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Characteristics and outcomes in bladder Leiomyoma management: a systematic review of case reports and case series from the past 20 years

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Abstract

Introduction Bladder leiomyomas (LM) are uncommon, non-cancerous growths that originate from the smooth muscle cells of the bladder and constitute 0.5% of bladder tumor cases. This review aims to compile existing data and present a summary of bladder leiomyomas' characteristics, management, and related outcomes.

Method We conducted systematic review of studies that investigated bladder leiomyoma. Case studies or series describing individuals with bladder leiomyoma who underwent surgery and the outcomes were included. Four databases were used in our literature search, which was carried out until January 2024: PubMed, Proquest, EBSCOHost, and Google Scholar. We utilized MeSH terms such as "leiomyoma," "urinary bladder," and looked for synonyms of "bladder leiomyoma" in free text.

Results A total of 99 studies with 119 patients were included. Most reported bladder leiomyoma cases were female, accounting for 79.0% of all cases. While symptomatic patients primarily presented with lower urinary tract symptoms (LUTS) (59.7%), hematuria (24.4%), acute urine retention (11.8%), and about 16.8% of cases were incidentally detected. Storage-related symptoms were the most common LUTS (37.0%). Different diagnostic techniques were used, frequently combining CT (Computed Tomography), MRI (Magnetic Resonance Imaging), USG (Ultrasonography), and/or cystoscopy. Bladder leiomyomas were commonly found on the left lateral wall (26.9%) and the bladder neck (17.6%). In more than half of the cases (52.1%) the treatment techniques used were transurethral resection (TURBt/TUR). Fifteen out of 119 cases (12.6%) had recurrence or remain symptomatic. Symptomatic symptoms at first presentation and extended location are frequently found among recurrent or symptomatic cases after first management.

Conclusion Management of bladder leiomyoma should focus on the relief of symptoms and recurrence and be personalized based on the tumor characteristics, patient symptoms, and surgeon's expertise. Further investigation is necessary to fully understand the best course of treatment and long-term results for bladder leiomyomas. In

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particular, prospective trials with bigger participant pools and meticulously controlled factors should be the main emphasis of this research.

Keywords Bladder leiomyoma, Bladder neoplasm, Clinical characteristics, Management, Outcome of treatment

Introduction

Bladder leiomyomas (LM) are uncommon, benign tumors that develop from the smooth muscle cells of the bladder wall and constitute less than 0.5% of bladder tumour [1, 2]. Despite being benign, these tumors have the potential to restrict the bladder outlet if located near bladder outlet or neck, which can result in symptoms and consequences related to the urinary tract, including sensation of incomplete emptying, weak stream, urine retention, recurrent urinary tract infections, and renal impairment [3–5]. The symptoms vary according to the size and location of the tumor. Bladder LM may present as irritative symptoms, hematuria, and flank pain. Bladder tumor may cause disorganized contraction of bladder leading to lower urinary tract symptoms. Tumor near ureteral orifice might cause obstruction leading to ureteral colic, flank pain, and obstructive uropathy. There were also a few patients who had no symptoms at all [6].

Bladder LMs have been treated with a variety of modalities; they include transurethral resection, open surgical excision, and minimally invasive methods like laparoscopy and robotic-assisted surgery [6–8]. However, opinions on the best course of action for diagnosis and management are diverse. Furthermore, the majority of the literature on bladder LM therapy consists of case reports and short case series, which makes it challenging to draw definitive conclusions about the features and results of various treatment approaches.

As such, single case reports and small case series are excellent sources for understanding the subtleties of the clinical presentation and therapeutic strategies for this rare illness. To summarize the existing data and offer insights into the characteristics, approaches to treatment, and outcomes related to bladder LMs, a thorough analysis of case reports and case series is necessary. This study aims to better understand the clinical presentation, diagnostic strategy, treatment methods, and results of bladder LMs by methodically locating and examining published cases. This will help guide future research directions and support clinical decision-making.

Method

This systematic review was performed based on Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines and registered on PROSPERO (CRD42024506575).

Eligibility criteria

Research studies may be eligible for inclusion if they explore or document cases of patients diagnosed with bladder LM who underwent surgical management with reported post-management outcomes. The literature should be in the form of a case report or case series. Additionally, letters or correspondences providing information about bladder LM, with adequate details, will also be incorporated to prevent overlooking crucial information on this uncommon occurrence. Reports from the same health center and demographic will be excluded to ensure the avoidance of duplicate patient inclusions. Studies that were not reporting bladder LM or no management data were also excluded. Pediatric cases were also excluded due to the rarity in children. No year of publication was applied for identifying studies, however, only studies published in 2000 and over were included. We only included studies using English or Indonesian.

Search strategy

We employed four databases—PubMed, Proquest, EBSCOHost, and Google Scholar to conduct a literature search up to January 2024. Our search utilized the MeSH term (“urinary bladder” AND “leiomyoma”) OR free text word of “bladder leiomyoma” and its word variants (listed in Supplementary File 1). Two authors (AH and SKL) independently screened research titles to exclude studies that did not meet eligibility criteria, and subsequently, selected studies underwent abstract and full-text reviews (Fig. 1). Any disagreements between the two authors were resolved through discussion with a third and fourth author (JCP and SPH).

Data selection, collection, and extraction

The data were extracted by two independent co-authors and double-checked by the third author to ensure the data were matched and organized. The following information was extracted from the selected studies: author, study year, country, study design, duration of follow-up, number of patient(s), age, complaints, diagnostic data, location of the tumor, size of the tumor, presence of comorbidity, management, and outcome of the patient (quality of life, residual symptoms, urodynamic studies, and complications).

Quality assessment

We used The Joanna Briggs Institute (JBI) critical appraisal checklist designed for case series and case reports to assess the quality of the studies.

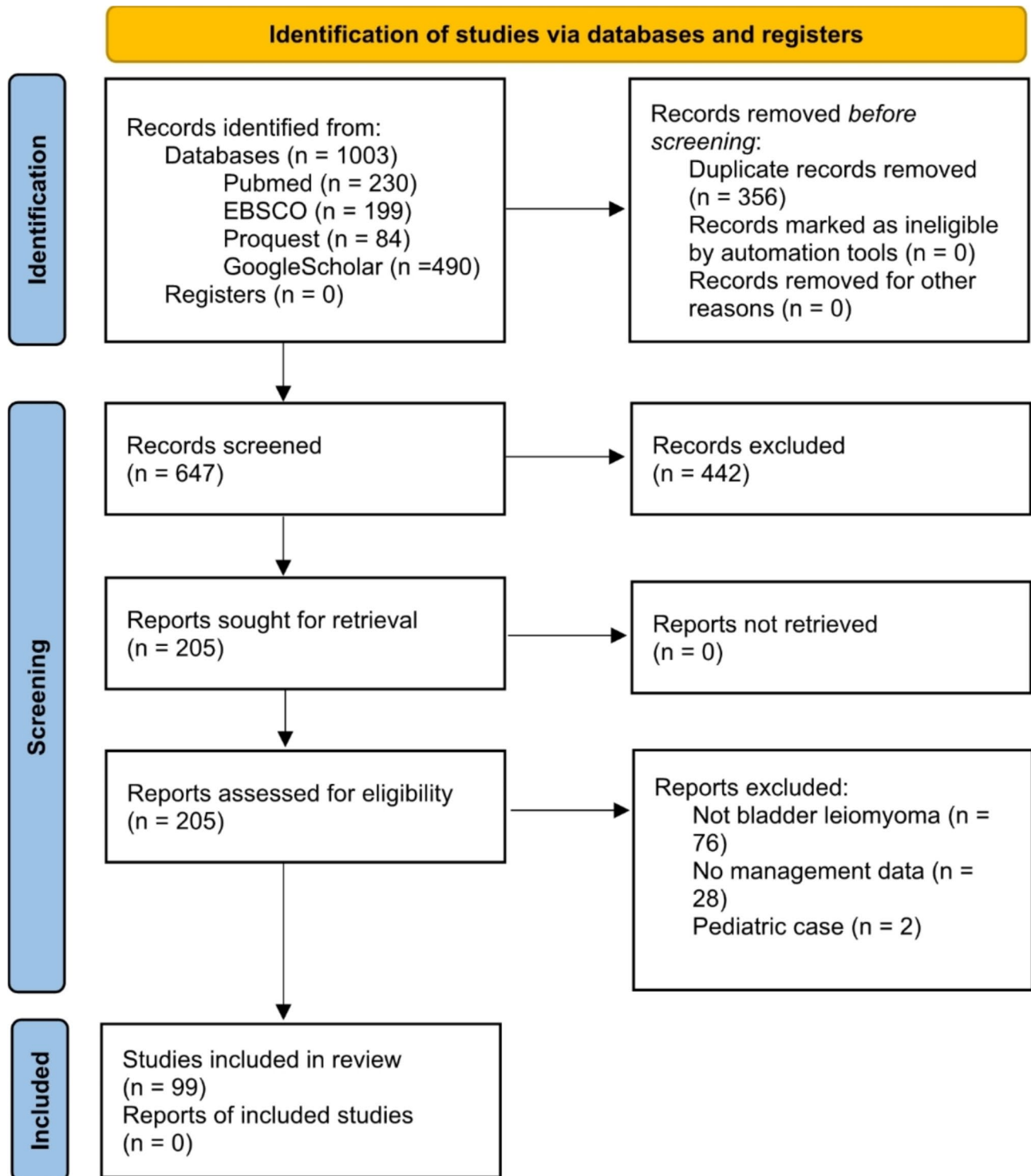


Fig. 1 PRISMA flow diagram 2020

Results

A total of 1003 studies were retrieved from four databases and screened independently by two co-authors resulting in 99 studies eventually included in this review (Fig. 1) [2, 3, 5–101]. All included cases are shown in Table 1. The

total number of patients included in this review is 119 patients, with ages ranging from 22 to 75 years (median 43) (Table 2).

Most of the reported cases were female, which comprised 79.0% of total cases. A total of 16.8% cases were

Table 1 Characteristics of included studies

Author	Country	Year	Pa-tient No.	Age	Sex	Symptoms	Imaging	Location	Size	Management	Follow-up	LOS	Outcome
Gaynor-Krupnick, et al.	US	2004	1	50	F	LUTS (storage)	CT, MRI, Cystoscopy, VCUG	Bladder Neck	3.0 cm (d)	TURBt/TUR	NR	NR	NR
Ninan et al.	US	2005	1	61	M	Incidental	CT, Cystoscopy	Ureteric Orifice (right)	1.0 cm (d)	Cystoscopic enucleation	6 months	NR	Symptom-free
Sawada et al.	Japan	2005	1	47	M	Incidental	CT, MRI, USG, Cystoscopy	Anterolateral Wall (left)	2.0 × 2.0 cm	TURBt/TUR	13 months	NR	Symptom-free & no recurrence
Chung et al.	Taiwan	2006	1	47	F	LUTS (storage), Hematuria	CT, USG, Cystoscopy	Dome	5.0 × 3.5 × 3.0 cm	TURBt/TUR, Partial Cystectomy (Laparoscopic)*	NR	10 days	Persistent symptoms after first procedure, but symptom-free after the second procedure.
Lee et al.	Taiwan	2006	1	53	F	Flank Pain, Fever	CT, Cystoscopy, IVP	Not Specified	8.0 cm (d)	Cystostomy (Open)	1 month	NR	Symptoms-free & no recurrence
Lin et al.	Taiwan	2006	1	35	F	LUTS, Abdominal Pain	CT, MRI, Cystoscopy, VCUG	Anterior Bladder Wall	8.0 cm (d)	Partial Cystectomy (Open)	3 months	NR	Small capacity of the bladder (240 mL) with right VUR (grade 2) at 1 month
Horton et al.	US	2007	1	73	F	LUTS (storage)	MRI	Dome	2.6 × 2.3 × 2.1 cm	TURBt/TUR	1 year	NR	Symptoms-free & no recurrence
Metzdorf et al.	US	2007	1	59	F	LUTS (voiding), Abdominal Pain	CT, Cystoscopy	Anterolateral Wall (left)	3.0 cm (d)	Open Local Excision	NR	NR	NR
Bai et al.	South Korea	2007	1	55	F	LUTS	USG	Posterolateral Wall (right)	4.0 cm (d)	TURBt/TUR	NR	NR	No recurrence
Chatzi-georgiou et al.	Germany	2008	1	36	F	LUTS (storage), Flank Pain	CT, USG, Cystoscopy	Lateral Wall (left)	5.5 × 5.0 × 3.2 cm	Open Local Excision	3 months	NR	Symptom-free
Sudhakar et al.	Bahrain	2008	1	45	F	LUTS	CT, USG, Cystoscopy, IVP	Lateral Wall (left)	10.0 × 8.0 × 7.0 cm	Partial Cystectomy (Open)	NR	NR	NR
Bhuiyan et al.	Malaysia	2008	1	30	F	LUTS, Hematuria	USG, CT	Posterior Floor	NR	Partial Cystectomy (Open)	NR	NR	NR
Farouk et al.	Pakistan	2008	1	65	M	LUTS (storage), Hematuria	CT, USG, Cystoscopy, Plain Abdominal X-ray	Lateral Wall (left)	4.2 × 1.9 cm and 1.7 × 2.2 cm	TURBt/TUR	3 month	NR	NR
Castillo, et al.	Chile	2008	1	38	M	Pelvic Pain	CT	Anterolateral Wall (left)	2.0 cm (d)	Partial Cystectomy (Laparoscopic)	NR	NR	NR
Hong et al.	South Korea	2009	1	45	F	LUTS (storage), Palpable Mass	USG	Dome	7.0 × 7.0 cm	Laparoscopic Enucleation	4 months	3 days	Symptom-free
Nazir et al.	India	2009	1	30	F	AUR, LUTS (storage), Hematuria	CT, USG, Cystoscopy	Anterior Bladder Wall	NR	Partial Cystectomy (Laparoscopic)	1 year	NR	Symptom-free
Matsushima et al.	Japan	2010	1	56	F	AUR, LUTS	MRI, USG, Cystoscopy	Bladder Neck	2.7 cm (d)	TURBt/TUR	1 week	NR	Symptom-free

Table 1 (continued)

Author	Country	Year	Pa-tient No.	Age	Sex	Symptoms	Imaging	Location	Size	Management	Follow-up	LOS	Outcome
Sellaturay et al.	UK	2010	1	63	F	AUR, Palpable Mass, AUB, Pelvic Pain	MRI, Cystoscopy	Bladder Neck	3.0 cm (d)	TURBt/TUR	18 months	NR	Symptom-free
Park et al.	South Korea	2010	1	42	F	Hematuria	CT, USG	Lateral Wall (left)	5.5 cm (d)	TURBt/TUR	54 months	NR	Recurrence occurred and follow up TUR performed.
	South Korea	2010	2	41	F	Incidental	CT, USG	Lateral Wall (left)	3.0 cm (d)	TURBt/TUR	7 months	NR	No recurrence
	South Korea	2010	3	47	F	LUTS (storage)	CT, USG	Trigone	NA	TURBt/TUR	77 months	NR	Recurrence and treated with Enucleation.
	South Korea	2010	4	24	F	LUTS (storage)	CT, USG	Lateral Wall (left)	7.0 cm (d)	Partial Cystectomy (Laparoscopic)	38 month	NR	No recurrence
	South Korea	2010	5	36	F	LUTS	CT, USG	Bladder Neck	3.5 cm (d)	Partial Cystectomy (Laparoscopic)	39 month	NR	No recurrence
	South Korea	2010	6	65	F	Incidental	CT, USG	Anterior Bladder Wall	4.7 cm (d)	TURBt/TUR	3 month	NR	No recurrence
	South Korea	2010	7	53	F	LUTS	CT, USG	Lateral Wall (right)	4.0 cm (d)	Transvesical Enucleation (Open)	3 month	NR	No recurrence
	South Korea	2010	8	34	F	Incidental	CT, USG	Lateral Wall (right)	2.4 cm (d)	TURBt/TUR	1 month	NR	No recurrence
	South Korea	2010	9	50	F	LUTS	CT, USG	Ureteric Orifice (left)	3.2 cm (d)	TURBt/TUR	14 month	NR	No recurrence
Paul et al.	India	2010	1	22	F	LUTS	USG, Cystoscopy	Not Specified	7.0 × 5.3 × 3.0 cm	Open Local Excision	NR	2 days	NR
Singh et al.	India	2011	1	35	F	Hematuria	CT, USG, Cystoscopy	Lateral Wall (left)	5.0 × 4.5 cm	Laparoscopic Enucleation	1 year	NR	Symptoms-free & no recurrence
Bullock et al.	Jamaica	2011	1	42	F	LUTS (voiding)	CT, MRI, USG	Lateral Wall (left)	4.0 cm (d)\	TURBt/TUR	NR	NR	Recurrent urinary tract infection, patient was planned for complete excision
Fang et al.	Taiwan	2011	1	51	M	LUTS (storage)	CT, MRI, Cystoscopy, Plain Abdominal X-ray	Lateral Wall (right)	6.5 × 6.5 × 6.0 cm	TURBt/TUR	NR	NR	Symptom-free
Tupikowski et al.	Poland	2011	1	29	F	AUR	MRI, USG, Cystoscopy	Bladder Neck	4.5 cm (d)	TURBt/TUR	6 months	1 day	No recurrence
Kaviani et al.	Iran	2012	1	46	F	Palpable Mass, LUTS (storage)	CT, MRI, USG, Cystoscopy	Bladder Neck	3.0 × 4.0 cm	Partial Cystectomy (Open)	2 years	4 days	No recurrence
Erdem et al.	Turkey	2012	1	49	F	Incidental	MRI, USG, Cystoscopy	Lateral Wall (left)	3.0 × 2.5 × 2 cm	TURBt/TUR	NR	NR	NR
Ortiz et al.	Colombia	2012	1	71	F	LUTS (storage)	CT, MRI, USG, Cystoscopy	Anterolateral Wall (right)	4.0 cm (d)	Partial Cystectomy (Laparoscopic)	1 year	NR	Improved symptoms

Table 1 (continued)

Author	Country	Year	Pa-tient No.	Age	Sex	Symptoms	Imaging	Location	Size	Management	Follow-up	LOS	Outcome
Barayan et al.	Saudi Arabia	2012	1	62	F	LUTS (storage)	CT, USG, Cystoscopy	Anterior Bladder Wall	1.7×1.1×0.8 cm	Cystoscopic Enucleation	12 months	NR	Persistent urgency which was controlled by oxybutanin 5 mg twice a day
Khater et al.	Beirut	2013	1	41	F	Hematuria, Flank Pain, LUTS (storage)	CT, USG	Lateral Wall (left)	6.0×4.2 cm	TURBt/TUR	NR	NR	NR
Ghadian et al.	Iran	2013	1	42	F	Hematuria	CT, Cystoscopy	Trigone and Bladder Neck	Multiple tumor weighted 170 g	TURBt/TUR	NR	NR	NR
Agrawal et al.	India	2014	1	45	F	AUR, AUB	USG, Cystoscopy	Bladder Neck	1.4 cm (d)	TURBt/TUR	6 months	NR	Symptom-free & no recurrence
Jain et al.	India	2014	1	42	F	LUTS (storage), Suprapubic Pain	USG, CT, Cystoscopy	Lateral Wall (left)	6.0×4.0 cm	Open Local Excision	36 months	NR	Symptom-free & no recurrence
	India	2014	2	46	F	LUTS, Hematuria	CT, MRI, USG, Cystoscopy	Interureteric ridge	4.0×3.0×2.0 cm	TURBt/TUR	6 months	NR	Symptom-free & no recurrence
Musayev et al.	Azerbaijan	2014	1	55	M	Incidental	CT, USG, Cystoscopy	Lateral Wall (left)	2.0×2.5×3.0 cm	Partial Cystectomy (Open)	25 months	3 days	Symptom-free
Chatterjee et al.	India	2014	1	35	F	Dyspareunia, Palpable Mass	CT, USG, Cystoscopy	Posterior Floor	6.0×4.0 cm	Open Local Excision	12 months	NR	Symptom-free & no recurrence
Dewaele et al.	Belgium	2014	1	26	F	LUTS (storage), Palpable Mass	MRI, USG, Cystoscopy	Lateral Wall (right)	5.0 cm (d)	Transvesical Enucleation (Open)	15 months	NR	Symptom-free
Rosenblatt et al.	Brazil	2014	1	60	F	LUTS (storage), Pelvic Discomfort	CT, MRI, USG, Cystoscopy	Lateral Wall (left)	4.0 cm (d)	TURBt/TUR	7 months	3 days	Symptom-free & no recurrence
Vitagliano et al.	Argentina	2014	1	30	F	Incidental	CT, USG	Lateral Wall (right)	10.1 cm x 4.9 cm	Cystostomy (Laparoscopic)	NR	2 days	NR
Goktug et al.	Turkey	2014	1	27	M	LUTS (storage)	MRI, USG, Cystoscopy	Anterolateral Wall (left)	7.0×8.0 cm	TURBt/TUR	1 year	2 days	No recurrences
Dere et al.	Turkey	2015	1	41	M	Incidental	CT, Cystoscopy	Anterolateral Wall (left)	2.5×2.0×2.0 cm	Open Local Excision	3 months	NR	Symptom-free
Kalathia et al.	India	2015	1	55	F	LUTS (voiding), Palpable Mass, Abdominal Pain	MRI, USG, Cystoscopy, IVP	Lateral Wall (left)	6.76×5.1 cm	TURBt/TUR	3 months	1 day	Symptom-free & no recurrence
Gungor et al.	Turkey	2015	1	26	M	Premature Ejaculation	CT, USG, Cystoscopy	Dome	5.4×5.0 cm	TURBt/TUR, Partial Cystectomy (Laparoscopic)*	1 year	5 days	Residual tumor after 2 months, then undergo Partial Cystectomy. After followup, patient was symptom-free and has no recurrence.
Yin et al.	China	2015	1	22	F	Abdominal Pain	CT, USG, Cystoscopy	Bladder Neck	3.2×2.5 cm	Transvaginal Resection	24 months	NR	Symptom-free

Table 1 (continued)

Author	Country	Year	Pa-tient No.	Age	Sex	Symptoms	Imaging	Location	Size	Management	Follow-up	LOS	Outcome
Mehta et al.	India	2015	1	63	F	AUR	CT, USG, Cystoscopy	Lateral Wall (left)	4.3 × 4.0 cm	TURBt/TUR	NR	NR	NR
	India	2015	2	43	F	AUR, Hematuria	CT, USG, Cystoscopy	Cranial Wall	5.5 × 5.0 cm	TURBt/TUR	NR	NR	NR
Mendes et al.	Portugal	2016	1	22	F	LUTS (storage), Dyspareunia, Pelvic Discomfort	USG, Cystoscopy	Not Specified	1.6 × 1.1 × 0.6 cm	TURBt/TUR	NR	NR	Symptom-free
Itam et al.	UK	2016	1	56	M	AUR, LUTS (voiding), Hematuria and Palpable Mass	CT, MRI, Cystoscopy	Bladder Neck, Trigone	9.1 cm (d)	Transvesical Enucleation (Open)	6 weeks	6 days	Symptom-free & no recurrence
Xin et al.	China	2016	1	44	F	Dyspareunia	CT, USG, Cystoscopy	Trigone	7.3 × 6.1 × 5.8 cm	Open Local Excision	8 months	10 days	Symptom-free & no recurrence
Haddad et al.	Jordan	2016	1	37	M	LUTS (storage), Fever	CT, USG, Cystoscopy	Lateral Wall (left)	5.5 × 4.3 cm	TURBt/TUR	1 year	NR	Symptom-free
Caliskan et al.	Turkey	2017	1	39	M	Hematuria	USG, CT, Cystoscopy	Anterior Bladder Wall	4.8 × 6.2 cm	TURBt/TUR	6 months	NR	Symptom-free & no recurrence
Vijay et al.	India	2017	1	53	F	AUR, LUTS (storage), Hematuria	CT, USG, Cystoscopy	Lateral Wall (left)	5.0 × 5.0 cm	TURBt/TUR	6 months	NR	Symptom-free & no recurrence
Ameli et al.	Iran	2017	1	75	F	LUTS (storage), Colicky Pain, Flank Pain	CT, USG	Posterior Floor	4.0 cm (d)	TURBt/TUR	NR	NR	NR
Barlotta et al.	US	2017	1	31	M	Purulent drainage from the umbilicus	CT, Cystoscopy	Lateral Wall (left), Dome	6.5 cm (d)	Cystostomy (Laparoscopic)	4 months	7 days	Symptom-free
Chaker et al.	Tunisia	2017	1	43	F	Pelvic Pain	MRI, USG	Trigone	4.3 × 4.7 cm	Transvesical Enucleation (Open)	14 months	NR	Symptom-free & no recurrence
Dodia et al.	India	2017	1	35	F	LUTS (storage), Hematuria, Dysuria	MRI, USG	Lateral Wall (left)	3.3 × 4.3 cm	Transvesical Enucleation (Open)	NR	NR	NR
Gok et al.	Turkey	2017	1	46	F	LUTS	CT, USG, Cystoscopy	Junction between Bladder Neck dan Lateral Wall (left)	9.0 × 6.0 cm	TURBt/TUR	6 month	NR	Residual LUTS (storage) after first surgery. All complaints were resolved after second TURBt
Zachoval et al.	Czech Republic	2017	1	32	F	Incidental	USG, MRI	Anterior Bladder Wall	5.0 cm (d)	Open Local Excision	1 year	NR	Symptom-free & no recurrence
Danacioglu et al.	Turkey	2018	1	45	F	LUTS (storage)	CT, MRI, USG	Bladder Neck	2.5 × 2.0 × 1.5 cm	TURBt/TUR	NR	5 days	Symptom-free
Izzo et al.	Italy	2018	1	51	F	LUTS (storage)	USG, Cystoscopy	Posterior Floor	1.5 × 2.0 cm	TURBt/TUR	30 days	NR	Symptom-free

Table 1 (continued)

Author	Country	Year	Pa-tient No.	Age	Sex	Symptoms	Imaging	Location	Size	Management	Follow-up	LOS	Outcome
Juraski et al.	Brazil	2018	1	50	F	AUR, LUTS	MRI	Anterior Bladder Wall	3.7 × 3.7 × 3.1 cm	Partial Cystectomy (Laparoscopic)	45 days	NR	Symptom-free
Ahmed et al.	Iraq	2018	1	24	F	LUTS (storage), Hematuria	USG, Cystoscopy, IVP	Ureteric Orifice (left)	1.5 × 2.5 cm	TURBt/TUR	NR	NR	NR
He et al.	China	2018	1	47	F	LUTS (storage)	CT	Posterolateral Wall (left)	4.0 cm (d)	Partial Cystectomy (Open)	8 month	NR	Symptom-free
Li et al.	China	2018	1	34	F	Incidental	CT, USG, Cystoscopy	Lateral Wall (left)	4.0 cm (d)	TURBt/TUR	30 month	2 days	No recurrence
Ahmed et al.	China	2018	2	55	F	LUTS (storage)	CT, USG, Cystoscopy	Trigone	3.3 cm (d)	TURBt/TUR	21 month	2 days	No recurrence
He et al.	China	2018	3	54	F	Hematuria	CT, USG, Cystoscopy	Trigone	5.4 cm (d)	TURBt/TUR	13 month	2 days	No recurrence
He et al.	China	2018	4	46	F	LUTS (storage)	CT, USG, Cystoscopy	Lateral Wall (left)	6.7 cm (d)	TURBt/TUR	12 month	2 days	No recurrence
He et al.	China	2018	5	45	F	Incidental	CT, USG, Cystoscopy	Bladder Neck	2.4 cm (d)	TURBt/TUR	11 month	2 days	No recurrence
He et al.	China	2018	6	67	M	Incidental	CT, USG, Cystoscopy	Lateral Wall (left)	1.8 cm (d)	TURBt/TUR	2 month	2 days	No recurrence
Jain et al.	India	2019	1	32	F	LUTS (storage)	MRI, USG	Anterior Bladder Wall	7.0 × 6.0 cm	Open Local Excision	2 years	7 days	Symptom-free
Kolukcu et al.	Turkey	2019	1	41	M	Hematuria, Muscle pain and fatigue	CT, Cystoscopy	Lateral Wall (left)	2.0 cm (d)	TURBt/TUR	2 years	3 days	No recurrence
Mendoza et al.	Philippines	2019	1	50	M	Incidental	CT, USG, Cystoscopy	Lateral Wall (left)	4.5 × 3.9 × 4.2 cm	Partial Cystectomy (Open)	1 month	NR	Symptom-free
Yoshioka	Japan	2019	1	46	F	Incidental	MRI, USG, Cystoscopy	Lateral Wall (left)	7.6 × 7.0 cm	Laparoscopic Enucleation	18 months	7 days	Residual urinary frequency but decreasing & no recurrence
Elhend et al.	Morocco	2019	1	32	M	LUTS (storage), Flank Pain	CT, USG, Cystoscopy	Trigone	7.0 cm (d)	Transvesical Enucleation (Open)	NR	NR	NR
Elhend et al.	Morocco	2019	2	37	F	Hematuria, LUTS (storage), Pelvic Pain and Palpable Mass	CT, MRI, USG	Lateral Wall (left)	6.0 cm (d)	Transvesical Enucleation (Open)	NR	NR	NR
Mitchell et al.	US	2019	1	64	M	Hematuria	CT, MRI, Cystoscopy	Ureteric Orifice (left)	5.0 × 5.0 × 2.5 cm	TURBt/TUR	6 months	4 days	Symptom-free with 1.8 cm of residual tumor was noted.
Sodo et al.	Italy	2019	1	33	M	LUTS (storage), Pelvic Pain	CT, MRI, USG	Anterior Bladder Wall	6.0 × 5.0 × 4.0 cm	Partial Cystectomy (Laparoscopic)	9 months	7 days	Improved symptoms

Table 1 (continued)

Author	Country	Year	Pa-tient No.	Age	Sex	Symptoms	Imaging	Location	Size	Management	Follow-up	LOS	Outcome
Kumar et al.	India	2019	1	27	F	LUTS	MRI, USG, Cystoscopy	Bladder Neck	2.9×2.5×2.4 cm	TURBt/TUR	1 year	3 days	Symptom-free & no recurrence
	India	2019	2	30	F	AUR, LUTS (voiding)	CT, USG, Cystoscopy	Bladder Neck	2.7×1.6×1.7 cm	TURBt/TUR	1 year	3 days	Symptom-free & no recurrence
	India	2019	3	35	F	AUR, LUTS (voiding)	MRI, USG, Cystoscopy	Bladder Neck	3.7×2.6×3.1 cm	TURBt/TUR	1 year	3 days	Symptom-free & no recurrence
Delara et al.	US	2020	1	33	F	LUTS (storage), Abdominal Pain, AUB	MRI, Cystoscopy	Ureteric Orifice (left)	2.0×1.3×1.7 cm	TURBt/TUR	NR	0 day	NR
Godlewski et al.	Poland	2020	1	30	F	Incidental	USG, CT	Anterior Bladder Wall	1.5×0.5×2.5 cm	Cystostomy (Laparoscopic)	2 months	NR	Symptom-free
	Poland	2020	2	30	F	Hematuria	CT, USG	Ureteric Orifice (left)	3.1×3.1×2.8 cm	Partial Cystectomy (Laparoscopic)	10 days	NR	NR
Lu et al.	China	2020	1	40	F	LUTS (storage)	MRI, USG, Cystoscopy	Bladder Neck	4.0×3.4 cm	TURBt/TUR	6 months	NR	No recurrence
Mavridis et al.	Greece	2020	1	28	M	Incidental	CT, Cystoscopy	Lateral Wall (left)	3.3×2.7×2.2 cm	Open Retropubic Surgical Exploration	NR	NR	NR
Pramod et al.	Indonesia	2020	1	43	F	LUTS (storage), Hematuria, Pyuria	CT, USG	Posterior Floor	7.0×6.5×4.0 cm	Open transvesical excision	NR	3 days	NR
Vaizacchi et al.	Argentina	2020	1	45	F	AUR, LUTS	MRI, USG, Cystoscopy	Bladder Neck	3.6×4.6 cm	Transvesical Laparoscopy	60 months	2 days	Symptom-free
Zachariou et al.	Greece	2020	1	52	M	LUTS, Hematuria	CT, MRI, Cystoscopy	Trigone	4.1×2.4 cm	TURBt/TUR	12 month	NR	No recurrence
Alkharouf et al.	Ireland	2021	1	42	F	LUTS (storage), Hematuria, Dyspareunia	MRI	Trigone	4.5 cm (d)	Transvaginal Resection	3 months	2 days	Symptom-free
Asdemir et al.	Turkey	2021	1	53	F	Abdominal Pain	CT, Cystoscopy	Lateral Wall (left)	2.6 cm x 2.4 cm	TURBt/TUR	NR	5 days	NR
Wei et al.	China	2021	1	62	F	Incidental	CT, MRI, Cystoscopy	Lateral Wall (left)	2.9 cm × 2.4 cm	Partial Cystectomy (Laparoscopic)	6 months	NR	Symptom-free & no recurrence
Gorgorap-tis et al.	Greece	2021	1	61	F	LUTS (storage)	CT, USG	Bladder Neck	2.7 cm x 3.1 cm	TURBt/TUR	3 months	1 day	Symptom-free & no recurrence
Tosun et al.	Turkey	2021	1	23	F	Flank Pain, LUTS (storage)	MRI	Lateral Wall (right)	15.5 cm x 14.5 cm x 14 cm	Partial Cystectomy (Open)	8 years	6 days	Symptom-free & no recurrence
Al Solu-many et al.	Saudi Arabia	2021	1	50	F	Hematuria	CT, MRI	Anterolateral Wall (left)	7×5×3.5 cm	TURBt/TUR	1 year	8 days	Symptom-free
Moawad et al.	UAE	2021	1	33	F	Hematuria, Ab-dominal Pain	CT, MRI	Bladder Neck	7.6×7×6.5 cm	Open Local Excision	6 months	2 week	NR

Table 1 (continued)

Author	Country	Year	Patient No.	Age	Sex	Symptoms	Imaging	Location	Size	Management	Follow-up	LOS	Outcome
Bangash et al.	Pakistan	2021	1	52	F	LUTS, Abdominal Pain	CT, USG	Anterolateral Wall (left)	3.2 × 1.6 cm	TURBt/TUR, Intra-vesical Mitomycin-C	3 Year	1 day	Residual tumor with size 3 × 2 cm after 6 months. Re-TURBt was performed. After 3 years of follow-up, patient has no recurrence.
AlHalak et al.	Pakistan	2021	2	42	F	LUTS, Hematuria	CT, USG, Cystoscopy	Ureteric Orifice (left)	2.0 × 3.0 cm	TURBt/TUR and Single Dose Intra-vesical Mitomycin-C, followed by Partial Cystectomy (laparoscopic)*	3 year	1 day	Recurrence of tumor after 2 years sizing 2.0 × 3.0 cm. Partial cystectomy was done. After 1 year, patient was symptom-free & has no recurrence
AlHalak et al.	UAE	2022	1	24	F	LUTS (storage)	MRI, USG	Trigone	4.0 × 2.8 × 3.2 cm	TURBt/TUR	2 months	NR	Symptom-free & no recurrence
Kashkoush et al.	US	2022	1	38	F	AUR, LUTS (voiding), Suprapubic Pain, Nocturia	MRI, USG, Cystoscopy, CT	Bladder Neck	3.7 × 3.7 × 4.1 cm	TURBt/TUR	2 year	NR	LUTS (storage) persist after 1 year with recurrent lesion. Re-TUR was performed, however, residual tumor still persist after 1 more year of follow-up. patient opted out repeat TUR and her symptoms improved.
Nazari et al.	Iran	2022	1	50	F	LUTS, Abdominal Pain, AUB	MRI, USG, Cystoscopy	Posterior Floor to Dome	7.2 × 5.7 cm	Partial Cystectomy (Open), total abdominal hysterectomy (TAH), bilateral salpingo-oophorectomy (BSO)	1 year	3 days	Symptom-free & no recurrence
Stanescu et al.	UK	2022	1	53	F	LUTS (storage), Hematuria	CT, USG, Cystoscopy	Bladder Neck	1.5 cm (d)	TURBt/TUR	NR	NR	Symptom-free
AlAmri et al.	Saudi Arabia	2022	1	34	M	LUTS	USG, Cystoscopy	Anterolateral Wall (left)	1.5 × 1.1 cm	TURBt/TUR	2 weeks	5 days	Improved symptoms
Manoj et al.	India	2022	1	27	F	Flank Pain, Nausea and Vomiting	CT, MRI, USG, Cystoscopy	Anterolateral Wall (right)	3.3 × 2.0 cm	Partial Cystectomy (Laparoscopic)	10 days	5 days	NR
Abou-Bieh et al.	Egypt	2022	1	32	F	Hematuria, Suprapubic Pain	MRI	Bladder Neck	Unspecified	TURBt/TUR	NR	NR	NR
Victoria et al.	Philippines	2022	1	56	F	Abdominal Pain, Palpable Mass, Weightloss	CT, USG	Cranial Wall	11.0 × 9.0 × 7.5 cm	Partial Cystectomy (Open)	NR	7 days	Symptom-free

Table 1 (continued)

Author	Country	Year	Pa-tient No.	Age	Sex	Symptoms	Imaging	Location	Size	Management	Follow-up	LOS	Outcome
Baird et al.	US	2022	1	30	M	LUTS	CT, Cystoscopy	Ureteric Orifice (left)	4.1 × 2.9 × 3.4 cm	Transvesical Excision (laparoscopic)	NR	3 weeks	Symptom-free
Jakus et al.	Croatia	2023	1	44	F	Dyspareunia	CT, USG, Cystoscopy	Trigone	7.3 × 6.1 × 5.8 cm	TURBt/TUR	8 months	10 days	Symptom-free
Lamy et al.	Saudi Arabia	2023	1	36	F	LUTS (storage), Abdominal Pain	CT, MRI, Cystoscopy	Lateral Wall (left)	3.0 × 2.0 cm	Partial Cystectomy (Open)	26 days	1 day	Urinary frequency and nocturia with negative urine culture
Lim et al.	Australia	2023	1	41	F	LUTS (storage), Anteromedial thigh pain	CT, MRI, USG, Cystoscopy	Lateral Wall (left)	4.4 × 4.2 × 2.8 cm	Open Local Excision	NR	NR	NR
Ali et al.	UK	2023	1	51	F	LUTS (storage), Hematuria	CT	Lateral Wall (left) extending to Bladder Neck	2 × 2.3 × 2 cm	Robotic-Assisted Transvesical Excision	14 month	2 weeks	Symptom-free
Taniuchi et al.	Japan	2023	1	47	M	Incidental	CT, MRI	Lateral Wall (left)	8.7 cm (d)	Partial Cystectomy (Laparoscopic)	1 year	NR	NR
Bala-wender et al.	Poland	2023	1	31	M	Incidental	MRI, USG, Cystoscopy	Lateral Wall (left)	2.2 × 2.0 cm	Laparoscopic Resection	NR	NR	NR

F, female; M, male; LUTS, lower urinary tracts symptoms; CT, computed tomography; MRI, magnetic resonance imaging; VCUG, voiding cystourethrography; d, diameter; TURBt, transurethral resection of bladder tumor; TUR, transurethral resection; NR, not reported; US, United States; UK, United Kingdom; UAE, United Arab Emirates; USG, ultrasonography; IVP, intravenous pyelography; AUB, abnormal uterine bleeding

*Second procedure

Table 2 Patient’s characteristics

Characteristics	Total		Outcome			
	N	%	Asymptomatic and no recurrence		Symptomatic or recurrence	
	N	%	N	%	N	%
Total patients	119	100	75	100	15	100
Age (range, median)	22 to 75 years, 43		6 to 73 years, 45		26 to 64, 46	
Sex						
Male	25	21.0	17	22.7	2	13.3
Female	94	79.0	58	77.3	13	86.7
Symptoms						
AUR	14	11.8	11	14.7	1	6.7
LUTS	71	59.7	45	60.0	11	73.3
LUTS (predominantly Storage)	44	37.0	28	37.3	5	33.3
LUTS (predominatly Voiding)	7	5.9	4	5.3	2	13.3
Hematuria	29	24.4	12	16.0	5	33.3
Dyspareunia	5	4.2	5	6.7	0	0.0
Mass	9	7.6	8	10.7	0	0.0
Abdominal Pain	11	9.2	7	9.3	3	20.0
Suprapubic Pain	3	2.5	1	1.3	1	6.7
Flank Pain	7	5.9	3	4.0	0	0.0
Pelvic pain/discomfort	7	5.9	5	6.7	0	0.0
AUB	4	3.4	3	4.0	0	0.0
Incidental (asymptomatic)	20	16.8	14	18.7	1	6.7
Others (fever, premature ejaculation, purulent drainage, thigh pain, muscle fatigue/pain, pyuria, nocturia and weightloss)	8	6.7	5	6.7	2	13.3
Diagnostic modalities						
CT Scan	86	72.3	50	67.7	14	93.3
MRI	48	40.3	31	41.3	6	40.0
USG	89	74.8	58	77.3	11	73.3
Cystoscopy	79	66.4	51	68.0	10	66.7
Others (voiding cystourethrography, plain abdominal x-ray, IVP)	6	5.0	3	4.0	1	6.7
Tumor Location						
Bladder Neck	21	17.6	16	21.3	1	6.7
Trigone	10	8.4	8	10.7	1	6.7
Ureteric orifice (right)	1	0.8	1	1.3	0	0.0
Ureteric orifice (left)	7	5.9	2	2.7	2	13.3
Interureteric ridge	1	0.8	1	1.3	0	0.0
Posterior floor	5	4.2	2	2.7	0	0.0
Anterolateral wall (right)	2	1.7	1	1.3	0	0.0
Anterolateral wall (left)	8	6.7	5	6.7	1	6.7
Lateral wall (right)	6	5.0	5	6.7	0	0.0
Lateral wall (left)	32	26.9	16	21.3	4	26.7
Posterolateral Wall (right)	1	0.8	1	1.3	0	0.0
Posterolateral Wall (left)	1	0.8	1	1.3	0	0.0
Anterior wall	10	8.4	8	10.7	2	13.3
Dome	4	3.4	2	2.7	2	13.3
Cranial wall	2	1.7	1	1.3	0	0.0
Others (junction between bladder neck and left lateral wall, lateral wall and dome, lateral wall and bladder neck, posterior floor to dome, trigone to bladder neck)	5	4.2	3	4.0	2	13.3

Table 2 (continued)

Characteristics	Total		Outcome			
	N	%	Asymptomatic and no recurrence		Symptomatic or recurrence	
			N	%	N	%
Not specified	3	2.5	1	1.3	0	0.0
Management (first intervention)						
TURBt/TUR	62	52.1	40	53.3	10	66.7
Cystoscopic Enucleation	2	1.7	1	1.3	1	6.7
Open Local Excision	11	9.2	7	9.2	0	0.0
Transvesical Enucleation (open)	7	5.9	4	5.3	0	0.0
Transvesical Excision (open)	1	0.8	0	0.0	0	0.0
Transvesical Excision (laparoscopic)	1	0.8	1	1.3	1	6.7
Partial Cystectomy (laparoscopic)	11	9.2	7	9.3	0	0.0
Partial Cystectomy (open)	11	9.2	7	9.3	2	13.3
Laparoscopic Enucleation	3	2.5	2	2.7	1	6.7
Laparoscopic Resection	1	0.8	0	0.0	0	0.0
Cystostomy (open)	1	0.8	1	1.3	0	0.0
Cystotomy (laparoscopic)	3	2.5	2	2.7	0	0.0
Transvaginal Resection	2	1.7	2	2.7	0	0.0
Transvesical Laparoscopy	1	0.8	1	1.3	0	0.0
Open Retropubic Surgical Exploration	1	0.8	1	1.3	0	0.0

found incidentally (asymptomatic), while in symptomatic patients, most experienced LUTS (59.7%), followed by hematuria (24.4%), acute urinary retention (11.8%), abdominal pain (9.2%), flank pain (5.9%), palpable mass (7.6%), pelvic pain or discomfort (5.9%), and abnormal uterine bleeding (3.4%). The most common type of LUTS experienced by the patients was predominantly storage type (37.0%).

Diagnostic modalities used in these reported cases were combinations of either USG, CT scan, MRI, or cystoscopy. All cases underwent pathology examination to determine the final diagnosis of bladder LM. There is no mismatch between preliminary biopsy and final pathology results. Some studies that did not undergo preliminary biopsy directly conducted excisional surgery for final pathology. Bladder LM is composed of smooth muscle fibers mixed with connective tissue without mitotic activity, cellular atypia, necrosis, or infiltration. Most of the bladder LMs were found on the left lateral wall (26.9%), bladder neck (17.6%), bladder trigone (8.4%), and anterior wall (8.4%), with a wide range of sizes ranging from 1.0 to 18 cm of the longest dimension (median 4.1 cm). More than half of the reported cases were managed by TURBt/TUR (52.1%), followed by partial cystectomy (18.4%), open local excision (9.2%), open transvesical enucleation (5.9%), laparoscopic enucleation (2.5%), and laparoscopic cystostomy (2.5%).

A total of 15 out of 119 cases had a recurrence or remained symptomatic, 75 patients did not have recurrence or symptoms, and the rest 29 patients did not have reported information regarding the final outcome

of the management (Table 2). Most were symptomatic at the beginning, only 6.7% were incidental findings and extending to more than one location. Ten out of 15 cases underwent TURBt/TUR (66.7%) and residual tumors were frequently found.

Discussion

The present systematic review synthesized data from 99 studies encompassing 119 patients diagnosed with bladder LM over the past two decades. Our findings highlight several key characteristics and outcomes pertinent to the management of this rare condition. Even if the precise etiology is still unclear, several important processes have been suggested with most research derived from uterine LM studies [102–104]. The intricate interaction of genetic, hormonal, and environmental variables is responsible for the pathogenesis of LM.

Demographics

Our analysis revealed a predominance of female cases, comprising 79% of the total cohort. The age range of affected individuals varied widely, spanning from 22 to 75 years, with a median age of 43 years. It frequently occurs in middle-aged women and rarely in young men. For pediatric cases, the youngest cases were from a 1-year-old boy and 6-year old boy [105, 106].

Diagnosis

Notably, a considerable proportion of cases (16.8%) were incidentally detected. Among symptomatic patients, lower urinary tract symptoms (LUTS) were the most

commonly reported clinical presentation, affecting 59.7% of cases (Table 2). Urinary retention occurs usually in bladder outlet tumours or large LMs.

It might be difficult to distinguish bladder LMs from bladder cancer for a variety of reasons. Clinical distinction is challenging since both illnesses frequently present identical symptoms, such as hematuria, lower urinary tract symptoms (LUTS), and pelvic pain. Moreover, mass lesions within the bladder in both entities may be detected by radiological imaging techniques, confounding the diagnosis even more. Thus, diagnostic evaluation typically involves a combination of imaging modalities such as ultrasonography (USG), computed tomography (CT) scan, magnetic resonance imaging (MRI), and cystoscopy to ascertain what lesion the clinicians are dealing with. In the end, histological analysis of tissue taken from a biopsy or surgical resection is required for a definite diagnosis of bladder LMs or bladder cancer, highlighting the significance of careful pathological assessment in clinical decision-making. Unlike uterine LM, bladder LM was never reported to transform into malignant leiomyosarcomas [107].

Urinary bladder usually investigated using USG through transabdominal route. On USG, LM usually characterized as having smooth-walled homogenous hypoechoic solid mass with thin echogenic surface [6]. A LM may show up on a CT scan as a homogeneous, pedunculated mass that lacks distinguishing characteristics from other bladder neoplasms. The visual characteristics of bladder LMs on MRI are determined by the presence of collagen and smooth muscle, just like uterine LMs. They often have variable degrees of dynamic enhancement and a uniform T2-hypointense and T1-hypointense look that resembles muscle tissue [108]. Furthermore, they might exhibit a “T2-weighted black-out” effect, which would show up as low signal intensity regions on diffusion-weighted MRI, hypointense areas on high b-value diffusion-weighted MRI, and hyperintense areas on ADC maps. In urothelial carcinoma, it frequently manifests as a strongly enhancing mass with limited dissemination that arises from the wall of the bladder. Non-muscle-invasive urothelial carcinomas are usually present as sessile or flat lesions that are only visible following a cystoscopy as erythema or anomalies of the mucosa. Interestingly, there is usually no thickening or abnormality in the surrounding bladder wall associated with these lesions. On occasion, papillary frond surfaces can show signs of calcification. Leiomyosarcoma typically appears as big, polypoid masses, usually near the bladder dome. It can be difficult to differentiate from a bladder LM since both lesions usually show low signal intensity on T2-weighted MRI. However, characteristics including poorly defined borders, invasion into neighboring structures, and necrotic patches can help differentiate

LM from leiomyosarcoma. As with the distinction between leiomyosarcomas and uterine LMs, testing for diffusion limitation can help separate bladder leiomyosarcomas from bladder LMs. The diagnostic accuracy of bladder LM by any imaging modalities is not known due to rarity of cases, however, investigation by Ozden et al., showed that CT has 100% detection rates for bladder tumor larger than 5 mm, while USG has detection rate ranged from 90 to 100% for tumor larger than 5 mm, except for anterior wall region (with detection rate only 60-66.6%) [109]. Tumors with size less than 5 mm also difficult to be detected with USG (0-75% detection rate) or CT (0-66.6% detection rate). Other than diagnosis, USG can be applied to assess if there is invasion to bladder wall. Diffusion-weighted MR can reach sensitivity 95% and specificity 85% for bladder cancer detection [110].

In practice, USG appearance of malignant tumor or any mass-like benign lesions might be similar, it is difficult to differentiate them [111]. At CT, LM is indistinguishable from other bladder neoplasm [108]. Regardless the result of USG, CT, or MRI, whenever bladder tumor is suspected, cystoscopy and biopsy should be conducted as gold standard diagnostics. If bladder mass is found, the differential diagnoses include urothelial carcinoma, malignant mesenchymal mass (such as leiomyosarcoma, lymphoma of bladder, or angiosarcoma), other benign masses (such as paraganglioma, hemangioma, lymphangioma), inflammatory lesions (such as pseudotumor, polypoid cystitis) [108].

Treatments

To the best of our knowledge, the lack of established studies identifying a superior treatment can be attributed to the rarity of cases and the variability observed among tumors, including variations in size, location, and accessibility [5]. Transurethral resection of bladder tumor (TURBT) is presently utilized as the primary treatment option, owing to its safety and un-eventful procedure, particularly in small, endovesical tumors that are easily accessible [88]. The genesis of TURBT can be traced back to 1806 [112], with subsequent refinement in 1910 by Beer [113], who introduced the utilization of electrocoagulation for the management of bladder tumors. After these historical developments, TURBT has been deemed sufficient for the management of endovesical tumors when performed by experienced operators, following confirmation through imaging modalities [5, 114].

In cases where tumors exhibit larger dimensions or entail extensive involvement of the bladder wall, the consideration of segmental resection via either open surgical or laparoscopic approaches may be done, ensuring comprehensive lesion eradication beyond submucosal levels [5, 48]. Minimally invasive techniques upon segmental

resection, including laparoscopic approaches for managing bladder LMs, have been documented as early as 2002 [115]. Moreover, a transvesical method can be used to enhance visualization and manipulation of the lesion. This approach, augmented by the integration of robotic-assisted techniques and guided imaging on occasion, offers advantages such as improved precision and reduced risk of damage to surrounding structures when executed by a trained surgeon [8, 78].

The TURBT procedure exhibits the shortest duration, however, it is imperative to consider the recurrence rate and its constraints regarding the extent of the lesion [88]. The minimum length of stay ranged from a single day to a maximum of eight days among patients undergoing TURBT, while for open surgery, it extended from one day to two weeks, and for laparoscopic approaches, it varied from 10 days to three weeks across the studies included within our analysis. The duration of stay should not be the main concern, more invasive approach is indeed causing the longest hospitalization. Choosing the exact surgery for complete removal is the most important.

Our study presents the first comprehensive systematic review of case reports concerning to LM of the bladder, encompassing a cohort of 99 studies involving 119 patients across 38 countries. Furthermore, it encompasses essential data concerning precise anatomical localization, dimensional measurements, therapeutic modalities, and symptomatic presentations, with detailed consideration of age and gender demographics on a global scale.

In summary, our thorough review offers a significant understanding of the clinical characteristics, approaches to diagnosis, therapeutic strategies, and results of bladder LMs. Our results highlight the large age range of affected individuals, the preponderance of female cases, and the variety of clinical presentations, with lower urinary tract symptoms being the most frequently reported. MRI, CT scan, ultrasonography, and cystoscopy are among the imaging modalities commonly used in diagnostic evaluation. Nonetheless, a significant percentage of individuals have recurrence or persistent symptoms, emphasizing the necessity of ongoing observation and monitoring. Due to overlapping symptoms and radiological features, differentiating bladder LMs from bladder cancer can be difficult, underscoring the significance of histological investigation for conclusive. Our opinions for surgical management are that it should focus on the patient's condition and tumour's characteristics. Smaller lesions could be managed by TURBT, while larger lesions might require open surgery if full tumour removal cannot be achieved.

Several limitations are inherent in our study. Firstly, the studies included in our analysis predominantly consist of case reports or case series, rendering them vulnerable to biases, particularly selection and publication

bias. Moreover, the typically small patient sizes inherent in these study designs may constrain the reliability and generalizability of the findings to larger populations with controlled variability. Consequently, the interpretation and utilization of our results within reviews necessitate careful consideration.

Conclusion

For an understanding of the best course of treatment and long-term results for bladder LMs, more investigation is necessary. This should primarily take the form of prospective trials with bigger sample sizes and controlled variability. Good sensitivity imaging and pathology examination should be done to exclude leiomyosarcoma. Since there is no standard intervention, management of bladder LM should focus on the relief of symptoms and recurrence and be personalized based on the surgeon's experience, the patient's condition, and tumour characteristics.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12894-024-01624-3>.

Supplementary Material 1

Author contributions

JCP: Resources, Supervision; JCP & AH: Conceptualization, Investigation; AH, SKL, SPH: Data Curation, Methodology, Formal Analysis, Project Administration, Validation, Visualization, Software, Writing – Original Draft, Writing – Review & Editing.

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Data availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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