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Original Contribution

Paratesticular tumors. A clinicopathological study from a single tertiary hospital in North India

Preethi A.M. Paul [a,*], Nalini Calton [a], Sarah Arnestina [a], Kim J. Mammen [b]

[a] Department of Pathology, Christian Medical College and Hospital, Ludhiana, Punjab, India
[b] Department of Urology, All India Institute of Medical Sciences, Rishikesh, Uttarakhand, India

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ABSTRACT

Objective: Paratesticular tumors (PTT) are rare and form a heterogenous group, ranging from benign to malignant high grade sarcomas. This study was undertaken to describe the clinicopathological spectrum of PTTs received over a 20-year period.

Methods: All primary and secondary PTTs diagnosed from 2000 to 2019 in the pathology department of a tertiary care hospital in North India were retrospectively reviewed. Gross, histopathological features and immunohistochemistry (IHC) findings were correlated with clinical details.

Results: A total of 169 intra-scrotal tumors were diagnosed during the study period, out of which there were 30 PTTs (in 27 patients) comprising 17.75%. Age range was 4 to 85 years (median 58 years). Benign PTTs were the commonest (n = 21, 70%), followed by metastasis to the paratesticular region (n = 6, 20%) and then primary malignant PTTs (n = 3, 10%). The commonest benign PTT was lipoma (n = 16, 76.19%), followed by adenomatoid tumor (n = 3, 14.28%) with one case each (4.76%) of cellular angiofibroma and hemangioma. Among primary malignant PTT, there were two cases of rhabdomyosarcoma, and one case of biphasic malignant mesothelioma. Metastatic tumors included four cases of prostatic adenocarcinoma, and one case each of pancreatic signet ring cell carcinoma and clear cell renal cell carcinoma.

Conclusion: PTTs show a wide clinicopathological spectrum. Benign PTTs are commoner than malignant PTTs. Meticulous grossing and histopathological examination supplemented by IHC is essential for an accurate diagnosis of this heterogenous class of tumors, which influences the role of adjuvant therapy and patient prognosis.

1. Introduction

Paratesticular tumors (PTTs) form a heterogenous group of rare tumors. The paratesticular (PT) region consists of the testicular collecting system, epididymis, spermatic cord, testicular tunics and remnants of the embryonic Müllerian and Wolffian ducts, hence a variety of epithelial, mesothelial and mesenchymal elements are encountered here [1]. Among these, soft tissue neoplasms are the commonest and account for 52% [2].

An estimated 70% of PTTs are benign, the commonest being lipoma and adenomatoid tumor [3]. Malignant PTTs account for around 30% of all PTTs. The common PT sarcomas are rhabdomyosarcoma (RMS) and leiomyosarcoma [4,5]. Malignant mesothelioma (MM), epididymal and rete testis adenocarcinoma have also been described [6]. Tumors from distant sites may rarely metastasize to the PT region [7].

This study was undertaken to describe the clinicopathological spectrum of PTTs often described as case reports in literature.

2. Patients and methods

2.1. Patients

All cases diagnosed as PTTs, primary and secondary, over a period of 20 years (2000 to 2019) in the department of pathology of a tertiary care hospital were retrospectively reviewed, described and classified according to the fourth edition of World Health Organization (WHO) classification of testicular and PT tumors [6]. The study protocol was approved by the Institutional Research Committee. Tumor-like lesions and cysts of the PT region, and tumors arising from the scrotal skin and skin appendages were excluded from this study.

* Corresponding author at: Dept of Pathology, Christian Medical College & Hospital, Brown Road, Ludhiana 141008, Punjab, India.
E-mail address: paulpreethi123@gmail.com (P.A.M. Paul).

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2.2. Method

Specimen biopsies were fixed in 10% neutral buffered formalin, processed routinely and stained for hematoxylin and eosin. The histology was reviewed and special stains like periodic acid Schiff (PAS) with diastase digestion and Masson's trichrome (MT) were done where required. Immunohistochemistry (IHC) was done in select cases, following automated protocol on Ventana BenchMark XT slide staining system, Ventana Medical Systems, Arizona, USA. Paraffin sections of 2–3 μm thickness were taken from representative blocks onto adhesive 3-aminopropyltriethoxysilane (APES) coated slides. Antibody characteristics were as follows: CD34 (QBend/10, Ventana), chromogranin A (DAK-A3, Dako), desmin (D33, Dako), myogenin/MYF4 (LO26, Biogenex), PSA (ErPr8, Biogenex), S100 (4C4.9, Ventana), SMA (1A4, Ventana) and synaptophysin (SP11, Ventana).

Clinical information including age, laterality, examination findings, radiological and operative findings, modes of treatment and clinical outcomes were noted from the histopathology request forms and patient record files. Gross and histopathological findings of PTTs and their subtypes were reviewed in detail by all three pathologists. Data was descriptively analyzed with calculation of mean and median for continuous variables, while nominal variables were expressed as percentages.

3. Results

3.1. Spectrum of PTTs

Of 1125 intra-scrotal biopsies and orchidectomies received during the study period, a total of 169 intra-scrotal tumors were diagnosed. Of these, there were 30 PTTs (in 27 patients) comprising 17.75% of all intra-scrotal tumors. Table 1 shows the spectrum of PTTs diagnosed in our study with age range, median age, laterality and median size of tumor. Benign PTTs were commonest (n = 21, 70%), followed by metastasis to the PT region (n = 6, 20%) and primary malignant PTTs (n = 3, 10%). Among benign PTTs, the commonest was lipoma (n = 16, 76.19%), followed by adenomatoid tumor (n = 3, 14.28%) with one case each (4.76%) of cellular angiofibroma and hemangioma. Of the three primary malignant PTT, there were two cases of RMS, and one case of MM. Metastatic tumors to the PT region included four cases of prostatic adenocarcinoma, of which there was one case prostatic neuroendocrine carcinoma (NEC), along with one case each of pancreatic signet ring cell carcinoma and clear cell renal cell carcinoma (RCC).

3.2. Clinicopathological features

Overall median age was 58 years with a wide age range, 4–85 years. Two-thirds of PTTs were diagnosed in older adults >50 years (n = 21, 70%). These included spermatic cord lipomas (n = 12), hemangioma, cellular angiofibroma, MM and all cases of secondary PTTs. In the age group 18–50 years, adenomatoid tumor (n = 3), spermatic cord lipomas (n = 4) and embryonal RMS was seen (total 8 cases, 26.67%). In the pediatric age group (<18 years), there was only one case of alveolar RMS.

Majority of patients with PTTs (26/30 cases, 86.67%), exclusive of four metastatic prostatic adenocarcinomas, presented with complaints of inguino-scrotal swelling, and of these, there was associated pain in six cases (23.07%) and hydrocoele in four cases (13.33%). Most patients with spermatic cord lipomas had co-existing inguinal hernia (11/13, 84.61%). One of the patients with lipoma had cryptorchidism, while one patient with adenomatoid tumor presented with infertility.

Primary malignant PTT were much larger than benign tumors; median size of malignant PTT 15 cm (range 11.5–19 cm) vs median size of benign PTT 5 cm (range 1–10.5 cm). Overall the largest PTT was RMS and the smallest were adenomatoid tumors (median 1.5 cm). Table 2 depicts site of localization of PTT. Benign PTTs were found most frequently in the spermatic cord (16/21, 76.19%), followed by epididymis, testicular tunica and in the testis as well. Overall, only a slight right-sided predominance was observed (R:L = 1.1:1), whereas bilaterality was seen in three patients with spermatic cord lipomas and one patient with metastatic prostatic adenocarcinoma.

3.3. Benign PTTs

3.3.1. Lipoma

All cases of lipomas were thinly encapsulated and localized to the spermatic cord. Microscopically, lipomas showed lobules of mature adipose tissue separated by fibrocollagenous septae of variable thickness and few large thick-walled congested blood vessels. Angiolipoma was diagnosed in two cases (2/16, 12.5%) which showed numerous small capillary-sized vessels with fibrin thrombi (Fig. 1A). One case showed areas of infarction with fat necrosis, foamy macrophages and thrombosed vessels.

3.3.2. Adenomatoid tumor

Adenomatoid tumors appeared grossly as greyish white and fairly well circumscribed nodules. Two were located in the epididymis (one in the epididymal head) and the third was seen in the lower testicular pole (Fig. 1B). Microscopic patterns identified were tubular, cystic-angiomatoid with thread-like bridging strands (Fig. 1C), and cords

Table 1
Relative frequency of various paratesticular tumors with age, laterality and size.

Paratesticular tumor	Number (n = 30)	Relative frequency %	Median age (range) in years	Laterality (right/left)	Median size (range) in cm
Tumors of paratesticular structures					
Adenomatoid tumor	3	10	30 (30–40)	2/1	1.5 (1–2.4)
Malignant mesothelioma	1	3.3	85	1/0	14
Mesenchymal tumors of spermatic cord and testicular adnexae					
Lipoma	16	53.3	61 (24–82)	5/4[a]	5 (1.2–8.6)
Cellular angiofibroma	1	3.3	55	0/1	10.5
Hemangioma	1	3.3	62	0/1	5
Rhabdomyosarcoma	2	6.6	14.5 (4–25)	1/1	15.2 (11.5–19)
Metastatic tumors to paratesticular region					
Metastatic prostatic carcinoma	4	33.3	75 (55–80)	1/1[b]	nil[c]
Metastatic clear cell RCC	1	3.3	55	1/0	9
Metastatic signet ring carcinoma pancreas	1	3.3	60	0/1	6
Median (range)			58 (4–85)	11/10	5 (nil-19)

[a] Three patients had bilateral spermatic cord lipomas, in one case laterality was not known.
[b] One patient had metastasis to one side epididymis and other side spermatic cord; in another patient laterality was unknown.
[c] Metastatic prostatic carcinoma was seen as only microscopic tumor deposits with no evidence of gross tumor.

Table 2
Site of localization of paratesticular tumors.

Paratesticular tumor	Number (n = 30)	Site of localization				
		Epididymis	Spermatic cord	Testicular tunics	Paratesticular region	Testis
Benign paratesticular tumors						
Lipoma	16	–	16	–	–	–
Adenomatoid tumor	3	2	–	–	–	1
Hemangioma	1	–	–	1	–	–
Cellular angiofibroma	1	–	–	–	1	–
Primary malignant paratesticular tumors						
Malignant mesothelioma	1	–	–	1	–	–
Rhabdomyosarcoma	2	–	–	–	2	–
Secondary tumors to paratesticular region						
Metastatic prostate carcinoma	4	4	2	–	–	1
Metastatic clear cell RCC	1	1	–	–	–	1
Metastatic signet ring carcinoma pancreas	1	1	1	–	–	1
Total (percentage)	30 (100%)	8 (26.6%)	19 (63.3%)	2 (6.6%)	3 (3.3%)	4 (13.3%)

RCC: Renal cell carcinoma.

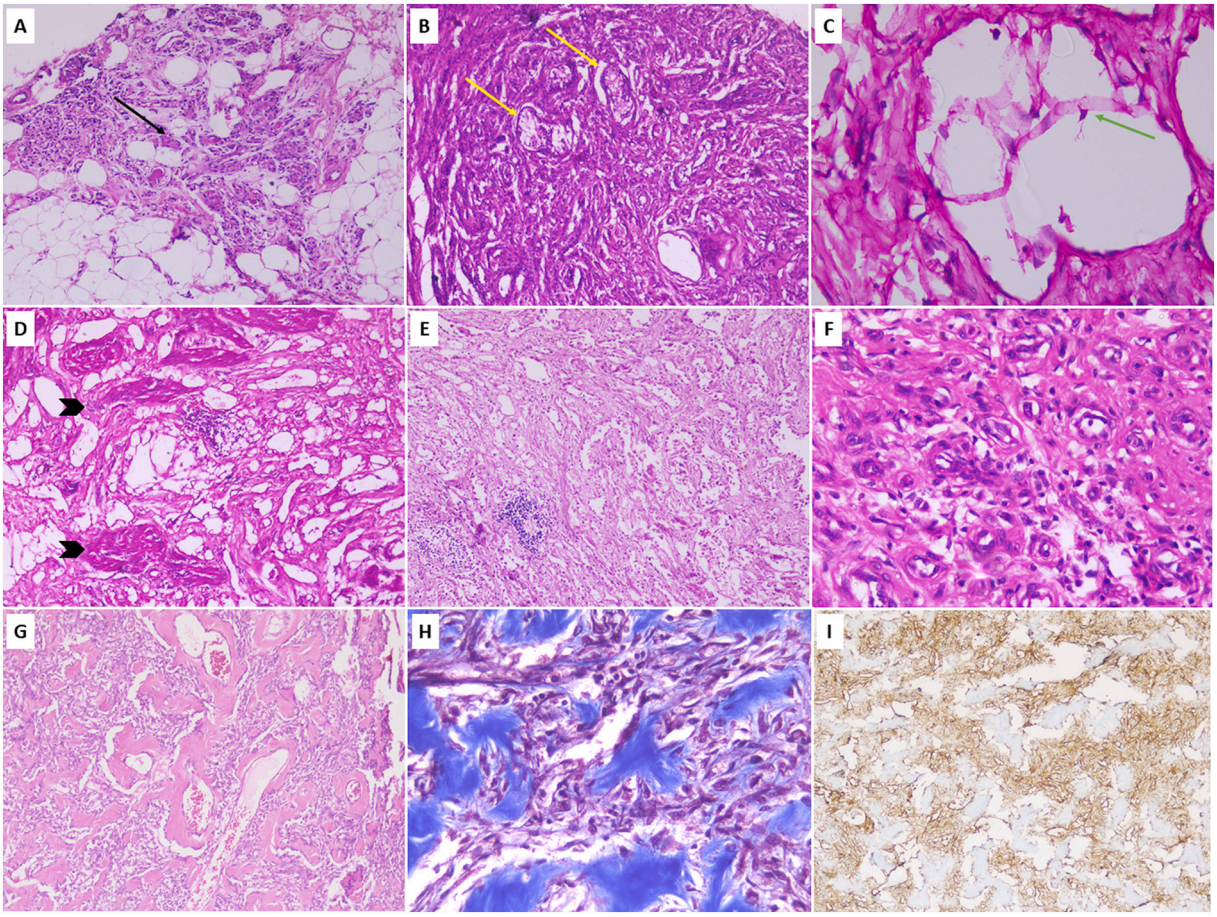

Fig. 1. Benign paratesticular tumors; A) angiolipoma showing mature adipose tissue and small-sized capillary vessels with fibrin thrombi (black arrow) in vascular lumen, H&E 100×; B) adenomatoid tumors showing various features: intra-testicular tumor with entrapped seminiferous tubules (yellow arrows), H&E 100×; C and D) adenomatoid tumor: characteristic thread-like bridging strands (green arrow), H&E 400×, and smooth muscle bundles (black arrowheads), respectively, H&E 100×; E) infarcted adenomatoid tumor with ghost outlines of tubular structures and necrotic tumor cells, H&E 100×; F) tunical hemangioma showing numerous small-sized vessels lined by endothelial cells, H&E 400×; G to I) cellular angiofibroma: bland spindle-shaped cells with prominent hyalinized vascular channels, H&E 100×; collagen rosette-like structures staining blue with MT stain, 400×; and diffuse CD34 positivity in spindle cells, DAB chromogen, 100×, respectively. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

with small nests. The lining cells were flattened to cuboidal with eosinophilic to vacuolated cytoplasm. Stroma was hyalinized and showed smooth muscle bundles in two cases (Fig. 1D). All cases were well circumscribed, non-infiltrative and showed scattered lymphoid aggregates at the periphery. One case showed extensive infarction necrosis, however lacked significant nuclear atypia, mitotic activity, cellularity and permeative borders seen in MM (Fig. 1E).

3.3.3. Hemangioma

Hemangioma was diagnosed in a 62-year-old man with a painful hard left-sided swelling, hydrocoele and discharge from the scrotal region since 6 days. Orchidectomy was done for clinical diagnosis of testicular tumor. Gross examination showed an ill-defined 5 × 3.5 cm dark brown hemorrhagic mass in the tunica with multiple cystic spaces filled with yellowish-brown material. Microscopically, lobules of small capillaries were seen in the tunica with larger gaping vascular channels, thrombosed vessels and extensive areas of hemorrhage (Fig. 1F). The testis and epididymis showed chronic inflammation.

3.3.4. Cellular angiofibroma

Cellular angiofibroma was diagnosed in a 55-year-old man with painless left-sided scrotal swelling of 12 months duration. Grossly, the orchidectomy specimen weighed 550 g, and showed a hard circumscribed tumor in the PT region measuring 10.5 × 9 × 8 cm. Microscopically, the tumor showed bland spindle-shaped cells with oval to elongated nuclei, tiny nucleoli and moderate amount of cytoplasm. No atypia or mitotic activity was observed. Numerous thick-walled and hyalinized vessels were seen throughout the tumor, along with wispy collagen forming bundles and "giant rosette-like" structures (Fig. 1G). The latter were highlighted blue by the MT stain (Fig. 1H). On IHC, the tumor cells and vasculature were CD34 diffuse and strong positive (Fig. 1I), while SMA, S100 and desmin were negative.

3.4. Primary malignant PTTs

3.4.1. Biphasic malignant mesothelioma

Biphasic MM was diagnosed in an 85-year-old gentleman with right sided tender scrotal swelling of 1 year duration. No history of asbestos exposure or hydrocoele was documented. Grossly, a large greyish white and partly necrotic, widely infiltrative growth measuring 14 × 12 × 9 cm was seen involving a thickened tunica vaginalis. The scrotal skin was adherent to the tumor, with ulceration and sinus formation. The testicular parenchyma, epididymis and spermatic cord did not show any tumor infiltration. Microscopically, a biphasic pattern of growth was seen with the epithelial component seen as plump cuboidal cells arranged in papillary, tubulopapillary and cribriform patterns. Few cellular sarcomatous areas were also seen. The tumor cells showed moderately pleomorphic, vesicular nuclei with conspicuous nucleoli and moderate to abundant eosinophilic to vacuolated cytoplasm. The tumor was infiltrating into the scrotal dartos muscle with large tumor emboli in the dermal lympho-vascular spaces and ulceration of the scrotal skin (Fig. 2A–C). Brisk mitoses and areas of necrosis were also seen. IHC could not be performed due to financial constraints.

3.4.2. Rhabdomyosarcoma

RMS was diagnosed in a 4-year-old boy and in a 25-year-old man. Both presented with painful large scrotal swellings accompanied with hydrocoele; orchidectomy was performed for clinical suspicion of

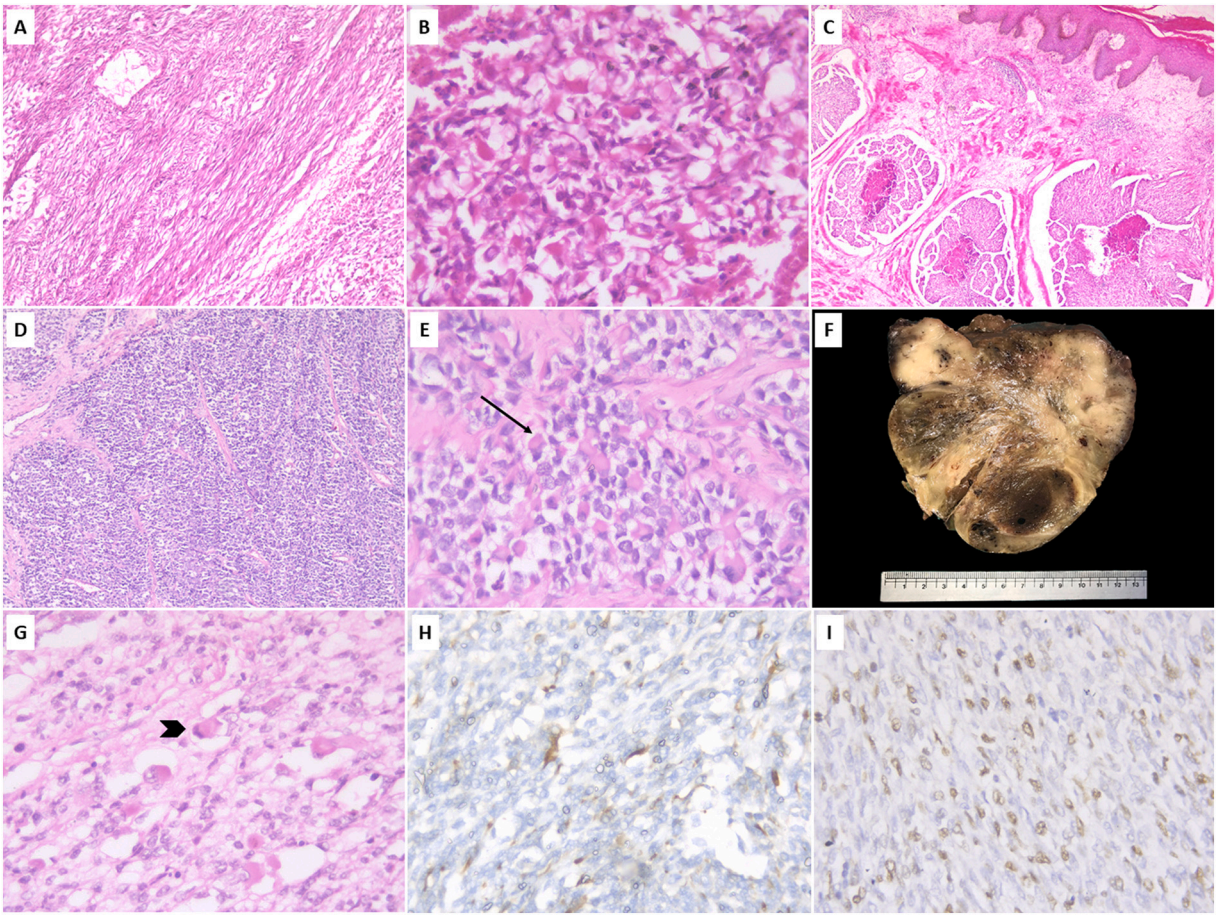

Fig. 2. Primary malignant paratesticular tumors; A–C) malignant mesothelioma: sarcomatoid areas and spindling of cells, H&E 100×; epithelioid to polygonal cells with cytoplasmic vacuolation, H&E 400×; prominent invasion of dermal lymphatic channels of the scrotal skin, H&E 100×, respectively; D–E) alveolar rhabdomyosarcoma showing sheet-like arrangement of a small round cell tumor showing focal alveolar pattern with few rhabdomyoblasts (black arrow); F–I) embryonal rhabdomyosarcoma: gross image showing a large solid fleshy tumor with focal dark brown areas; few rhabdomyoblasts (arrowhead) were identified in this case, H&E 400×; showing heterogenous desmin positivity, DAB chromogen 400×, and heterogenous MYF4/myogenin nuclear positivity, DAB chromogen 400×, respectively. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

testicular tumor. Grossly, the tumors were large (mean size 15.2 cm) with variegated cut surface showing grey white solid areas, necrotic, hemorrhagic foci and infiltrative margins. The tumors were centered in the PT region and showed infiltration into the testis, epididymis and tunica, however were localized within the tunica vaginalis. Microscopically, the pediatric case showed small round blue cells arranged in solid nests with focal alveolar pattern separated by fibrohyalinized septae and few scattered rhabdomyoblasts (Fig. 2D–E). IHC was not possible in this case due to financial constraints, however due to presence of rhabdomyoblasts, a diagnosis of alveolar RMS was made. The second case also showed a cellular small round cell tumor with some areas showing spindling of cells. Scattered rhabdomyoblasts were also seen. IHC showed positivity for heterogenous positivity for myogenin/MYF4 (nuclear) and desmin (Fig. 2F–I).

3.5. Secondary PTTs

All the four prostatic carcinomas were incidentally detected as microscopic deposits of acinar adenocarcinoma in the PT region (Fig. 3A–B). These four cases comprised 1.4% of 284 bilateral orchidectomies done during the 20-year study period as part of surgical castration for carcinoma prostate. One case was a metastatic small cell NEC prostate to the tail of left epididymis (Fig. 3C). IHC positivity for synaptophysin, chromogranin A and PSA (weak, focal) was seen (Fig. 3D–F). Primary prostatic tumor was usual adenocarcinoma mixed with small cell NEC component, overall Gleason score 5 + 4 = 9/10, grade group 5 of 5. Another patient, previously diagnosed left side RCC and chondrosarcoma of the right foot, presented with 2-month duration of right-sided testicular swelling. In view of raised β-HCG levels, orchidectomy was performed. Gross examination of the specimen showed a large growth measuring 9 × 7 × 3 cm entirely replacing the testis, epididymis and PT region. Microscopically, nests of clear cells were seen with moderately pleomorphic nuclei and prominent nucleoli (Fig. 3G). In another case, the initial presentation was that of left-sided scrotal swelling with hydrocoele; orchidectomy was performed for suspicion of testicular tumor. Gross examination of the orchidectomy specimen showed a 6 cm-size ill-defined greyish white growth within the PT region and spermatic cord (Fig. 3H). Histopathology showed signet ring cell carcinoma (Fig. 3I), and a later dated Computed Tomography (CT) abdomen showed occult primary in the pancreas. The patient was lost to follow up.

4. Discussion

PTTs are rare, representing approximately 7–10% of all intra-scrotal tumors. Among this heterogenous group with varying histological subtypes, benign PTTs account for 70% while 30% are malignant [1]. In the present study, PTTs comprised 17.75% of all intra-scrotal tumors, with

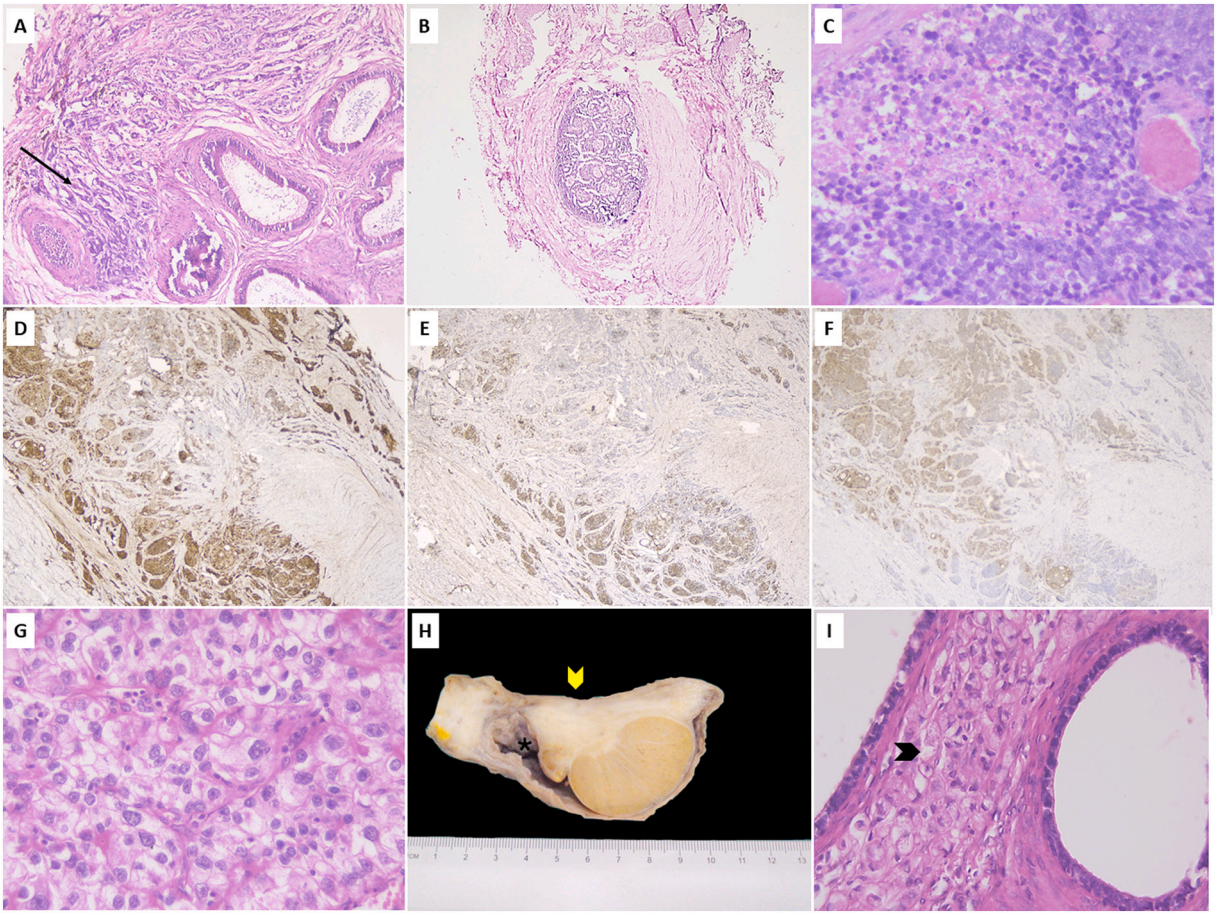

Fig. 3. Secondary paratesticular tumors; A) prostatic adenocarcinoma (arrow) metastasizing between epididymal tubules, H&E 100×; B) metastatic prostatic adenocarcinoma within the vascular lumen of the spermatic cord, H&E 40×; C–F) metastatic prostatic neuroendocrine carcinoma to epididymis, H&E 400× showing positivity for chromogranin A (D), synaptophysin (E) and PSA (focal) (F), DAB chromogen, 100×; G) metastatic renal clear cell carcinoma showing cells arranged in nests with moderately pleomorphic nuclei and abundant clear cytoplasm, H&E 400×; H) metastatic pancreatic signet ring cell carcinoma with gross specimen showing grey white diffuse areas in the paratesticular area (yellow arrowhead) and epididymis, along with hydrocoele (asterisk); I) same case, section from epididymis showed metastatic signet ring cell carcinoma (black arrowhead) from occult primary in pancreas, H&E 400×. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

benign tumors constituting the majority (70%). Lioe et al. from Belfast reported a series of 85 PTTs with wide age range (2–86 years) and variable size (microscopic-13 cm), largest being primary malignant PTTs (mean size 7.7 cm), followed by metastatic tumors (mean 5.2 cm) and benign PTTs (mean 2 cm) [7]. In another series from Western India which included PTTs as well as tumor-like lesions, the age range was wide (1–76 years), with majority in the fourth decade [8]. Overall, spermatic cord has been reported to be the commonest site of origin of PTTs, with difficulty in ascertaining site in cases of large infiltrative tumors [1]. A slight right-sided predominance of PTTs has also been observed (54.9%) [9].

Lipomas are the commonest PT soft tissue tumor, accounting for up to 90% of cases [3]. In a series of 91 PTTs diagnosed on orchidectomies performed over 17 years, incidental spermatic cord lipomas comprised 92% of all benign PTTs [9]. In our study, lipomas were also the commonest, comprising 76.2% of all benign PTTs, and were associated with inguinal hernia in majority (84.61%). Apart from angiolipoma variant which we encountered, other variants like vascular myxolipoma and myolipoma have also been reported [6]. Spermatic cord is the most common site [7,9].

Adenomatoid tumors are the commonest of PT mesothelial neoplasms. These tumors usually present in the third to fifth decade as 0.5–5 cm size small painless nodular masses, most commonly involving the head of epididymis. Less common sites include tunica vaginalis and rarely, the lower pole of testis [1,10,11]. In our study similar clinical and pathological findings were seen to those reported in literature, median age being 30 years [10,12]. One of the cases showed infarction. Infarction of adenomatoid tumor is a diagnostic dilemma that has been reported in up to 25% of adenomatoid tumors. Though the cause of infarction is unknown, trauma has been suggested as a possible cause [10,13].

Hemangiomas can arise within the spermatic cord, epididymis and rarely in the tunica [14,15]. Due to hemorrhage within tumor, patients may present with rapid enlargement with pain simulating malignancy. Microscopic variants include cavernous, capillary and anastomosing hemangiomas [6].

Cellular angiofibroma is a rare benign mesenchymal tumor composed of bland spindle-shaped cells arranged in no particular pattern within a finely collagenous stroma rich in acid mucopolysaccharides and prominent vasculature. It was first described by Nucci et al. in 1997 within the vulva of middle-aged women, and soon also described within the inguino-scrotal region of adult men as "angiomyofibroblastoma-like" tumor by Laskin et al. in 1998 [16,17]. Rare cases have also been described in the PT region. The median age of presentation is 60 years, and patients usually present with a slow-growing painless mass (median duration 5 months). The tumor can range in size from 3 cm to 25 cm (median 7 cm), and has a lobulated greyish white to tan cut surface [18,19]. The patient in our series was a 55-year-old gentleman who presented with a 10.5 cm mass in the PT region. In addition to solid hard white cut surface, few tiny cystic spaces were also seen filled with mucoid material. Microscopically, numerous hyalinized vessels were seen along with scattered foci of wispy collagen resembling "giant rosettes." Immunoreactivity for CD34 and vimentin is typical, however fewer cases can show variable positivity for SMA, desmin, EMA and CD99. S100 is typically negative, as in our case. Monoallelic deletion of *RB1* can be seen in these tumors by Fluorescence in situ hybridization (FISH), demonstrating a link between cellular angiofibroma, mammary-type myofibroblastoma and spindle cell lipoma [20].

MM is extremely rare tumor, albeit the commonest malignant PTT with an 'epithelial' growth pattern that originates from the serosal mesothelium covering the tunica [3]. Asbestos exposure has been implicated as a risk factor in more than a third of cases, however MM may also arise in its absence as seen in our case [10]. Highest incidence is in middle-aged to elderly men, mean age 60 years, and patients present with painless scrotal swelling with hydrocoele (56.3%) or a PT solid mass (32.8%) [21,22]. Gross examination often shows thickened tunica vaginalis with tumor nodules studding the surface, and may show invasion of the testis, PT structures and scrotal skin [10]. Microscopically, most tumors are epithelial (60–70%) with papillary, tubulopapillary and solid patterns. Around 30–40% of tumors have biphasic morphology with an additional sarcomatoid component and spindling of tumor cells [3,23]. On IHC, positive staining for WT1, CK5/6 and calretinin is usually seen [3]. MM is an aggressive tumor with approximately 52% of patients developing local recurrences or metastasis, and a high mortality rate (median survival 24 months) [1]. Molecular basis of MM is poorly characterized with multiple chromosomal losses, gains reported but no specific diagnostic alteration [21].

RMS is a rare tumor with aggressive growth pattern, and represents the most common non-germ cell malignant tumor of the PT region [4,24,25]. Paratesticular RMS may develop from mesenchymal spermatic cord elements, testicular tunics, or the epididymis. Clinical presentation is usually short, with swelling of scrotum in a child or young adult [26], and can be associated with pain in 7% of cases [1]. RMS occurs at a younger mean age (18.3 years) as compared to other PT sarcomas [9]. Embryonal RMS is the predominant histological subtype of RMS, and carries an excellent prognosis if disease is localized. Other common subtypes seen are alveolar, pleomorphic and mixed. Spindle cell RMS, a variant of embryonal RMS, carries an excellent prognosis [1]. In the present study, both cases of RMS were lost to follow up. On IHC, tumor cells express desmin, and skeletal muscle-specific nuclear regulatory proteins myogenin/MYF4 and MYOD1. MSA and SMA may also be positive, while CK, S100 and neurofilament may show aberrant expression [27]. Most cases with alveolar RMS show presence of *PAX3-FOXO1* or *PAX7-FOXO1* fusion gene [27].

The PT region can very rarely be the seat of metastasis, and has been documented in 4.4–13.6% of patients with PTTs [1,7]. In our study metastasis to the PT region comprised 20% of all PTTs. A higher frequency may be due to the inclusion of bilateral therapeutic orchidectomies done as part of surgical castration for carcinoma prostate patients. Metastasis to the PT region may present as intra-scrotal mass, induration of spermatic cord, irreducible hernia, or can be detected incidentally with lack of a distinct mass in up to 15% of cases, or on autopsy [1,7,28]. Testicular metastasis has been reported to be the first presentation of malignancy in up to 62% of cases [28], as was seen in one of our cases with occult pancreatic signet ring cell carcinoma. Patients usually are a decade older (mean 67 years) than those with primary malignant PTTs (mean 58 years) [7]. Common sites of origin of metastasis include prostate, gastrointestinal tract carcinomas and RCC, and bilaterality has also been observed in few cases [10]. Small cell NEC of the prostate is rare, comprising 0.5–2% of all prostatic carcinomas. By IHC these tumors are positive for at least one neuroendocrine marker – synaptophysin, chromogranin A, CD56 and/or NSE, with occasional cases showing PSA (19%) immunoreactivity [29]. Similar immunoreactivity was seen in our case with metastatic prostatic NEC.

The most important limitations of this study are small sample size and possible selection bias. Future studies involving collaboration of multiple centers with larger statistical power may be able to more precisely define PTTs.

In conclusion, PTTs are rare and show a wide pathological spectrum. Lack of awareness may lead to delayed or misdiagnosis, as presentation in most cases is that of inguino-scrotal swelling. Benign PTTs are commoner than malignant tumors, and among the former, spermatic cord lipoma is the commonest. Primary malignant PTTs are usually larger than benign tumors, however can present with localized disease, infiltration into surrounding structures or distant metastasis. Prostatic adenocarcinomas can have incidentally detected microscopic metastatic deposits in the PT region. Meticulous grossing and histopathological examination of the testis and PT region supplemented by IHC is essential for accurate diagnosis and early detection of tumors, which influences the role of adjuvant therapy and patient prognosis.

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Dr. Sarah Arnestina presented this paper (in part).
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CRediT authorship contribution statement

	Contributor 1 (Preethi A.M Paul)	Contributor 2 (Nalini Calton)	Contributor 3 (Sarah Arnestina)	Contributor 4 (Kim J Mammen)
Concepts		✓		✓
Design		✓		✓
Definition of intellectual content	✓	✓		
Literature search	✓			
Clinical studies	✓	✓	✓	
Experimental studies	✓			
Data acquisition	✓		✓	
Data analysis	✓			
Statistical analysis	✓			
Manuscript preparation	✓			
Manuscript editing	✓			
Manuscript review	✓	✓	✓	✓
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Consent to participate

All authors wrote and are in agreement with the content of the manuscript.

Consent for publication

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Declaration of competing interest

The authors have no conflicts to declare.

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Ethics approval

This article does not contain any studies with human participants or animals performed by any of the authors.

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