spinal meningeal

diverticula (red arrows). Also, note renal cysts (yellow arrows) and liver with multiple cysts (green arrow).

As expected, the ADPKD group had a higher prevalence of pancreatic cysts, seminal megavesicles and midline prostate cysts than the control group, as previously reported[5,6].Serum albumin and aspartate transaminase were slightly higher in ADPKD compared to the control group, however, these values were within normal limits for both groups.

Interobserver Variability

Inter-observer agreement for the presence of spinal meningeal diverticula was high, with Pairwise Cohen kappa =0.74. Inter-observer agreement for the number of spinal meningeal diverticula in each subject was excellent, with intraclass correlation coefficient (ICC) =0.95.

Genotype

Among ADPKD patients with either a *PKD1* (n=187/245= 76.3%) or *PKD2* (n=58/245 =23.7%) mutation, 95 of 187 (51%) with *PKD1* mutations had spinal meningeal diverticula compared to 30 of 58 (52%) with *PKD2* mutations (Online Supplemental Data; p=0.9). The prevalence of truncating mutations in PKD1 was similar in those with and without spinal meningeal diverticula.

Correlation with Laboratory and Imaging Parameters

The presence of spinal meningeal diverticula on MRI in ADPKD subjects was significantly correlated with female gender, and severe headache by bivariate analysis (Supplemental Table 7). The presence of spinal meningeal diverticula negatively correlated with height, weight, body mass index, body surface area, blood urea nitrogen, creatinine, height-adjusted total kidney volume, height-adjusted total spleen volume, number of renal cysts and number of hemorrhagic renal cysts. However, a multivariate analysis, including gender, height, weight, body mass index, body surface area, blood urea nitrogen, creatinine, height-adjusted total kidney volume, height-adjusted total spleen volume, number of renal cysts, number of hemorrhagic renal cysts, severe headache and spinal meningeal diverticula showed that sex was the only parameter to retain statistical significance (Table 1), although the number of hemorrhagic cysts was of borderline significance.

Table 1. Multivariate Analysis for the presence of spinal meningeal diverticula in ADPKD patients, including parameters with p-value <0.05 on bivariate analysis (model p- value = <0.0001), (significant p values are in **bold**).

Variable	Coefficients	95% CI (asymptotic)	P-value
Intercept	-0.18	-5.84 to 5.48	0.94
Male Sex	-0.31	-0.481 to -0.14	**<0.001**
Height (cm)	0.91	-4.944 to 6.76	0.76
Weight (kg)	0.003	-0.051 to 0.06	0.92
Body Mass Index (kg/m2)	-0.01	-0.107 to 0.09	0.83
Body Surface Area (m2)	-0.24	-5.473 to 4.98	0.92
Blood Urea Nitrogen (mg/dl)	0.004	-0.003 to 0.01	0.31
Creatinine (mg/dl)	-0.07	-0.161 to 0.02	0.11
Total Kidney Volume/Height (ml/m)	-0.00003	-0.0001 to 0.00004	0.40
Spleen Volume/Height (ml/m)	-0.0007	-0.001 to 0.0003	0.17
Number of renal cysts	0.00002	-0.0002 to 0.0002	0.85
Number of Hemorrhagic renal cysts	-0.0009	-0.0019 to 2.670e-005	0.06
Severe Headache	0.093	-0.02503 to 0.2107	0.12

Clinical Effects and Progression of spinal meningeal diverticula

There was more frequent reporting of severe headache in the APDKD group with spinal meningeal diverticula (68/145 [47%]) compared to those without spinal meningeal diverticula (48/140 [34%], p=0.03). Headache prevalence data was not systematically available for the control group. None of the 145 ADPKD subjects with spinal meningeal diverticula reported any other symptoms attributable to these cysts. Supplemental FIG 1 shows the number of spinal meningeal diverticula observed for each of the 285 ADPKD subjects, showing no relationship with patient age.

There were 50 ADPKD subjects who had 10+ years of MRI scans, median follow-up = 11.2 years [10.6,13.1]). Supplementary Table 8 shows the characteristics of these ADPKD patients with 10+ years of follow-up are similar to the entire ADPKD population. One of these ADPKD subjects with follow-up initially had no spinal meningeal diverticula but developed a 5.8 mm spinal meningeal diverticulum. ADPKD subjects with follow-up also included 32 subjects with a spinal meningeal diverticulum on the initial MRI. For these 32 affected ADPKD subjects with follow-up, Supplemental Table 9, the mean number of cysts on their first scan, 3.3$\pm$2.7 was similar to the mean number of cysts on the most recent scan, 3.2$\pm$2.6 (p=0.4). However, the mean diameter of the largest cyst increased from 8.1$\pm$3.2 mm on the first scan to 8.9$\pm$3.7 mm, (p=0.01) on the most recent scan (FIG 4). Supplemental FIG2 shows the growth of spinal meningeal diverticula from the first scan compared to the most recent scan in all ADPKD subjects with 10+ years follow-up.

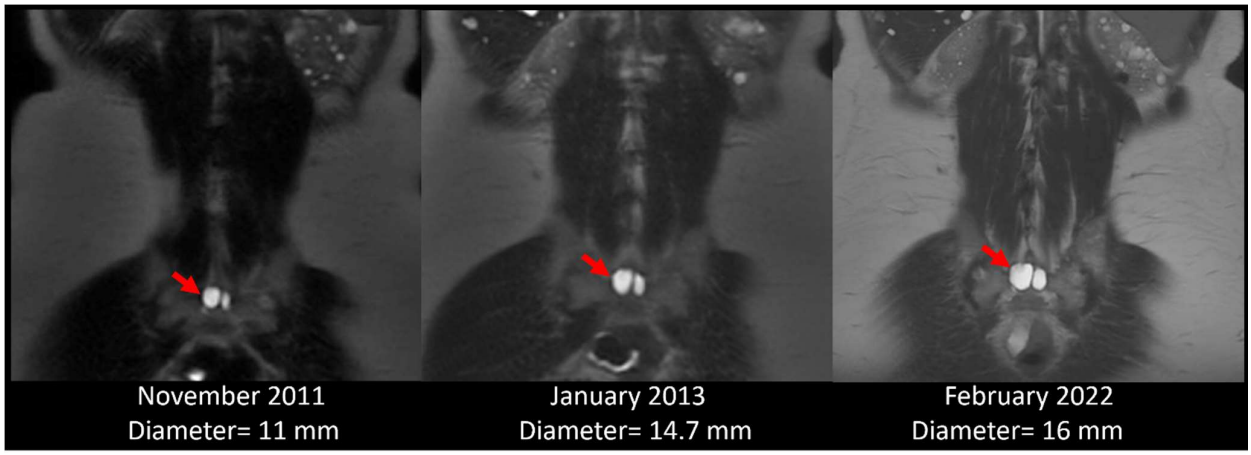

FIG 4. Coronal T2 SSFSE (single shot fast spin echo) images spanning 10 years in a 44-year-old female with ADPKD showing a right sacral spinal meningeal diverticulum (red arrows) which increased in short-axis diameter from 11 to 16 mm.

DISCUSSION

These data from 285 ADPKD and matched control patients show the prevalence of spinal meningeal diverticula were 51%, 2.2 times higher in ADPKD than the control group. In a multivariable model, women with ADPKD were more likely than men to have spinal meningeal diverticula. Furthermore, spinal meningeal diverticula were larger and more numerous in ADPKD subjects and total spinal meningeal diverticular volume was 60% greater compared to controls.

In 1997, Schievink and Torres reported spinal meningeal diverticula in 3 women with ADPKD being evaluated for headache, visual blurring aggravated by upright positioning, and low cerebrospinal fluid pressure. Symptoms in one patient resolved after surgical repair of an 8cm thoracic spinal meningeal diverticulum[12]. Additional reports of spinal CSF leaks related to spinal meningeal diverticula in ADPKD subjects also showed resolution of headache after surgical repair or epidural blood patch[14,16]. Although, Kranz et al., in 2013, reported no difference in the prevalence of spinal meningeal diverticula between patients with spontaneous intracranial hypotension (SIH) and controls[32]. Asymptomatic spinal meningeal diverticula have also been reported in ADPKD patients, all of whom were female[15,18]. Our data confirm the findings of Asik et al., who reported more and larger cysts in 50 ADPKD subjects compared to 37 controls without ADPKD. In that study, the number and size of spinal meningeal diverticula correlated with a headache severity score. However, the ADPKD population in that study was not randomly selected, the prevalence of spinal meningeal diverticula was not reported and they did not report a female predominance[17].

Our data in control subjects without ADPKD, which showed spinal meningeal diverticula were twice as prevalent in females compared to males, is in agreement with Burdan et al. who evaluated spinal perineural cysts among East-European patients and Langdown et al. who reported that these cysts were seen in about 70 percent of females[33,34]. Higher female prevalence was also observed in a study of neurosurgical patients where 102 (84%) out of 122 patients who underwent percutaneous sealing of perineurial cysts were female[35].

Spinal meningeal diverticula, also known as nerve root sleeve cysts or perineural cysr, are hypothesized to arise at sites of dural weakness and are more prevalent in connective tissue disorders, suggesting meningeal connective tissue weakness as a risk factor[19,20]. Other proposed mechanisms include nerve root inflammation, followed by fluid accumulation, arachnoidal proliferation, and communications between dilated sheaths and the subarachnoid space expanding under the influence of pulsatile hydrodynamic CSF forces[21]. The association of spinal meningeal diverticula with ADPKD supports the concept that ADPKD is a more generalized connective tissue disorder. The observation of more and larger sacral spinal meningeal diverticula, compared to lumbar and thoracic regions, suggests that the increased hydrostatic pressure in the sacral region while upright may promote cyst formation. This concept is also supported by reports of spinal meningeal diverticula occurring with Type 2 CSF leak (ruptured spinal meningeal diverticulum) or Type 3 CSF leak (an aberrant connection between the subarachnoid space and an adjacent paraspinal vein) often presenting as postural headache indicating spontaneous intracranial hypotension[28-30].

The strengths of this study are the large, unselected population of ADPKD subjects in the Rogosin PKD Repository with an age- and sex-matched control group and multi-observer analysis blinded to the patient data. We further strengthened the study by excluding all subjects with known connective tissue disorders, debilitating spinal deformities and incomplete MRI sequences that may have confounded the analysis.

Limitations of this study include retrospective image analysis and failure of MRI sequences to cover the entire thoracic spine or cervical spine. This may have biased the study toward underreporting the true spinal meningeal diverticula prevalence. The true blinding was also not possible due to ADPKD status being apparent on the images. None of the patients in this study underwent a procedure to measure CSF pressure or for cyst drainage or excision which precluded histopathological evaluation.

CONCLUSIONS

In conclusion, these findings indicate that spinal meningeal diverticula are prevalent in ADPKD subjects, particularly in women, and should be included in the differential diagnosis of headache in ADPKD, especially when the headache is exacerbated or provoked by upright posture.

ACKNOWLEDGMENTS

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SUPPLEMENTAL TABLES

Online Supplemental Data. Demographic and laboratory data in 285 ADPKD subjects and 285 age/sex matched controls. Categorical variables are mean + standard deviation and or median (Interquartile range). Ordinal variables are shown as number and %. Significant p values are in **bold.**ssures are controlled on medication.

Demographic Data	ADPKD Group (n=285)	Control Group (n=285)	P-value
Spinal meningeal diverticula present	145/285 (51%)	66/285 (23%)	**<0.001**
Age	47 (37, 56)	48 (37, 57)	0.60
Sex: Male	132(46%)	132(46%)	>0.9
Race			**<0.001**
White	239 (84%)	186 (65%)	
Black	12 (4%)	30 (11%)	
Asian	22 (7%)	11 (4%)	
Native American	01 (1%)	00 (0%)	
Unknown	11 (4%)	58 (20%)	
Height (cm)	170 (163, 179)	170 (163, 178)	0.20
Weight (kg)	75 (64, 88)	74 (61, 86)	0.20
Body Mass Index (kg/m2)	25.1 (22.5, 28.5)	25.1 (22.1, 29.2)	0.70
Body Surface Area (m2)	1.88 (1.70, 2.06)	1.85 (1.65, 2.03)	0.15
Systolic (mmHg)*	120 (112, 130)	121 (112, 131)	0.60
Diastolic (mmHg)*	80 (72, 86)	76 (69-81)	**<0.001**
Estimated Glomerular Filtration Rate (ml/min/1.73m2)	63 (44, 87)	85 (71, 102)	**<0.001**
Blood Urea Nitrogen (mg/dl)	20 (15, 27)	13 (10, 17)	**<0.001**
Creatinine (mg/dl)	1.1 (0.9, 1.5)	0.8 (0.7, 1.1)	**<0.001**
Albumin (g/dl)	4.3 (4.2, 4.5)	4.1 (3.8, 4.4)	**<0.001**
Aspartate Transaminase (U/L)	23 (20, 27)	22 (18, 28)	**0.05**
Alanine Transaminase (U/L)	20 (17, 27)	21 (15, 30)	0.60
Total Kidney Volume/Height (ml/m)	760 (427, 1302)	203 (172, 238)	**<0.001**
Liver Volume/Height (ml/m)	1007 (852, 1250)	884 (780, 1037)	**<0.001**
Spleen Volume/Height (ml/m)	138 (107, 185)	119 (88, 161)	**0.002**
Number of Renal cysts	400 (200, 600)	0 (0, 2)	**<0.001**
Number of Hemorrhagic renal cysts	22 (7, 65)	0 (0, 0)	**<0.001**
Number of Liver cysts	100 (10, 200)	0 (0, 0)	**<0.001**
Pancreatic cysts	66/285 (23%)	29/285 (10%)	**<0.001**
Seminal Mega-vesicle	34/132 males (26%)	0/132 males (0%)	**<0.001**
Prostate cysts	30/132 males (23%)	5/132 males (4%)	**<0.001**
Pleural effusion	59/285 (21%)	21/285 (7%)	**<0.001**

* blood pressures are controlled on medication.

Online Supplemental Data. Demographic and laboratory data in 285 ADPKD patients without (n=140) and with (n=145) spinal meningeal diverticula. Categorical variables are given as mean + standard deviation and or median (Interquartile range). Ordinal variables are shown as number and %. Significant p values are in bold.

Demographic Data	No Spinal meningeal diverticula (n=140)	Spinal meningeal diverticula (n=145)	P-value
Age	46 (36, 55)	48 (37, 56)	0.40
Sex			**<0.001**
Male	85 (61%)	47 (32%)	
Female	55 (39%)	98 (68%)	
Race			0.30
White	114 (81%)	125 (86%)	
Black	5 (4%)	7 (5%)	
Asian	13 (9%)	9 (6%)	
Native American	0 (0%)	1 (1%)	
Unknown	8 (6%)	3 (2%)	
Height (cm)	173 (164, 180)	169 (162, 177)	0.02
Weight (kg)	80 (69, 93)	69 (60, 84)	**<0.001**
Body Mass Index (kg/m2)	26.6 (23.5, 29.6)	24.1 (21.9, 26.8)	**<0.001**
Body Surface Area (m2)	1.95 (1.77, 2.11)	1.78 (1.64, 2.00)	**<0.001**
Systolic (mmHg)*	120 (112, 132)	120 (113, 130)	0.80
Diastolic (mmHg)*	80 (74, 88)	79 (72, 84)	0.08
Estimated Glomerular Filtration Rate (ml/min/1.73m2)	61 (41, 84)	65 (49, 90)	0.10
Blood Urea Nitrogen (mg/dl)	20 (16, 28)	19 (15, 26)	0.09
Creatinine (mg/dl)	1.2 (0.9, 1.6)	1.0 (0.8, 1.4)	**<0.001**
Albumin (g/dl)	4.4 (4.2, 4.5)	4.3 (4.2, 4.5)	0.60
Aspartate Transaminase (U/L)	23 (19, 28)	23 (20, 27)	0.60
Alanine Transaminase (U/L)	21 (17-30)	20 (16-25)	0.12
Total Kidney Volume/Height (ml/m)	890 (479, 1605)	679 (399, 1085)	**0.005**
Liver Volume/Height (ml/m)	1022 (888, 1238)	994 (831, 1269)	0.20
Spleen Volume/Height (ml/m)	147 (117, 195)	131 (96, 171)	**0.003**
Number of Renal cysts	400 (200, 600)	300 (200, 500)	**0.02**
Number of Hemorrhagic renal cysts	24 (8, 79)	22 (6, 56)	0.20
Number of Liver cysts	90 (5, 200)	100 (15, 200)	0.20
Pancreatic cysts	33/140 (24%)	33/145 (23%)	0.90
Seminal Mega-vesicle (male only)	18/85 (21%)	16/47 (34%)	0.11
Prostate cysts (male only)	19/85 (22%)	11/47 (23%)	0.90
Pleural effusion	28/140 (20%)	31/145 (21%)	0.80
Severe Headache	48/140 (34%)	68/145 (47%)	0.03
PKD Mutation Genotype Data Available	120/140 (86%)	125/145 (86%)	0.90
PKD1 Mutation (n=187)	92/187 (49%)	95/187 (51%)	0.75
Truncating	57/92 (62%)	57/95 (60%)	0.78
Non truncating	35/92 (38%)	38/95 (40%)	0.78
PKD2 Mutation (n=58)	28/58 (48%)	30/58 (52%)	0.71
Truncating	26/28 (93%)	26/30 (87%)	0.44
Non truncating	2/28 (7%)	4/30 (13%)	0.44

* blood pressures are controlled on medication.

Supplemental Table 1. MRI imaging parameters for 285 index scans on ADPKD subjects acquired at 1.5T (n=279, Signa (30 years old but upgraded to Excite, GE Waukesha, WI) or 3T (n=3 for Signa Excite (20 years old) and n=3 for Skyra (10 years old), Siemens AG, Erlangen, Germany)

Field Strength	1.5T(n=279)		**3T(n=6)**	
MRI sequences	**Coronal HASTE*/ SSFSE****	**Axial HASTE*/ SSFSE****	**Coronal HASTE*/ SSFSE****	**Axial HASTE*/ SSFSE****
Image weighting	T2	T2	T2	T2
Field-of-view	35 - 48	28 - 48	35 - 48	29 - 42
Matrix	256 x 256	256 x 256	320 - 512 x 320 - 512	240 - 512 x 320 - 512
Slice thickness	3 - 8 mm	4 - 8 mm	5 - 8 mm	4 - 8 mm
Effective echo time	78 - 189	86 - 242	78 - 141	79 - 141
Bandwidth	81 - 488	81 - 488	163 - 725	195 - 710
Echo Train Length	184 - 264	184 - 264	129 - 159	108 - 159

*HASTE, Half-Fourier Acquisition Single Shot Turbo spin Echo, **SSFSE, Single Shot Fast Spin Echo.

Supplemental Table 2. Racial variations in the prevalence of spinal meningeal diverticula in ADPKD and control subjects showing greater prevalence of spinal meningeal diverticula with ADPKD subjects compared to controls for White and Black with a trend for Asian.

Race	ADPKD subjects	Control subjects	P-value
White	125/239 (52%)	44/186 (24%)	**<0.001**
Black	07/12 (58%)	3/30 (10%)	**<0.001**
Asian	09/22 (41%))	01/11 (9%)	0.06
Native American	01/01 (100%)	00 (0%)	-
Unknown	3/11 (27%)	18/58 (31%)	0.80
P-value	0.43	0.10	

Supplemental Table 3. Sex variations in the prevalence of spinal meningeal diverticula in ADPKD and control subjects.

	ADPKD Subjects			**Control Subjects**		
Sex	Males	Females	Overall	Males	Females	Overall
spinal meningeal diverticula	47 (32%)	98 (68%)	145	19 (29%)	47 (71%)	66
No spinal meningeal diverticula	85(61%)	55 (39%)	140	113 (52%)	106 (48%)	219
Rate of cysts	36%	64%	51%	14%	31%	30%

Supplemental Table 4. Regional variation in prevalence of spinal meningeal diverticula in ADPKD cases and matched control subjects (significant p values are in **bold**).

Region	Number of ADPKD subjects with cysts (%)	Number of Control subjects with cysts (%)	ratio	P-value
Thoracic	44/285 (15%)	20/285 (7%)	2.2	**<0.001**
Lumbar	66/285 (23%)	28/285 (10%)	2.4	**<0.001**
Sacral	121/285 (42%)	46/285 (16%)	2.6	**<0.001**
P value	<0.001	0.002	0.92	

Supplemental Table 5. Spinal meningeal diverticulum size distribution in ADPKD cases and matched controls (significant p values are in **bold**).

Size	Number of ADPKD subjects with cysts (%)	Number of Control subjects with cysts (%)	ratio	P-value
Less than 5 mm	83/285 (29%)	34/285 (12%)	2.4	<0.001
5 to 10 mm	116/285 (41%)	53/285 (19%)	2.2	<0.001
Greater than 10 mm	35/285 (12%)	06/285 (2%)	5.8*	<0.001

* Trend toward larger spinal meningeal diverticula (>10mm) in ADPKD compared to less than 10 mm (p=0.06)

Supplemental Table 6. Regional variation in mean spinal meningeal diverticulum size in ADPKD and Control subjects (significant p values are in **bold**).

Region	Mean spinal meningeal diverticulum diameter (mm)		P-value
	ADPKD	Controls	
Thoracic	5.4 ± 1.8	5.6 ± 1.7	0.6
Lumbar	5.8 ± 2.0	5.5 ± 1.1	0.2
Sacral	7.3 ± 4.1	6.8 ± 3.4	0.2
P values			
Global	**<0.001**	**0.01**	
Thoracic v lumbar	0.06	0.94	
Thoracic v Sacral	**<0.001**	**0.05**	
Lumbar vs. Sacral	**<0.001**	**0.01**	

Supplemental Table 7. Bivariate correlations between Spinal meningeal diverticula and clinical/laboratory variables in ADPKD (significant p values are in **bold**).

Variables	Correlation Coefficient(r):	P-value
Age	0.05	0.39
Sex M=1, F=0	-0.28	**<0.001**
Height (cm)	-0.14	**0.02**
Weight (kg)	-0.24	**<0.001**
Body Mass Index (kg/m^2)	-0.20	**<0.001**
Body Surface Area (m^2)	-0.23	**<0.001**
Systolic (mmHg)	-0.04	0.50
Diastolic (mmHg)	-0.10	0.08
Estimated Glomerular Filtration Rate (ml/min/1.73m^2)	0.08	0.16
Blood Urea Nitrogen (mg/dl)	-0.13	**0.02**
Creatinine (mg/dl)	-0.18	**0.002**
Albumin (g/dl)	-0.02	0.78
Aspartate Transaminase (U/L)	0.07	0.23
Alanine Transaminase (U/L)	-0.07	0.27
Total Kidney Volume/Height (ml/m)	-0.19	0.001
Liver Volume/Height (ml/m)	-0.09	0.51
Spleen Volume/Height (ml/m)	-0.16	**0.01**
Number of renal cysts	-0.12	**0.05**
Number of Hemorrhagic renal cysts	-0.15	**0.01**
Number of liver cysts	0.05	0.44
Pancreatic cysts	-0.06	0.29
Pleural effusion	0.02	0.77
Severe Headache	0.13	**0.03**
PKD1/2 Mutation	0.02	0.68

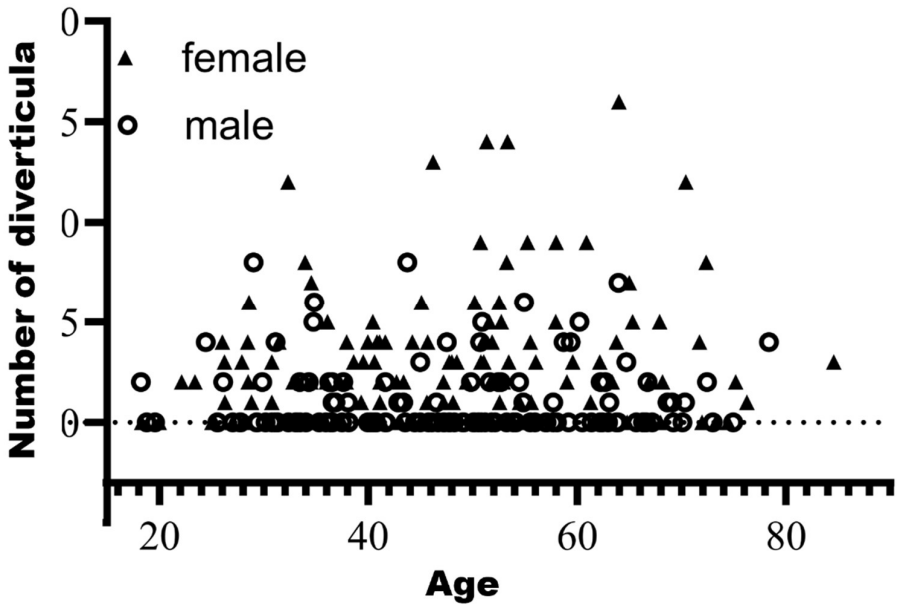
Supplemental Table 8. Demographic and laboratory data in 285 ADPKD patients and 50 ADPKD patients with 10+ years of follow-up. Categorical variables are given as mean + standard deviation and or median (Interquartile range). Ordinal variables are shown as number and %. Significant p values are in **bold**.

Demographic Data	ADPKD Subjects *(n=285)*	Follow-up ADPKD Subjects *(n=50)*	P-value
Spinal meningeal diverticula present	145/285 (51%)	32/50 (64%)	0.08
Age	47 (37, 56)	46.8 (38, 56)	>0.9
Sex: Male	132 (46%)	20 (41%)	0.47
Race			0.33
White	239 (84%)	46 (92%)	
Black	12 (4%)	02 (4%)	
Asian	22 (7%)	01 (2%)	
Native American	01 (1%)	01 (2%)	
Unknown	11 (4%)	00 (0%)	
Height (cm)	170 (163, 179)	170 (163, 180)	0.77
Weight (kg)	75 (64, 88)	70 (58, 83)	0.08
Body Mass Index (kg/m^2)	25.1 (22.5, 28.5)	23.6 (21.6, 27.8)	**0.03**
Body Surface Area (m^2)	1.88 (1.70, 2.06)	1.80 (1.62, 2.04)	0.18
Systolic (mmHg)	120 (112, 130)	118 (110, 130)	0.23
Diastolic (mmHg)	80 (72, 86)	79 (73, 83)	0.71
Estimated Glomerular Filtration Rate ($ml/min/1.73m^2$)	63 (44, 87)	57 (44, 82)	0.43
Blood Urea Nitrogen (mg/dl)	20 (15, 27)	20 (14, 27)	0.43
Creatinine (mg/dl)	1.1 (0.9, 1.5)	1.1 (0.9, 1.5)	0.17
Albumin (g/dl)	4.3 (4.2, 4.5)	4.4 (4.2, 4.5)	0.07
Aspartate Transaminase (U/L)	23 (20, 27)	24 (21, 28)	0.72
Alanine Transaminase (U/L)	20 (17, 27)	20 (17, 26)	0.57
Total Kidney Volume/Height (ml/m)	760 (427, 1302)	773 (381, 1160)	0.06
Liver Volume/Height (ml/m)	1007 (852, 1250)	1006 (854, 1358)	0.62
Spleen Volume/Height (ml/m)	138 (107, 185)	135 (107, 166)	0.25
Number of Renal cysts	400 (200, 600)	200 (124, 475)	0.15
Number of Hemorrhagic renal cysts	22 (7, 65)	12 (0, 56)	0.07
Number of Liver cysts	100 (10, 200)	100 (5, 200)	0.41
Pancreatic cysts	66/285 (23%)	8/50 (16%)	0.26
Seminal Mega-vesicle (male only)	34/132 males (26%)	7/20 males (35%)	0.38
Prostate cysts	30/132 males (23%)	6/20 males (30%)	0.47
Pleural effusion	59/285 (21%)	5/50 (10%)	0.08

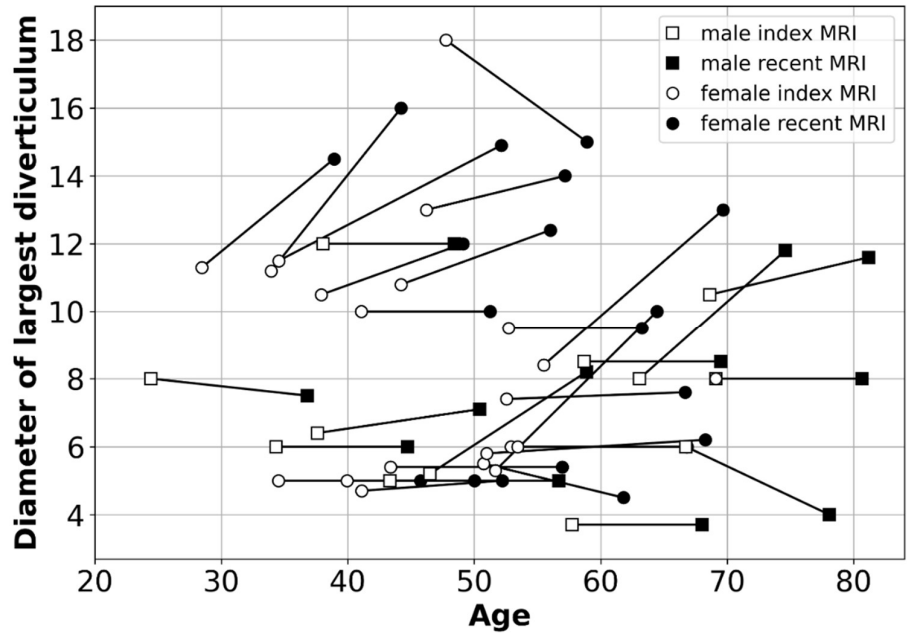
Supplemental Table 9. Demographic and laboratory data in 32 ADPKD patients with spinal meningeal diverticula and 10+ years of follow-up organized by spinal meningeal diverticulum diameter increasing >10%, decreasing by >10% or no change. Categorical variables are given as mean + standard deviation and or median (Interquartile range). Ordinal variables are shown as number and %. Significant p values are in **bold**.

Variable	Cyst increases *(n=11)*	Cyst decreases *(n=3)*	No change in cyst diameter *(n=18)* *	p-value
Age	44 (36, 54)	51 (49, 59)	45 (40, 53)	0.44
Sex: Male	4 (37%)	1 (33%)	7 (39%)	>0.9
Race: White	10 (91%)	3 (100%)	17 (94%)	>0.9
Height (cm)	169 (162, 180)	167 (165, 174)	171 (165, 176)	>0.9
Weight (kg)	63.5 (54, 88)	74.8 (70.5, 75)	69.2 (62, 82)	0.90
Body Mass Index (kg/m2)	22.2 (20.1, 26.7)	23.8 (23.4, 26)	24.1 (22.9, 25.1)	0.60
Body Surface Area (m2)	1.73 (1.56, 2.14)	1.81 (1.75, 1.94)	1.82 (1.68, 2.02)	>0.9
Systolic (mmHg)	114 (106, 130)	113 (112, 123)	119 (114, 128)	>0.9
Diastolic (mmHg)	79 (72, 80)	76 (74, 87)	80 (75, 84)	0.87
Estimated Glomerular Filtration Rate (ml/min/1.73m2)	61 (43, 89)	53 (42, 57)	57 (50, 67)	0.52
Blood Urea Nitrogen (mg/dl)	20 (15, 25)	23 (22, 30)	21 (14, 30)	0.63
Creatinine (mg/dl)	1.1 (0.8, 1.5)	1.1 (1.0, 1.6)	1.2 (1.0, 1.4)	0.81
Albumin (g/dl)	4.3 (4.2 ,4.4)	4.4 (4.3, 4.5)	4.4 (4.2, 4.6)	0.90
Aspartate Transaminase (U/L)	23 (22, 27)	23 (21, 24)	21 (17, 28)	>0.9
Alanine Transaminase (U/L)	19 (18, 21)	23 (21, 24)	21 (17, 28)	0.83
Total Kidney Volume/Height (ml/m)	403 (312, 817)	997 (957, 2903)	820 (456, 1440)	0.16
Liver Volume/Height (ml/m)	946 (705, 1016)	898 (806, 1731)	1003 (876, 1378)	0.30
Spleen Volume/Height (ml/m)	142 (105, 156)	154 (121, 163)	148 (115, 179)	0.90
Number of Renal cysts	200 (170, 378)	400 (230, 600)	200 (125, 550)	0.63
Number of Hemorrhagic renal cysts	21 (6, 50)	43 (22, 59)	13 (1, 65)	>0.9
Number of Liver cysts	100 (10, 125)	50 (26, 525)	100 (13, 500)	0.46
Pancreatic cysts	2/11 (20%)	1/3 (33%)	2/18 (10%)	0.60
Seminal Mega-vesicle (male only)	2/4 (50%)	0/1 (0%)	4/7 (57%)	0.80
Prostate cysts (male only)	2/4 (50%)	0/1 (0%)	3/7 (43%)	0.80
Pleural effusion	1/11 (9%)	0/3 (0%)	3/18 (17%)	0.56
Severe Headache	5/11 (45%)	0/3 (0%)	4/18 (22%)	0.20
PKD Mutation Genotype Data Available	9/11 (82%)	2/3 (67%)	14/18 (78%)	0.85
PKD1 mutation (%): PKD2 (%)	8/9 (89%): 1/9 (11%)	0/2 (0%): 2/2 (100%)	10/14 (71%): 4/14 (29%)	0.17

SUPPLEMENTAL FIGURES



Supplemental FIG 1. The relationship between the age at index scan and the number of spinal meningeal diverticula in ADPKD patients.



Supplemental FIG 2. Progression of spinal meningeal diverticulum size in 32 ADPKD patients with 10+ years of follow-up.

STROBE Statement

	Item No.	Recommendation	Page No.	Relevant text from manuscript
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1	Retrospective
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1	Correlation analysis, spinal meningeal diverticula were more prevalent in ADPKD
Introduction				
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	2	ADPKD is a multi-organ disorder with prior reported association with spinal meningeal diverticula as well in a few case reports
Objectives	3	State specific objectives, including any prespecified hypotheses	2	Evaluation of prevalence of spinal meningeal diverticula in ADPKD
Methods				
Study design	4	Present key elements of study design early in the paper	2	Retrospective cross-sectional
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	2	Retrospective analysis of clinical and imaging data acquired from 2003 to 2023 for PKD Repository
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	2	Participants were selected based on diagnosis of ADPKD and were enrolled in PKD repository.
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	2	Age/sex-matched controls without ADPKD were identified from electronic medical records. There was 1 control per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	3,4	Correlation coefficient, Pairwise Cohen Kappa, intraclass correlation coefficient
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	3,4	See Statistical Methods

Bias	9	Describe any efforts to address potential sources of bias	2,3	Age/sex-matched controls equal to ADPKD subjects. Blinding to all the patient's information
Study size	10	Explain how the study size was arrived at	2	Retrospective exploratory, we used all available cases

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to

Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	3	"For normally distributed continuous variables (assessed by Shapiro-Wilk Test), mean and standard deviation (SD) were reported. For non-normal distributions, median and interquartile range were reported. Frequency and percentage were calculated for categorical variables. For two-group matched continuous variables, a paired t-test was used to assess the statistical significance. For multi-group continuous variables, ANOVA was used to assess statistical significance. For categorical variables, Chi-square or Fisher's Exact test was used to assess statistical significance depending on sample size. Inter-observer agreement for identifying spinal meningeal diverticula and the number of spinal meningeal diverticula was assessed using Pairwise Cohen Kappa and intraclass correlation coefficient (ICC), respectively."
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	3,4	Bivariate analysis was used to estimate the correlation between the presence of spinal meningeal diverticula and age, gender, height, weight, body mass index, body surface area, blood pressure, blood urea nitrogen, creatinine, estimated glomerular filtration rate, albumin, aspartate transaminase, alanine transaminase, height-adjusted total kidney volume, height-adjusted total liver volume, height-adjusted total spleen volume, number of renal cysts, number of haemorrhagic renal cysts, number of liver cysts, number of pancreatic cysts, pleural effusion, severe headache and

				PKD genotype. The variables that had significance (i.e., $p<0.05$) were used in a multivariable linear regression analysis to assess their effect after adjusting for the other variables. The analysis was performed using GraphPad Prism software version 10.2.0(392)."
		(*b*) Describe any methods used to examine subgroups and interactions	7	Follow-up group
		(*c*) Explain how missing data were addressed		NA
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed		NA
		Case-control study—If applicable, explain how matching of cases and controls was addressed		NA
		Cross-sectional study—If applicable, describe analytical methods taking account of sampling strategy		NA
		(*e*) Describe any sensitivity analyses		NA
Results				
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	4,6,7	ADPKD subjects (a) 319 eligible and examined, 285 included in study and analysed. 50 ADPKD subjects with follow-up period of 10 or more years Control subjects (b) A control group of 285 subjects without ADPKD controlled for age and sex. No follow-up in control group.
		(b) Give reasons for non-participation at each stage	2	FIG 1
		(c) Consider use of a flow diagram	2	"FIG 1. Patient Flow Chart."
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	4	"Abdominal MRI results were available in 285 ADPKD subjects (Median age 47 [37,56], Female 54%, White 84%) and a control group without ADPKD controlled for age and sex (FIG 1, Online Supplemental Data). As expected, the ADPKD group had higher diastolic blood pressure, blood urea nitrogen and creatinine, lower estimated glomerular filtration rate and higher

				height-adjusted total kidney volume, height-adjusted total liver volume, height-adjusted total spleen volume, number of liver cysts and number of kidney cysts (Online Supplemental Data). The racial information was available for more ADPKD patients compared to control patients, reflecting willingness of ADPKD subjects to provide this information when enrolling in the Rogosin PKD repository. This resulted a significantly higher number of subjects with unknown race in the control population, (Supplemental Table 2). Indications for MRI in the control subjects included inflammatory bowel disease follow-up (n=99), indeterminate lesion (n=82), pain (n=51), cancer follow-up (n=23), liver disease (n=15), pancreatitis (n=7), hematuria (n=4), small bowel obstruction follow-up (n=2), endometriosis (n=1) and uterine leiomyomas (n=1). ”
		(b) Indicate number of participants with missing data for each variable of interest	2	FIG 1
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	7	“There were 50 ADPKD subjects who had 10+ years of MRI scans, median follow-up = 11.2 years [10.6,13.1]).”
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	7	Follow-up group results
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	4	Table 1
		Cross-sectional study—Report numbers of outcome events or summary measures	6	Table 2
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	6,7,14	Table 3, Supplemental Table 7
		(*b*) Report category boundaries when continuous variables were categorized		NA
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period		NA

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Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11,12,14,15	Supplemental Table 2-6 and Supplemental Table 8,9
Discussion				
Key results	18	Summarise key results with reference to study objectives	7,8	The prevalence of Spinal meningeal diverticula was 2.2 times higher in ADPKD than control group. Women were more likely than men to have spinal meningeal diverticula. Spinal meningeal diverticula were larger and more numerous in ADPKD. Spinal meningeal diverticula were larger and more common in sacral region.
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	8	"Limitations of this study include retrospective image analysis and failure of MRI sequences to cover the entire thoracic spine or cervical spine. This may have biased the study toward underreporting the true spinal meningeal diverticula prevalence."
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	7,8	Spinal meningeal diverticula are more prevalent in ADPKD, particularly in women.
Generalisability	21	Discuss the generalisability (external validity) of the study results	8	The analysis of "Large unselected population of ADPKD subjects in the PKD repository" is a valuable factor in the generalisability of the study results.
Other information				
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	8	"We acknowledge the support by The Rogosin Institute, the Department of Radiology of Weill Cornell Medicine, Weill Cornell Clinical and Translational Science Center (NIH Grant: UL1TR002384), and the Shaw Foundation."

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.