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Histopathological Analysis of Testicular Lesions: A Five-Year Experience

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ABSTRACT

Introduction: Testicular lesions comprise a wide spectrum of non-neoplastic and neoplastic conditions. Non-neoplastic lesions are more common, whereas testicular tumours, though rare (about 1% of all male cancers), are the most frequent solid malignancy in men aged 15 to 35 years. Histopathological examination remains the basis of definitive diagnosis, and regional data from Uttar Pradesh are limited.

Aim and Objectives: To study the histopathological spectrum of testicular lesions in orchidectomy specimens, to categorize them into non-neoplastic and neoplastic lesions, to determine their relative frequencies, to analyze age-wise distribution and laterality, and to compare the findings with other published studies.

Materials and Methods: This was a retrospective, descriptive, record-based study conducted in the Department of Pathology, SRMSIMS, Bareilly, over five years. All orchidectomy specimens were included; small biopsies for infertility evaluation and autolysed or inadequate specimens were excluded. Sections were stained with haematoxylin and eosin, and neoplasms were classified according to the WHO 2022 (5th edition) classification. Data were analyzed descriptively.

Results: A total of 147 cases were studied, of which 111 (75.51%) were non-neoplastic and 36 (24.49%) were neoplastic. Epididymo-orchitis was the commonest non-neoplastic lesion (27.03%), followed by hydrocoele/pyocoele (19.82%) and abscess (14.41%). Germ cell tumours accounted for 72.22% of neoplasms; mixed germ cell tumour was the commonest (30.56%), followed by seminoma (22.22%), while non-Hodgkin lymphoma constituted 13.89%. Right-sided specimens (50.34%) outnumbered left-sided (40.13%); 9.52% were bilateral. Non-neoplastic lesions peaked above 60 years (36.04%), whereas neoplastic lesions peaked in the third decade (36.11%).

Conclusion: Non-neoplastic lesions form the majority of orchidectomy specimens, with epididymo-orchitis the commonest. Neoplasms formed nearly a quarter of cases, a higher proportion than in most Indian series, with mixed germ cell tumour exceeding pure seminoma. Histopathological examination of every orchidectomy specimen remains indispensable for accurate diagnosis and management.

Key words: Testicular lesions, Orchidectomy, Histopathology, Germ cell tumour, Non-neoplastic and Neoplastic.

INTRODUCTION

The testis is a paired organ suspended in the scrotum by the spermatic cord, responsible for spermatogenesis and testosterone production. It is affected by a broad range of non-neoplastic and neoplastic diseases at different stages of life **[1,2]**. Non-neoplastic conditions include congenital anomalies such as cryptorchidism, inflammatory lesions such as acute and chronic epididymo-orchitis and abscess, vascular lesions such as torsion and infarction, and testicular atrophy with maturation arrest. Cryptorchidism, the commonest genital malformation of the male child, is also a well-recognised risk factor for testicular malignancy **[2]**.

Testicular tumours are relatively rare, accounting for approximately 1% of all male cancers, yet they are the most frequent solid malignancy in men aged 15 to 35 years **[3,4]**. Their incidence shows wide geographical variation and has risen over recent decades in Western populations **[3]**. Unlike most cancers, testicular germ cell tumours show a reverse age pattern, with incidence declining with advancing age, whereas lymphoma and spermatocytic tumour characteristically affect older men **[2,4]**. The WHO 2022 (5th edition) classification has reorganised these tumours into germ cell tumours derived from germ cell neoplasia in situ (GCNIS), germ cell tumours unrelated to GCNIS, sex cord-stromal tumours and others **[5]**.

Despite advances in imaging and serum tumour marker assays, the definitive diagnosis of testicular lesions continues to rest on histopathological examination, which also provides prognostic information and guides further management **[6,7]**. Most published Indian studies are from single centres with modest sample sizes, and the relative frequencies of lesions vary considerably between regions **[8-10]**. The present study was therefore undertaken to document the histopathological spectrum of testicular lesions encountered over five years at a tertiary care centre in Bareilly, Uttar Pradesh.

Aims and Objectives

1. To study the histopathological spectrum of testicular lesions in orchidectomy specimens and to categorize them into non-neoplastic and neoplastic lesions.
2. To determine the relative frequency of the various non-neoplastic and neoplastic lesions.
3. To analyze the age-wise distribution and laterality of these lesions.
4. To compare the findings with other published studies.

MATERIALS AND METHODS

Study design and setting: This was a retrospective, descriptive, record-based study conducted in the Department of Pathology, Shri Ram Murti Smarak Institute of Medical Sciences (SRMSIMS), Bareilly, Uttar Pradesh, a tertiary care teaching hospital, over a period of five years.

Inclusion criteria: All orchidectomy specimens (unilateral and bilateral), with or without attached paratesticular structures, received in the department during the study period.

Exclusion criteria: Small testicular biopsies submitted for infertility evaluation, and specimens that were autolysed, inadequate, or lacked essential clinical details.

Procedure: Clinical details including age, side involved and clinical diagnosis were retrieved from histopathology requisition forms and records. Specimens had been fixed in 10% neutral buffered formalin, examined grossly, and representative sections processed in an automated tissue processor, embedded in paraffin, cut at 3-5 µm and stained with haematoxylin and eosin (H&E). Slides were reviewed, and special stains and immunohistochemistry were used. Neoplasms were classified according to the WHO 2022 (5th edition) classification of tumours of the urinary system and male genital organs **[5]**. Patients were grouped into decades of age.

Statistical analysis: Data were entered in Microsoft Excel and analyzed descriptively; results are expressed as numbers and percentages.

Ethical considerations: Approval was obtained from the Institutional Ethics Committee, SRMSIMS. Being a retrospective study of archived material, the requirement for individual informed consent was waived and patient identity was kept confidential.

RESULTS

A total of 147 cases of testicular lesions were studied over the five-year period. Of these, 111 (75.51%) were non-neoplastic and 36 (24.49%) were neoplastic, a ratio of approximately 3:1.

Non-neoplastic lesions

Epididymo-orchitis was the commonest non-neoplastic lesion (30; 27.03%), followed by hydrocoele/pyocoele (22; 19.82%) and abscess (16; 14.41%). Eighteen specimens (16.22%) showed no significant pathological change (normal study). Torsion/trauma accounted for 10 cases (9.01%), atrophy with maturation arrest for 7 (6.31%), cryptorchidism for 6 (5.41%) and gangrenous testes for 2 (1.80%) (Table 1, Figure 1).

Table 1: Spectrum of non-neoplastic lesions (n = 111)

Histological type	Number of cases	Percentage
Epididymo-orchitis	30	27.03%
Hydrocoele / Pyocoele	22	19.82%
Normal study	18	16.22%
Abscess	16	14.41%
Torsion / Trauma	10	9.01%
Atrophy with maturation arrest	7	6.31%
Cryptorchidism	6	5.41%
Gangrenous testes	2	1.80%
Total	111	100%

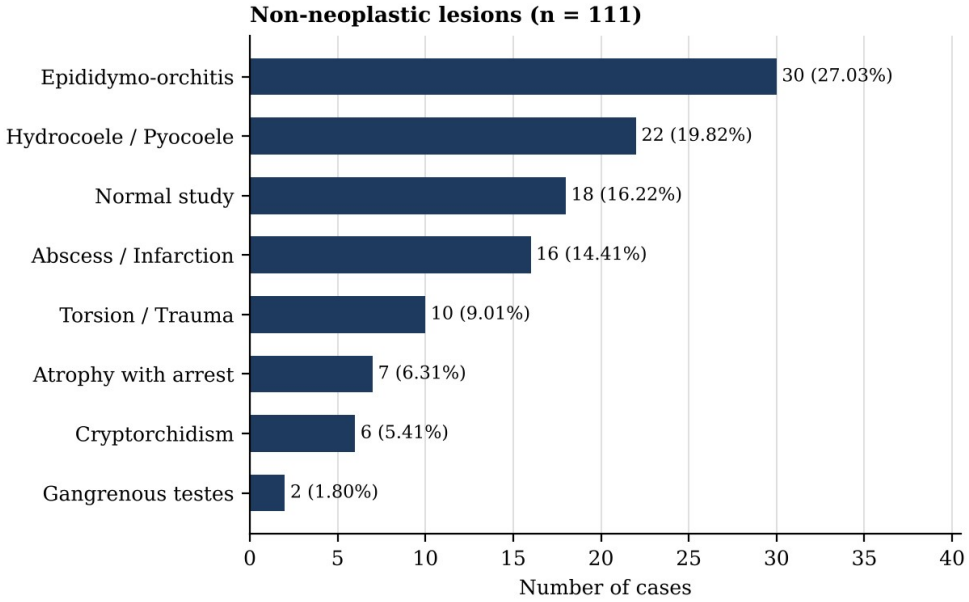


Figure 1: Distribution of non-neoplastic testicular lesions (n = 111).

Neoplastic lesions

Among the 36 neoplasms, germ cell tumours predominated (26; 72.22%). Mixed germ cell tumour was the single commonest neoplasm (11; 30.56%), followed by seminoma (8; 22.22%), embryonal carcinoma (5; 13.89%) and yolk sac tumour – pre pubertal (2; 5.56%). Non-seminomatous and mixed germ cell tumours together (18; 50.00%) outnumbered pure seminoma. Non-Hodgkin lymphoma accounted for 5 cases (13.89%). Smooth muscle/adipocytic (mesenchymal) tumours accounted for 4 cases (11.11%) and there was a single Leydig cell tumour (2.78%) (Table 2, Figure 2). Overall, 31 of 36 neoplasms (86.11%) were germ cell tumours or lymphomas.

Table 2: Spectrum of neoplastic lesions (n = 36)

Neoplastic lesion	WHO 2022 category	Number of cases	Percentage
Mixed germ cell tumour	GCT derived from GCNIS	11	30.56%
Seminoma	GCT derived from GCNIS	8	22.22%
Embryonal carcinoma	GCT derived from GCNIS	5	13.89%
Yolk sac tumour Pre Pubertal	GCT unrelated to GCNIS	2	5.56%
Non-Hodgkin lymphoma	Haematolymphoid tumour	5	13.89%
Smooth muscle / Adipocytic tumour	Mesenchymal tumour	4	11.11%
Leydig cell tumour	Sex cord-stromal tumour	1	2.78%
Total		36	100%

GCT: germ cell tumour; GCNIS: germ cell neoplasia in situ. Both yolk sac tumours occurred in the 0-10 year age group and therefore correspond to the prepubertal type (GCT unrelated to GCNIS) under WHO 2022.

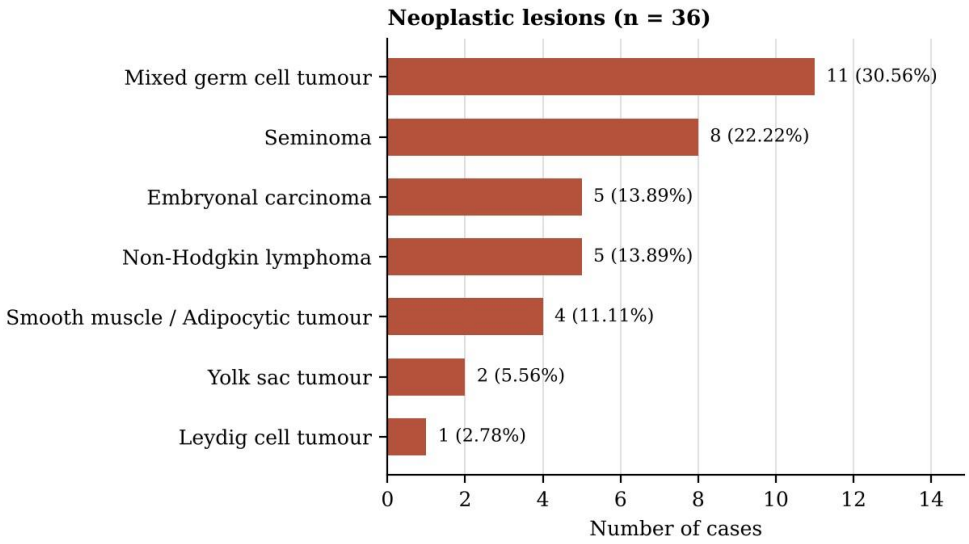


Figure 2: Distribution of neoplastic testicular lesions (n = 36).

Specimen Laterality

Right-sided specimens (74; 50.34%) outnumbered left-sided specimens (59; 40.13%); bilateral orchidectomy was performed in 14 cases (9.52%) (Table 3).

Table 3: Laterality of specimens (n = 147)

Specimen Laterality	Number	Percentage
Right-sided	74	50.34%
Left-sided	59	40.13%
Bilateral	14	9.52%
Total	147	100%

Age-wise distribution

Patients ranged from the first decade to beyond 60 years. The largest group was above 60 years (46; 31.29%), followed by the third decade (24; 16.33%). The two categories followed distinct age patterns: non-neoplastic lesions rose steadily with age and peaked above 60 years (40/111; 36.04%), whereas neoplastic lesions peaked in the third decade (13/36; 36.11%), with two-thirds (24/36; 66.67%) occurring up to 40 years of age (Table 4, Figure 3).

Table 4: Age-wise distribution of all cases (n = 147)

Age group (years)	Non-neoplastic	Neoplastic	Total	Percentage
0-10	3	2	5	3.40%
11-20	13	4	17	11.56%
21-30	11	13	24	16.33%
31-40	15	5	20	13.61%
41-50	16	3	19	12.93%
51-60	13	3	16	10.88%
>60	40	6	46	31.29%
Total	111	36	147	100%

Age-group totals in this table are derived from the lesion-wise distributions in Tables 5 and 6.

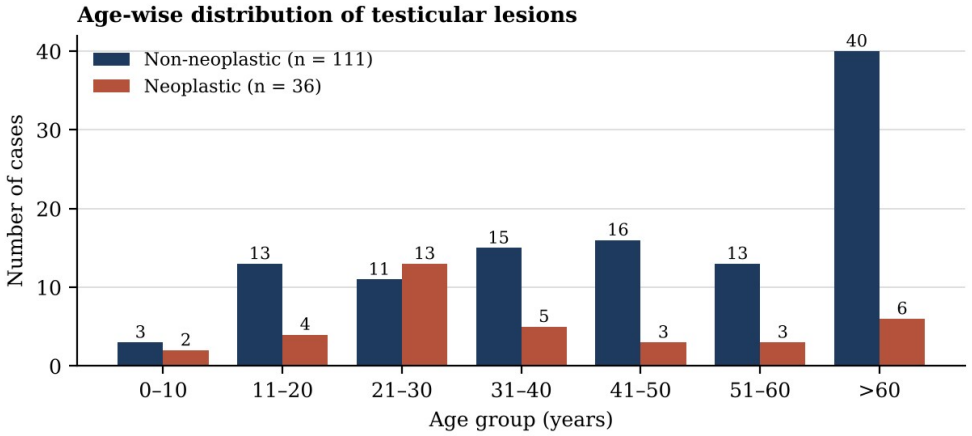


Figure 3: Age-wise distribution of non-neoplastic and neoplastic lesions.

Among non-neoplastic lesions, epididymo-orchitis was predominantly a disease of older men, with 21 of 30 cases (70.00%) above 40 years and a peak above 60 years (10 cases). Hydrocoele/pyocoele showed a striking predilection for the elderly (14/22; 63.64% above 60 years), as did normal-study specimens (10/18; 55.56%) and atrophy with maturation arrest (4/7 above 60 years). In contrast, torsion/trauma was concentrated in the second decade (7/10; 70.00%), with 9 of 10 cases occurring by 30 years of age. Cryptorchidism was seen in two children (0-10 years), but four of six cases (66.67%) presented in adulthood (21-50 years). Abscess peaked in the fifth decade (Table 5).

Table 5: Age-wise distribution of non-neoplastic lesions (n = 111)

Lesion	0-10	11-20	21-30	31-40	41-50	51-60	>60	Total	%
Epididymo-orchitis	0	1	3	5	5	6	10	30	27.03
Hydrocoele / Pyocoele	0	0	1	2	2	3	14	22	19.82
Atrophy with arrest	0	0	2	1	0	0	4	7	6.31

Lesion	0-10	11-20	21-30	31-40	41-50	51-60	>60	Total	%
Cryptorchidism	2	0	2	1	1	0	0	6	5.41
Abscess	0	3	1	4	5	2	1	16	14.41
Gangrenous testes	0	1	0	0	0	0	1	2	1.80
Torsion / Trauma	0	7	2	0	1	0	0	10	9.01
Normal study	1	1	0	2	2	2	10	18	16.22
Total	3	13	11	15	16	13	40	111	100

Among neoplasms, germ cell tumours clustered in young adults: all 8 seminomas occurred between 21 and 50 years (4 in the third decade); 10 of 11 mixed germ cell tumours occurred between 11 and 40 years (5 in the third decade); and all 5 embryonal carcinomas occurred between 11 and 30 years. Both yolk sac tumours were seen in the first decade. In contrast, all 5 non-Hodgkin lymphomas occurred after 50 years (3 above 60 years), and the solitary Leydig cell tumour was seen above 60 years. Mesenchymal tumours were spread across the third, fifth and seventh decades (Table 6).

Table 6: Age-wise distribution of neoplastic lesions (n = 36)

Tumour type	0-10	11-20	21-30	31-40	41-50	51-60	>60	Total	%
Seminoma	0	0	4	2	2	0	0	8	22.22
Yolk sac tumour	2	0	0	0	0	0	0	2	5.56
Mixed GCT	0	2	5	3	0	1	0	11	30.56
Non-Hodgkin lymphoma	0	0	0	0	0	2	3	5	13.89
Embryonal carcinoma	0	2	3	0	0	0	0	5	13.89
Smooth muscle / Adipocytic	0	0	1	0	1	0	2	4	11.11
Leydig cell tumour	0	0	0	0	0	0	1	1	2.78
Total	2	4	13	5	3	3	6	36	100

DISCUSSION

The present study analysed 147 orchidectomy specimens received over five years at a tertiary care centre in Bareilly, Uttar Pradesh. In keeping with virtually all published series, non-neoplastic lesions (75.51%) outnumbered neoplastic lesions (24.49%) **[6-10]**. However, the neoplastic fraction in our series is at the upper end of the reported range. Most Indian studies report neoplasms in 5-20% of cases (Table 7), and only a few series approach our figure. This likely reflects referral bias, as a tertiary oncology-capable centre receives a disproportionate share of suspected testicular malignancies, as well as the exclusion of infertility biopsies from our denominator.

Table 7: Comparison of non-neoplastic and neoplastic lesions with other studies

Study	Place	n	Non-neoplastic	Neoplastic
Sundari Devi et al. (2015) **[10]**	Telangana	-	94.20%	5.80%
Mansi S et al. (2017) **[8]**	Jammu	-	93.00%	7.00%
Myes D et al. (2020) **[11]**	Ahmedabad	167	88.62%	11.38%
Patel RA et al. (2026) **[12]**	Silvassa	62	95.10%	4.80%
Hemavathi R et al. (2016) **[6]**	Karnataka	-	86.00%	14.00%
Patel P et al. (2025) **[13]**	Surat	30	86.66%	13.34%

Study	Place	n	Non-neoplastic	Neoplastic
Sodha S et al. (2024) [14]	Bikaner	60	85.00%	15.00%
Tekumalla A et al. (2019) [9]	Karimnagar	80	81.25%	18.75%
Mahesh B Patel et al. (2015) [7]	Ahmedabad	-	80.00%	20.00%
Present study	Bareilly	147	75.51%	24.49%

n not stated where marked '-'. Myes et al. figure calculated from 148 non-neoplastic and 19 neoplastic cases of 167.

Non-neoplastic lesions

Epididymo-orchitis was the commonest non-neoplastic lesion in our study (27.03%). Inflammation has likewise been the leading lesion in several Indian series: Tekumalla et al. reported non-specific epididymo-orchitis in 38.5% of non-neoplastic cases [9], Myes et al. in 30.3% of non-neoplastic testicular lesions [11], and Jakkulwar and Sonwane in 60.34% of tumour-like lesions [15]. By contrast, torsion/infarction has dominated other series, ranging from 16.6% to 54.90% [12-14,16] (Table 8). Such variation is expected, since the relative frequency of each lesion depends heavily on local surgical practice, referral patterns, and whether paratesticular and prophylactic specimens are included.

The older age of our epididymo-orchitis patients (70% above 40 years) is consistent with Tekumalla et al., who reported a peak in the sixth and seventh decades, and with Kaver et al. [9,17]. In older men, ascending infection from the lower urinary tract, often related to prostatic enlargement or urethral stricture, is the usual mechanism, and severe or refractory cases come to orchidectomy, particularly when abscess formation or a mass-like presentation mimics a neoplasm [9,16].

Hydrocoele/pyocoele formed the second largest group (19.82%) and was overwhelmingly a lesion of the elderly. Long-standing hydrocoeles are associated with pressure atrophy and impaired spermatogenesis of the underlying testis, and secondary infection produces pyocoele, both of which favour orchidectomy in older patients [12,16]. Torsion/trauma showed the expected strong predilection for the second decade (70%), in agreement with the literature describing torsion as a surgical emergency of adolescence and young adulthood [14,18]. The smaller proportion of torsion in our series may reflect timely detorsion with salvage, so that only non-viable testes reached the pathology laboratory.

Eighteen specimens (16.22%) showed no significant pathology; more than half of these were from patients above 60 years. In this age group, bilateral orchidectomy is commonly performed as androgen-deprivation therapy for carcinoma prostate, and comparable proportions of histologically normal testes (21.5-45.3%) have been recorded by others [9,16]. Cryptorchidism (5.41%) was relatively infrequent; notably, two-thirds of our cases presented in adulthood, reflecting delayed surgical correction. Since cryptorchidism carries an increased risk of germ cell neoplasia, careful sampling to exclude GCNIS is recommended in such specimens [2,16].

Table 8: Comparison of common non-neoplastic lesions with other studies (%)

Study	Epididymo-orchitis	Torsion / Infarction	Abscess	Atrophy	Cryptorchidism
Tekumalla A et al. [9]	38.50	12.30	-	23.10	4.60
Myes D et al. [11]	30.30	27.50	20.20	-	11.00
Jakkulwar SB et al. [15]	60.34	24.14	-	-	-
Sodha S et al. [14]	9.80	54.90	15.68	-	7.84
Patel RA et al. [12]	12.90	20.90	-	19.30	8.00

Study	Epididymo-orchitis	Torsion / Infarction	Abscess	Atrophy	Cryptorchidism
Patel P et al. [13]	6.60	16.60	-	6.60	13.30
Present study	27.03	9.01	14.41*	6.31	5.41

*Denominators differ between studies (all non-neoplastic lesions, testicular lesions only, or all specimens), so figures are indicative. *Abscess and infarction were recorded together in the present study.*

Neoplastic lesions

Germ cell tumours constituted 72.22% of neoplasms in our study. This is lower than the 76-95% usually reported [9,19,20], because our series also includes lymphomas and paratesticular mesenchymal tumours within the orchidectomy material. Among testicular primaries alone, germ cell tumours remain the overwhelming majority, in agreement with the literature.

The most distinctive feature of our series is that mixed germ cell tumour (30.56%) outnumbered pure seminoma (22.22%), and non-seminomatous plus mixed tumours together formed half of all neoplasms. Most Indian series report seminoma as the commonest testicular tumour, at 26-44% [9,11,14,16,21]. Our pattern, however, closely matches Jakkulwar and Sonwane, who also found mixed germ cell tumour (34.61%) ahead of seminoma (26.92%) [15] (Table 9). Since a mixed tumour is managed as non-seminomatous regardless of any seminomatous component, and the proportion of embryonal carcinoma influences metastatic risk, meticulous sampling and reporting of each component's percentage is essential [5,16]. Embryonal carcinoma (13.89%) was also relatively frequent and confined to patients up to 30 years of age.

The age distribution of our germ cell tumours (peak in the third decade, with two-thirds of all neoplasms occurring by 40 years) is consistent with the reverse age pattern of testicular cancer and with previous reports [9,19,20]. Both yolk sac tumours occurred in the first decade. Under the WHO 2022 classification these correspond to the prepubertal type, which is unrelated to GCNIS and carries a biology distinct from the post-pubertal yolk sac tumour [5].

Non-Hodgkin lymphoma accounted for 13.89% of neoplasms, and all cases occurred after 50 years. This agrees with the recognized role of primary testicular lymphoma as the commonest testicular neoplasm in men above 60 years [22], and with Indian series reporting lymphoma in 10.5-22.2% of testicular neoplasms [11,14-16]. The single Leydig cell tumour in our series was seen in an elderly patient, and the four smooth muscle/adipocytic tumours most likely represent paratesticular mesenchymal lesions removed with the testis.

Table 9: Comparison of neoplastic lesions with other studies (% of neoplasms)

Study	n	Seminoma	Mixed GCT	Embryonal Ca	Teratoma	Yolk sac	NHL
Tekumalla A et al. [9]	15	40.00	33.33	-	13.33	6.66	6.66
Myes D et al. [11]	19	26.30	21.00	-	10.30	-	10.50
Jakkulwar SB et al. [15]	26	26.92	34.61	7.69	3.84	-	15.38
Athira KP et al. [16]	9	33.00	11.00	-	11.00	-	22.00
Sodha S et al. [14]	9	44.44	22.22	-	11.11	-	22.22
Present study	36	22.22	30.56	13.89	-	5.56	13.89

GCT: germ cell tumour; Ca: carcinoma; NHL: non-Hodgkin lymphoma. Mixed GCT for Tekumalla et al. combines seminomatous and non-seminomatous mixed tumours.

Specimen Laterality

Right-sided involvement (50.34%) predominated in our study, in agreement with Tekumalla et al., Jakkulwar and Sonwane, and Patel P et al. [9,13,15], while left-sided predominance has been reported by Myes et

al. and Athira et al. [11,16]. The proportion of bilateral specimens (9.52%) is intermediate, and largely reflects bilateral orchidectomy for carcinoma prostate; series with a high proportion of prophylactic orchidectomies report far higher bilateral rates (49% in Athira et al.) [16] (Table 10).

Table 10: Comparison of specimen laterality with other studies (%)

Study	Right	Left	Bilateral
Tekumalla A et al. [9]	51.25	31.25	17.50
Jakkulwar SB et al. [15]	53.58	46.43	0
Patel P et al. [13]	56.70	36.70	6.60
Myes D et al. [11]	46.71	49.70	3.59
Patel RA et al. [12]	50.00	50.00	-
Athira KP et al. [16]	23.74	27.34	48.92
Present study	50.34	40.13	9.52

Percentages for Myes et al. and Athira et al. calculated from case numbers reported in the respective articles.

Limitations

This was a retrospective, single-centre study, and clinical details such as presenting symptoms, serum tumour markers, staging and follow-up were not uniformly available. Some categories (hydrocoele/pyocoele, abscess/ infarction, smooth muscle/ adipocytic tumours) were recorded as combined groups, limiting finer subclassification. The relatively high proportion of neoplasms may reflect referral bias and may not represent the general population. Multicentric prospective studies with clinicopathological and immunohistochemical correlation are needed.

CONCLUSION

Non-neoplastic lesions constitute the majority of orchidectomy specimens, with epididymo-orchitis and hydrocoele/pyocoele being the commonest, predominantly in older men, while torsion remains a disease of adolescence. Neoplasms formed nearly a quarter of our cases, a higher proportion than in most Indian series, with mixed germ cell tumour exceeding pure seminoma and non-Hodgkin lymphoma confined to men above 50 years. The distinct age patterns of the two groups should inform clinical suspicion, but histopathological examination of every orchidectomy specimen, with thorough sampling and WHO 2022-based reporting, remains indispensable for accurate diagnosis, prognostication and management.

Declaration

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Conflict of Interest: The authors declare no conflict of interest.

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