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Clinicopathological Correlation of Germ Cell Tumours in Gonads

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Ovaries are paired pelvic organs located on thesides of the uterus. Although it is rare in the general population, between the age group of 20-40 years in males,Testicular germ cell neoplasms are the most common form of malignant tumour reported. In young women ovarian tumours rank second among the ovarian germ cell tumors and in males, the testicular germ cell tumorsserves as the leading percentage of tumors among all the testicular tumors seen in the early and late adulthood (3rd and 4th decade) of life. The people of reproductive age group are most vulnerable to gonadal germ cell tumours.Curing this age group without affecting their fertility is a challenging task. The risk of malignancy increases in existence of cryptorchidism/ undescended testis as in our study, 1 case of classical seminoma presented with undescended testis. To study germ cell tumors in gonads in relation to age, parity and mode of presentation and the correlation of biochemical markers and immunohistochemical markers at places in gonadal germ cell tumors.

Keywords: Testicular germ cell neoplasms; ovarian germ cell tumors; gonadal germ cell tumors; malignancy.

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1. INTRODUCTION

Germ cell tumors, arare and complex group of heterogeneous neoplasms, comprise both benignand malignant histology. These tumors can occur anywhere in the body, most commonly ovaries and testis and possess diagnostically challenging issues for the pathologist [1].The totipotent primordial germ cells of theembryonic gonad [2] serves as the birthplace of these tumors.Ovarian germ cell tumours accounts for 15 to 20% and constitute 2nd largest group of ovarian tumours, and accounts for only 2 - 5% [3] of all malignant ovarian neoplasms. The most of tumours being benign mature cystic teratomas [2]. The young women are relatively more affected by this tumour. It also occurs in infants and older women.Among the ovarian germ cell tumoursdysgerminoma, immature teratoma, yolk sactumour and mixed germ cell tumoursare most malignant. Embryonal carcinomas, choriocarinoma and malignant strumaovarii are less malignant.

19 years is the mean age of ovarian GCTs. The occurrenceof TGCTs is much higher than that of OGCT. At 19 years of age GCToccurs in 44.5 per million in males but only 10.4 per million in females. These tumours presents mostly with abdominal pain, abdominal mass, menstrual disturbances with 10% of patients exhibiting acute abdomen as a result of torsion, haemorrhage or tumour rupture. The other symptoms found commonly are abdominal distension, fever and vaginal bleeding [4]. Usually, these tumours are unilateral and bilateral in few cases.In order to preserve fertility in young patients, surgery should be conservative. Since most of the cases reported are benign, there is excellent prognosis. With appropriate management the aggressive malignant cases can also be controlled.

The malignant tumour that predominantly affects the 20-40 years age group in adult males areTesticular germ cell neoplasms. This tumouris rare in general population [5] with a worldwide incidence rate of 0.0015% with considerablevariations between countries [6]. One of the studies revealed that in the US the incidence of testicular germ cell tumourshas increased among black men [7], Making it one of the leading causes of death [8] and accounting for 1% to 1.5% of all testicular tumours.

The familial testicular germ cell tumours mostly occur among first degree relatives and accounts for 1% to 3% only [9,10] insisting the significance of genetic susceptibility in this disease [11,12,13]. Pathologically, the testicular germ cell tumours can be categorized as seminomatous(resemblingprimodial germ cells (PGCs)) and non - seminomatous(resembling undifferentiated differentiated or extraembryonic pattern [14-17].

The most common presentation is unilateral scrotal mass and testicular pain 15. 1% - 2% of testicular GCTs can present bilaterally.

Testicular swelling and other clinical history like painful or painless, change in size, sexual history, symptoms of UTI, history of surgery, infertility or mumps orfamily history of testicular cancer [16,18-22] should be evaluated thoroughly with clinical examination and in order to rule out the malignancy that incidence of benign testicular tumours is relatively less common.

2. MATERIALS AND METHODS

This prospective study conducted at Sree Balaji Medical College and Hospital, Chromepet, in the Department of Pathology. The study was undertaken during the period April 2015 to September 2016. The material was received as surgically resected specimen from patients admitted in Department of General Surgery and Department of Obstetrics and Gynaecology at SreeBalaji Medical College and Hospital, Chromepet.

Clinical details like age, sex, signs and symptoms, serum tumour markers and radiological findings were included. A Total of 30 germ cell tumours were studied, 25 out of 86 ovarian specimens were germ cell tumours and 5out of 58 orchidectomy specimens were germ cell tumours. The gross photographs were taken and specimens were allowed to fix in 10% formalin for 24 – 48 hours. On receiving the specimen, the gross features such as size, shape, colour, external appearance, findings on cut section were noted and multiple bits were taken from representative areas, processed for Histopathological Examination.

Paraffin blocks were made and cut at 4 microns thickness and stained with Hematoxylin and Eosin, Periodic Acid Schiff and Immunohistochemical stains were done wherever necessary. A detailed microscopic examination of the tumour was done to arrive at a histopathological diagnosis. The data complied was analysed for various parameters like age,

sex, parity, clinical signs and symptoms, gross features of the tumours and the incidence of different histological types.

3. RESULTS

The Departmentof Pathology, SreeBalaji Medical College and Hospital, Chennai received 86 cases of ovarian tumours and 58 cases of orchidectomy specimens during the period of April 2015 to September 2016. 30 cases of germ cell tumours (GCT) were studied in total, Out of 86 ovarian tumours, 25 cases were germ cell tumours and out of 58 orchidectomy specimens 5 cases were found to be germ cell tumours.

The 25 cases of ovarian germ cell tumours comprised of 19 benign cystic mature teratoma, 2 immature teratoma, 1 yolk sac tumour, 2 dysgerminoma and 1 carcinoid tumour. Out of 5 cases of testicular germ cell tumours, 2 cases were classical seminoma and 3 cases were mixed germ cell tumours (first was a yolk sac tumourwith seminoma, second was embryonal carcinoma with yolk sac tumour and the third was embryonal carcinoma with immature teratoma).

Out of 2 cases of classical seminoma, 1 case presented at the age of 28 years, which is younger than the normal range of age. This case had historyof orchiopexy done at 12 years of age. So the risk of malignancyat younger age was seen. The serum tumour markers were seen with many raise for malignant cases preoperativelyand immunohistochemical stain were used to identify histological subtypes and also in case of mixed germ cell tumours.

In this study, the most commonly found tumour were benign cystic mature teratoma (19 cases) out of 25 ovarian germ cell tumours, followed by immature teratoma (2 cases) and dysgerminoma (2 cases).

3.1 Immature Teratoma

Cases of immature teratoma of ovary were observed in this study. 1 case at 18 years years with raised AFP level 647 IU/ml and hCG negative. 2nd case at 21 years with CA 125 level 115 U/ ml and hCG negative. Tumour size measuring 7x6x4.5 cm and 13x8x3 cm respectively.

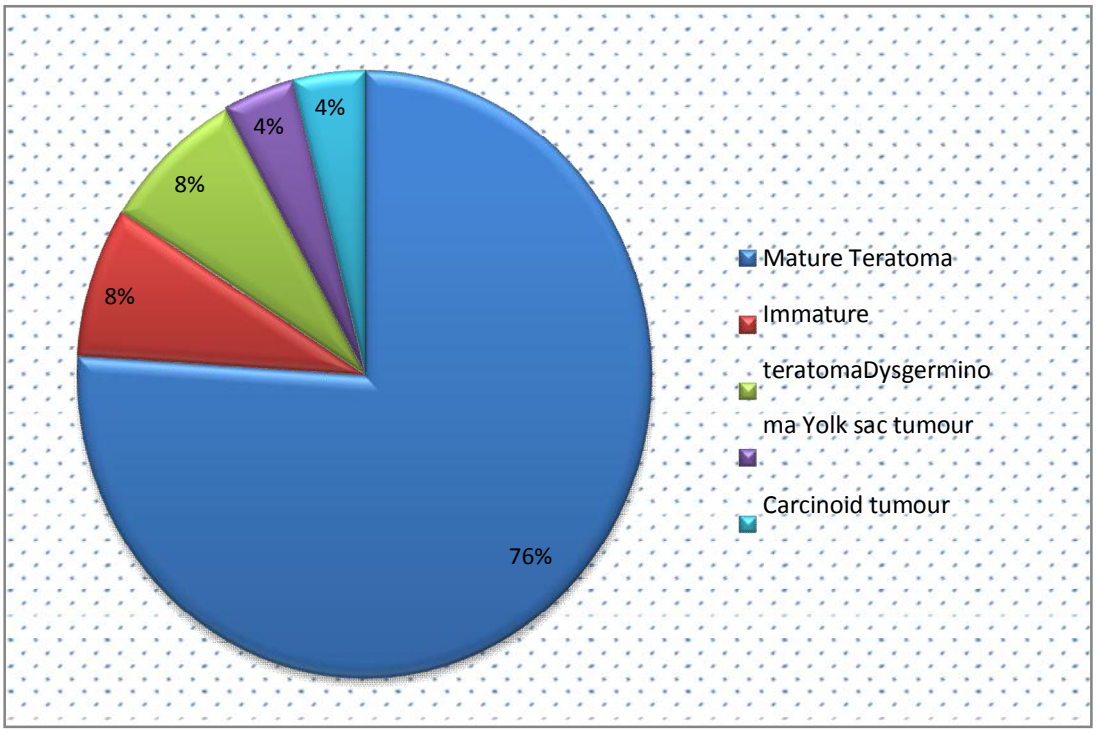

Chart 1. Distribution of histological types of ovarian germ celltumours

Grossly, both solid and cystic areas, containing pultaceous material with tuft of hair follicles seen (Figs. 1, 2). Microscopically, Section shows ovarian stroma with tumour composed with solid and cystic areas. The solid areas showing mature elements composed of skin with adnexal components, bone, cartilage, smooth muscle, neuroglial tissue, respiratory epitelium with mucous glands, adipose tissue. The cystic spaces are lined by columnar epithelium. Areas of immature neuroepethilial tissue and immature mesenchymal tissue are seen with few mitosis (Figs. 3-10).

3.2 Carcinoid Tumour

Case was observed at 33 years of age withtumour size 4x2.5x1 cm. Grossly, solid, homogenous yellow with cystic gelatinous material. Microscopically, Section shows well demarcated nests of small, uniform round cells with clumped chromatin in insular pattern admixed with fibrous stroma (Fig:12).

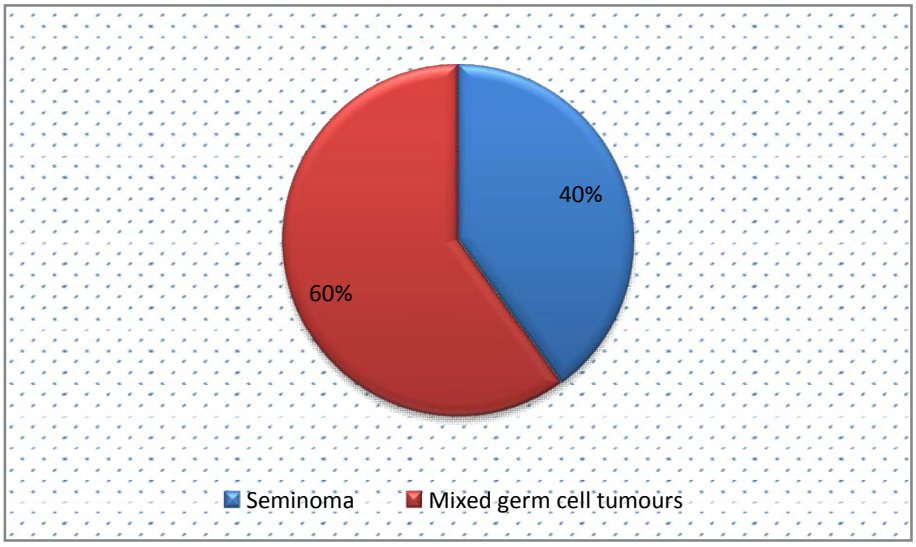

Chart 2. Distribution of histological types of testicular germ cell tumours

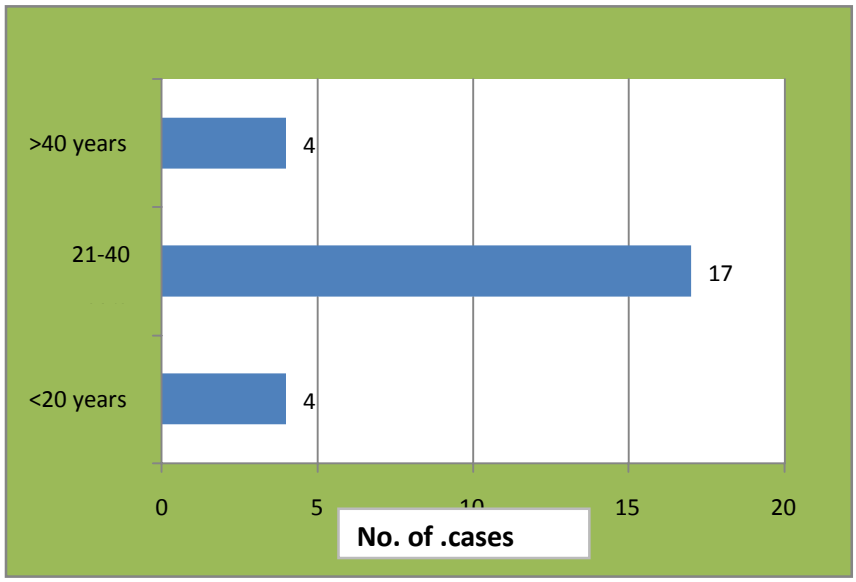

Chart 3. Percentage distribution of ovarian germ cell tumours according to age group

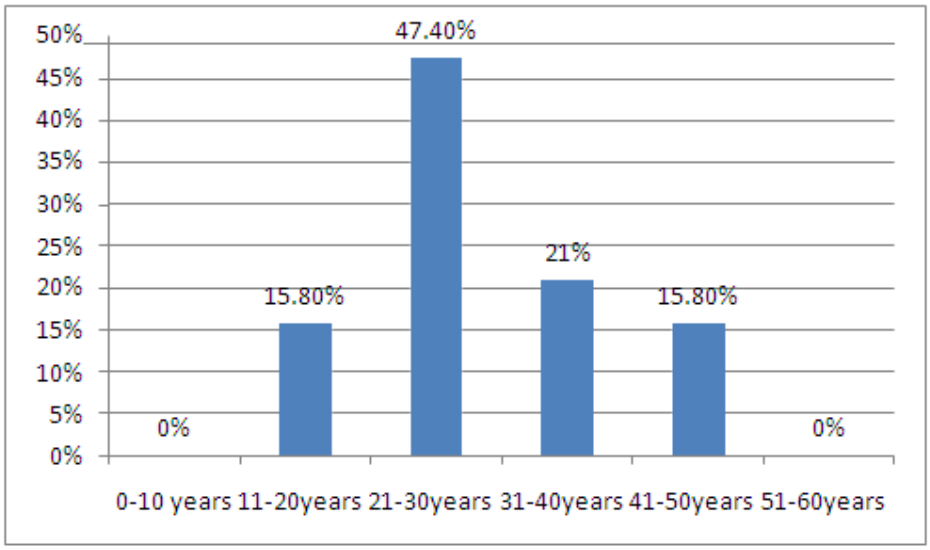

Chart 4. Percentage distribution of benign cystic teratoma according to agegroup

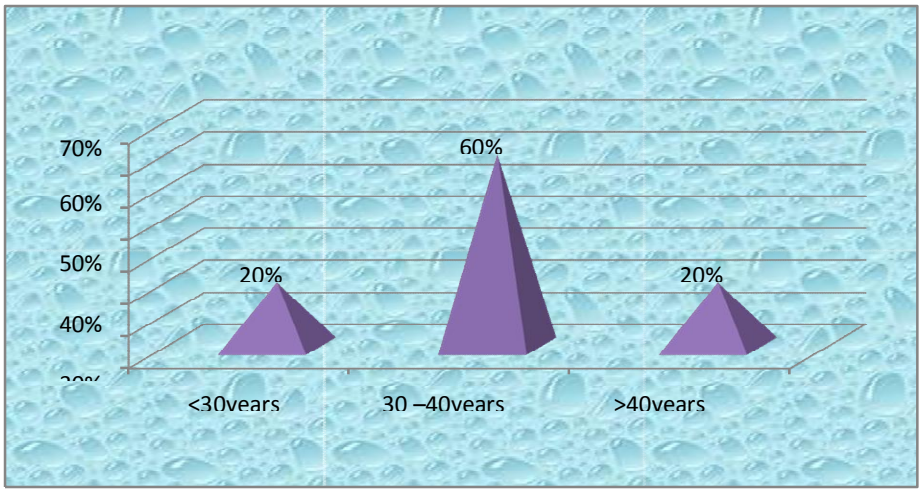

Chart 5. Percentage distribution of testicular germ cell tumoursaccording to age group

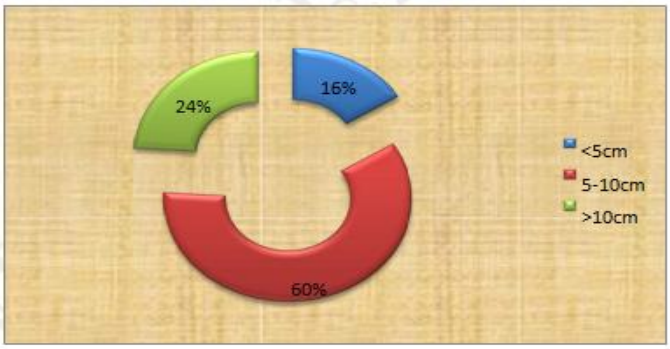

Chart 6. Percentage distribution of ovarian germ celltumoursaccording tosize

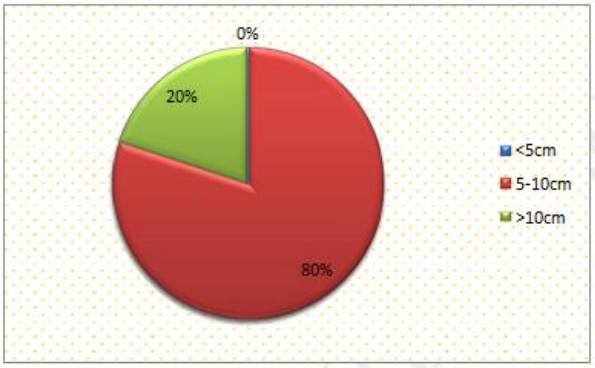

Chart 7. Percentage distributionoftesticular germ cell tumoursaccording tosize

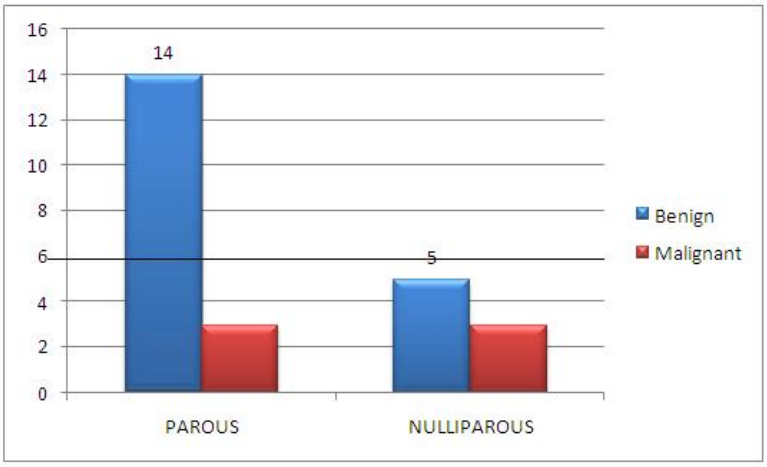

Chart 8. Distributionof ovarian germ cell tumoursaccording toparity

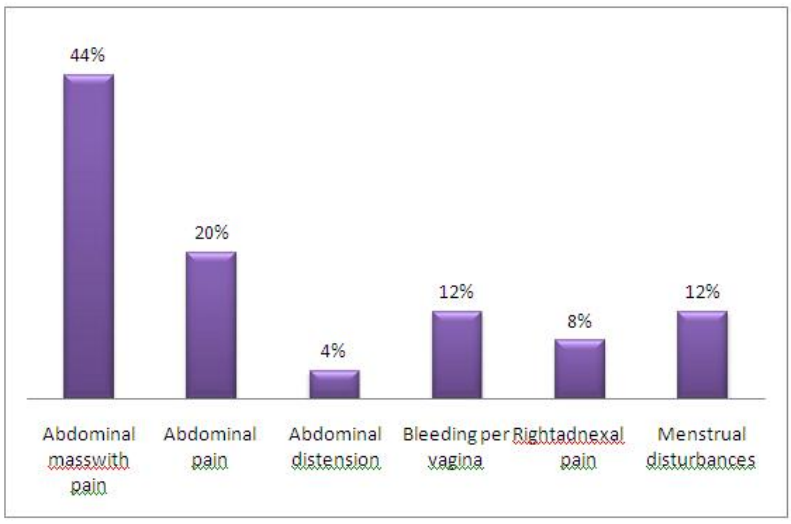

Chart 9. Distribution of presenting symptoms of ovarian germ cell tumour

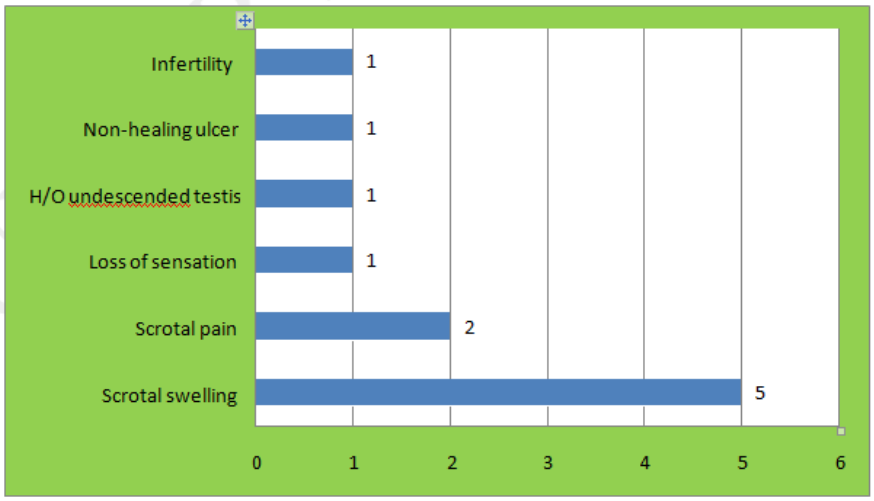

Chart 10. Distribution of presenting symptoms of testicular germ celltumours

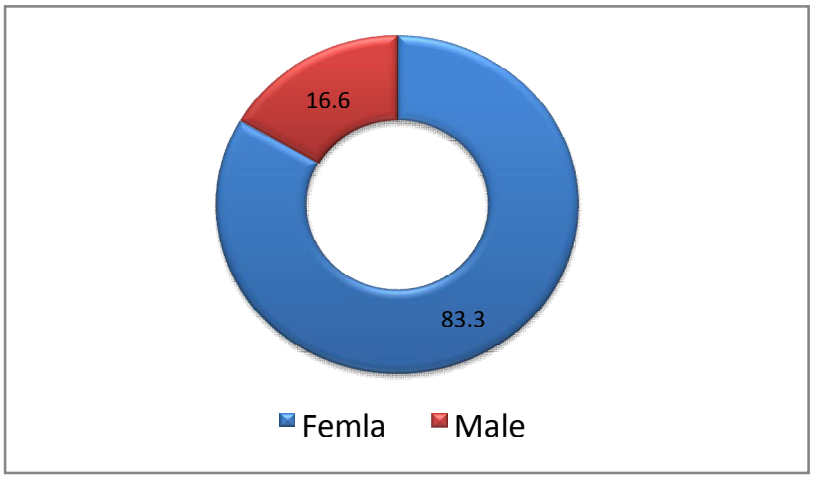

Chart 11. Percentage distribution of germ cell tumoursamong gonads in thisstudy

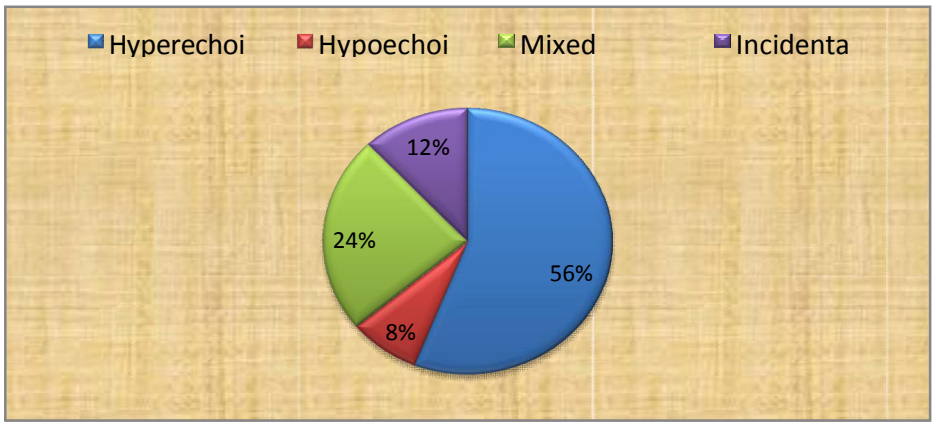

Chart 12. Radiological findings of ovarian germ cell tumours

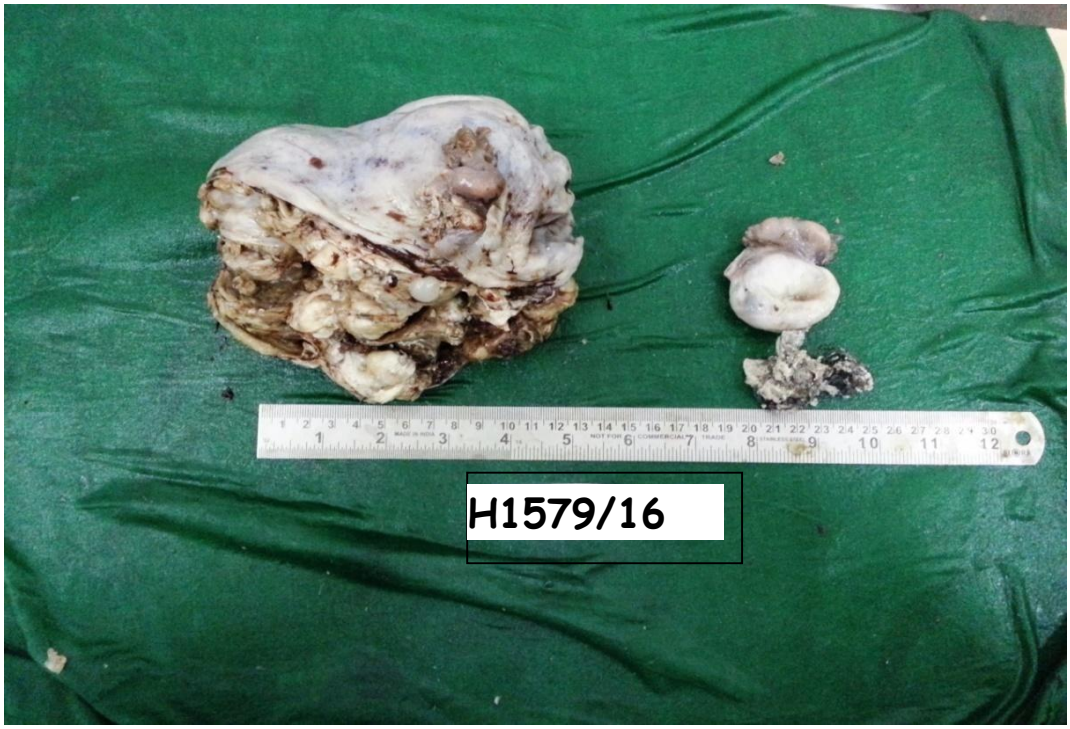

Fig. 1. Gross picture of immature teratoma : E/S – Breached capsule with solid and cystic areas

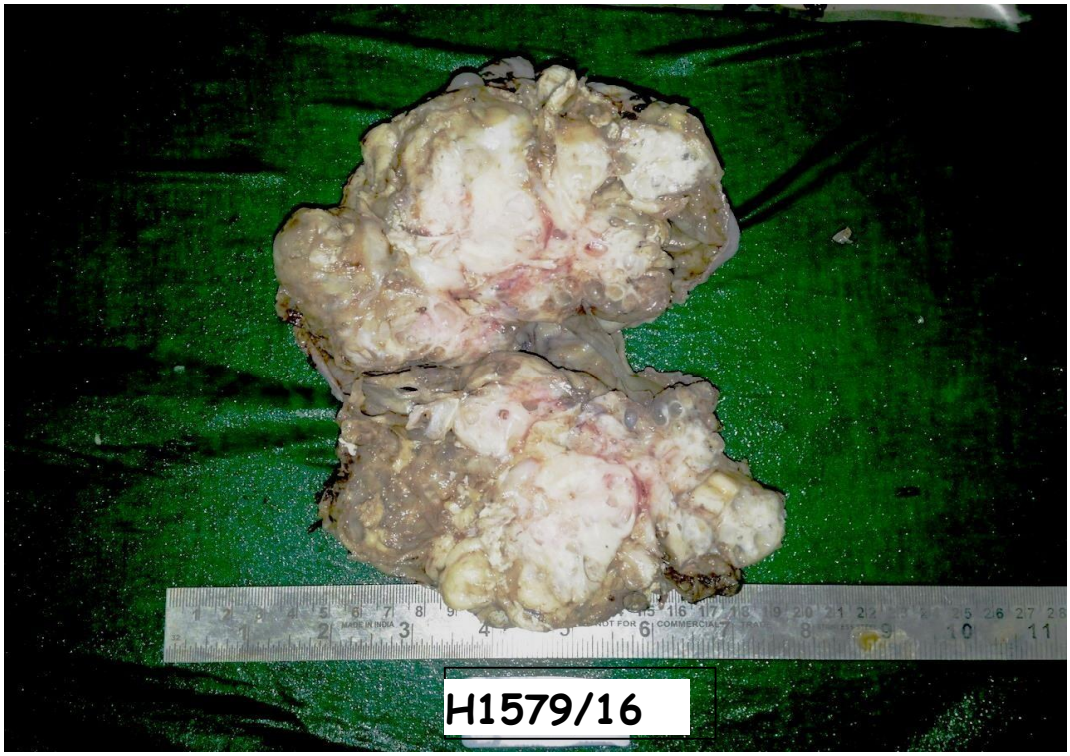

Fig. 2. Gross : Cut surface showing solid and cystic spaces with hair follicle

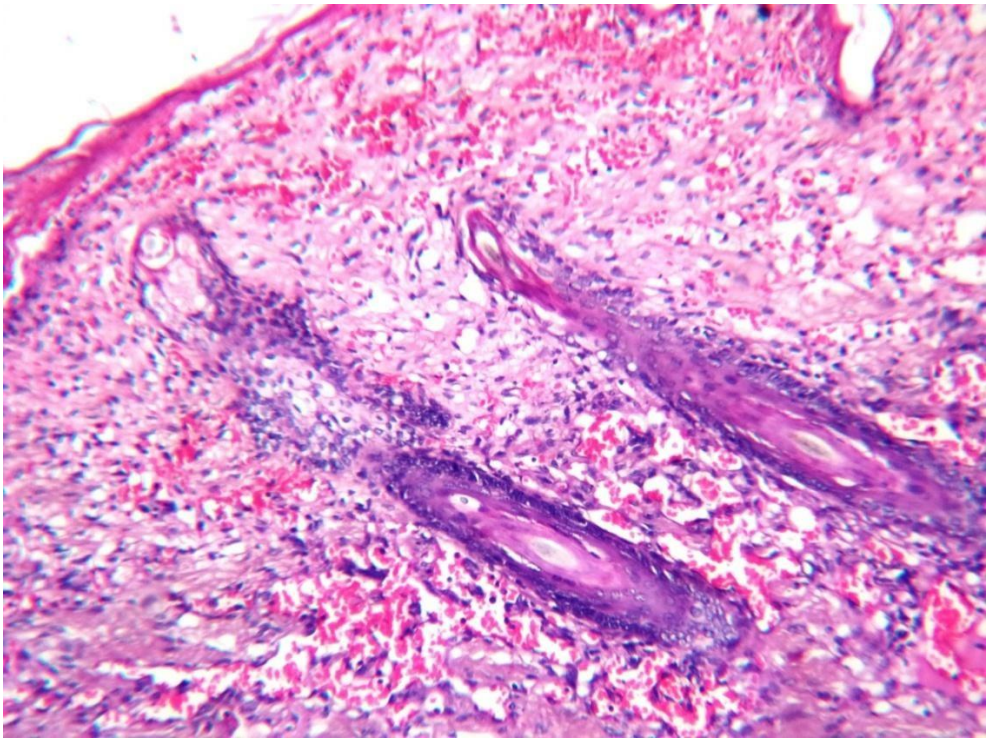

Fig. 3. LPF (100x) : H & E: Skin with pilosebeceous units in teratoma

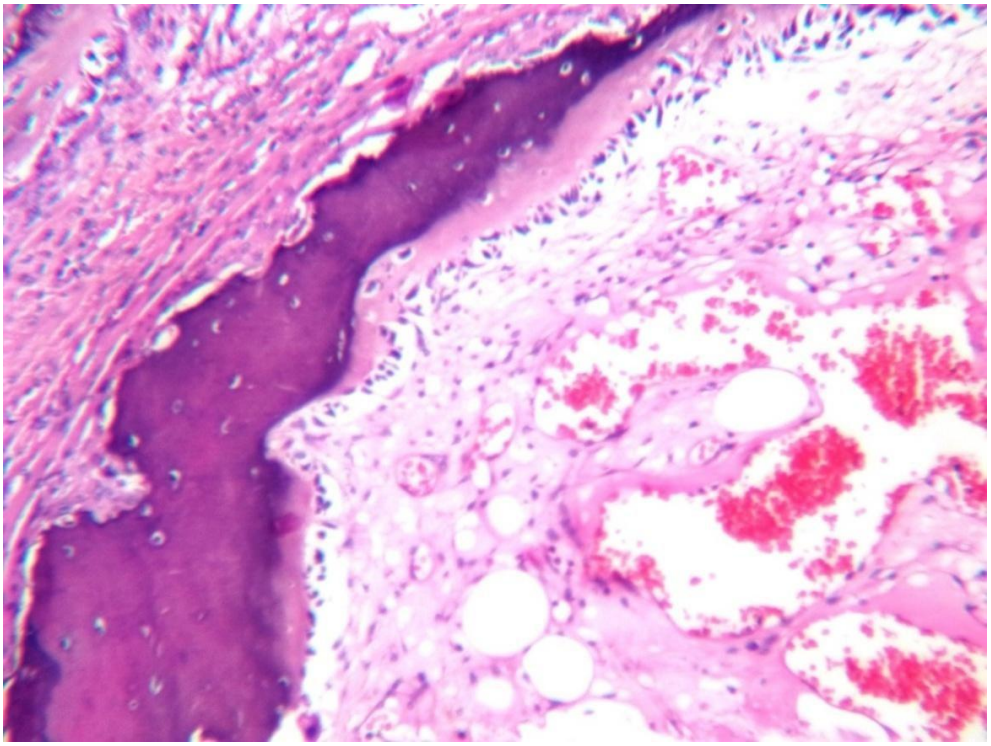

Fig. 4. LPF (100x): H & E: Picture showing bone tissue with adipose tissue and blood vessels in teratoma

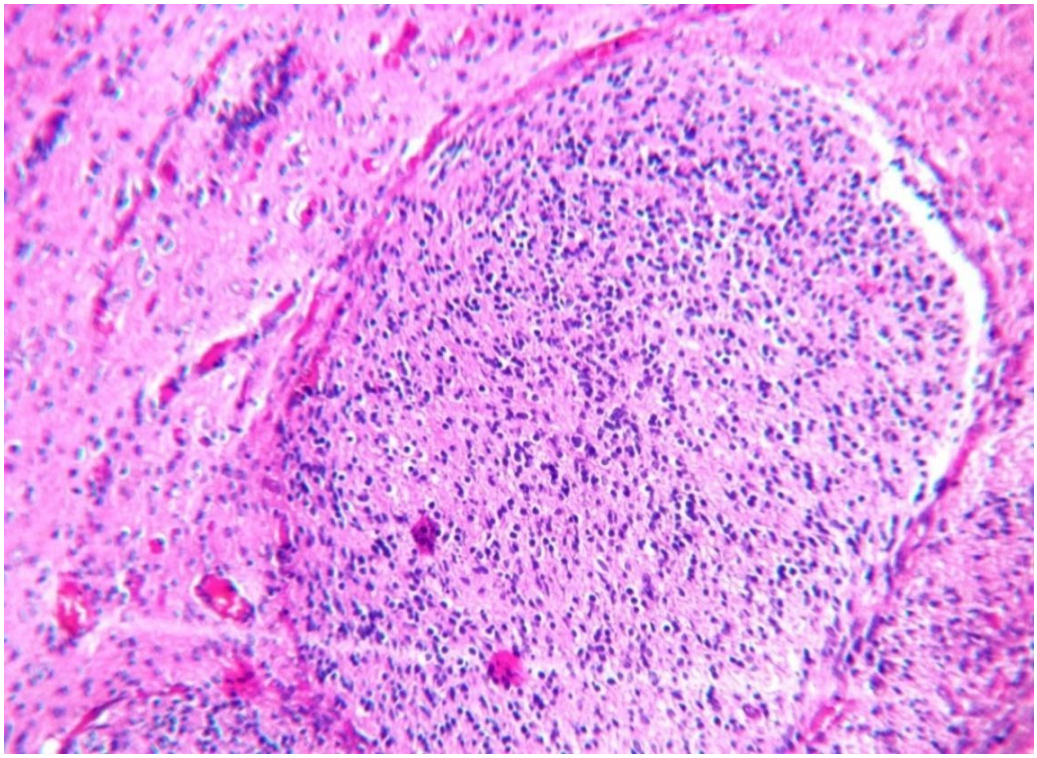

Fig. 5. LPF (100x): H & E: Islands of immature glial tissue in immature teratoma

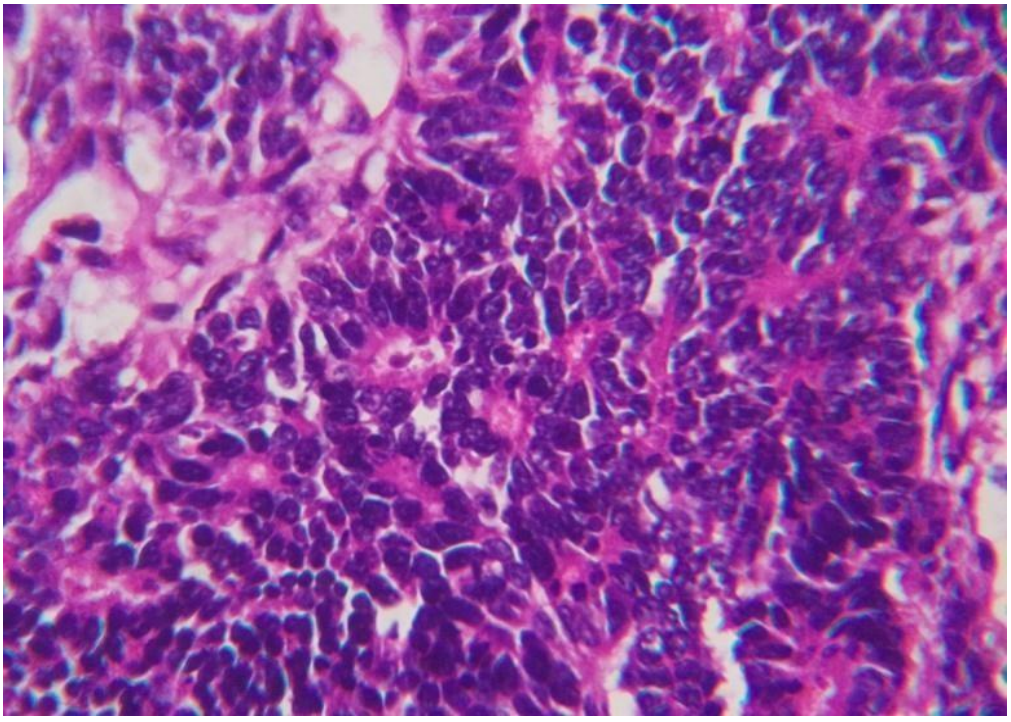

Fig. 6. LPF (100x): H & E: Primitive neuroepithelium with hyperchromatic nuclei arranged in rosettes in immature teratoma

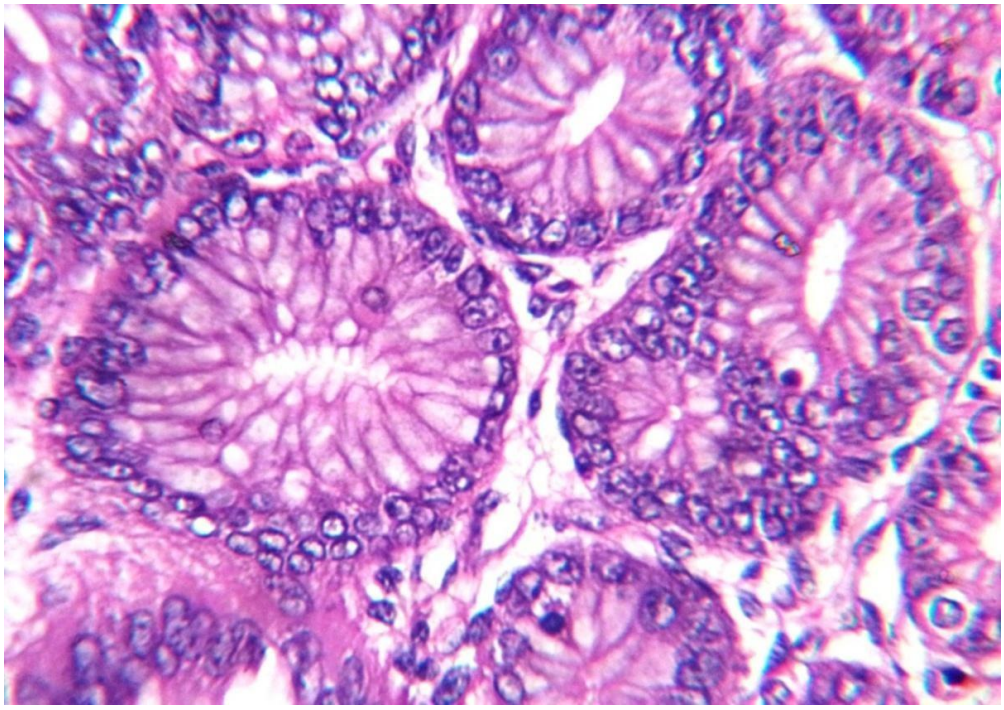

Fig. 7. HPF (400x): H & E: Intestinal type of glands in teratoma

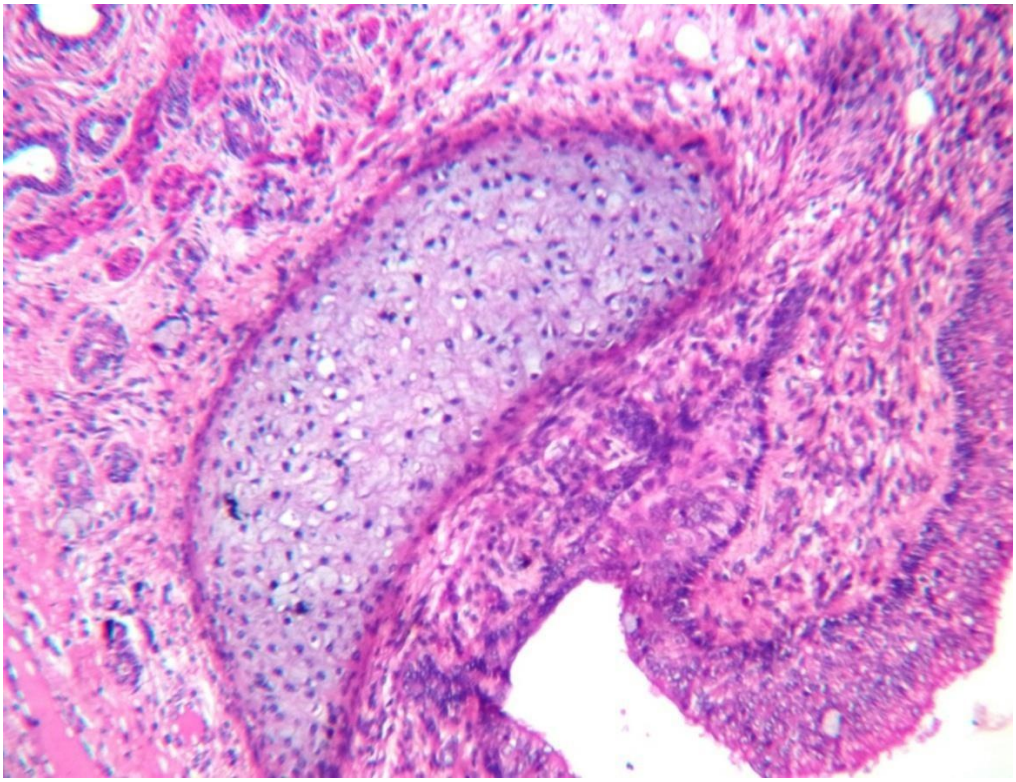

Fig. 8. LPF (100x): H & E: Island of cartilage, respiratory epithelium and glandular tissue in teratoma

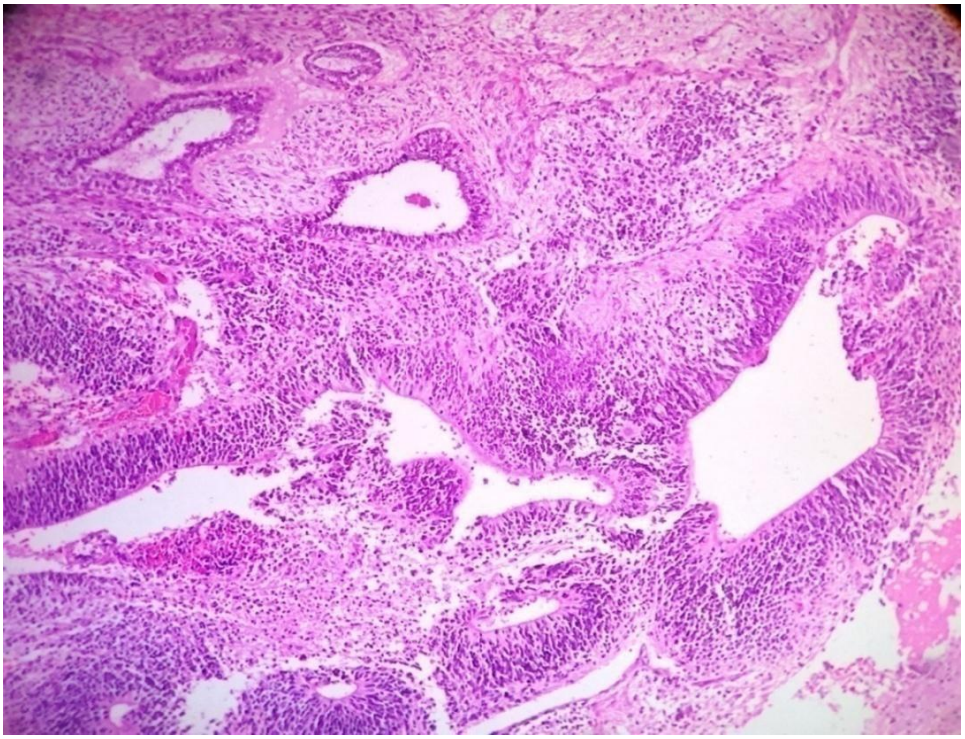

Fig. 9. LPF (100x) : H & E: Primitive neuroectodermal elements in immature teratoma

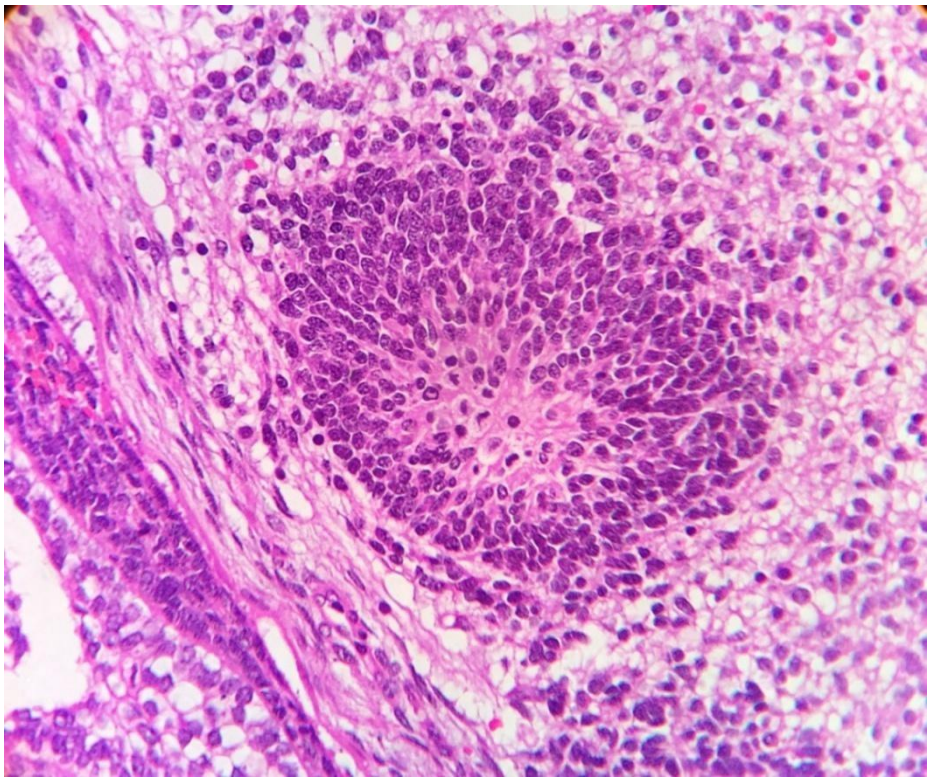

Fig. 10. HPF (400x): H & E: Primitive neuro epithelium in immature teratoma

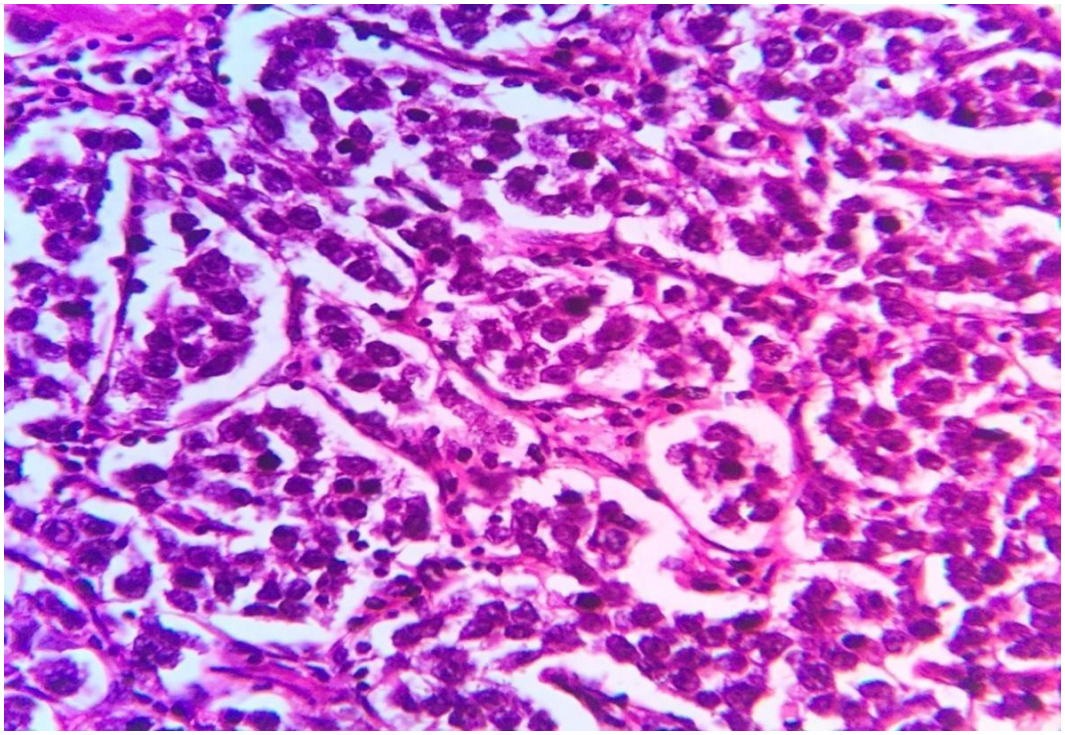

Fig. 11. HPF (400x): H & E: Large vesicular tumour cells with clear cytoplasm arranged in nests separated by fibrous stroma with lymphoctres

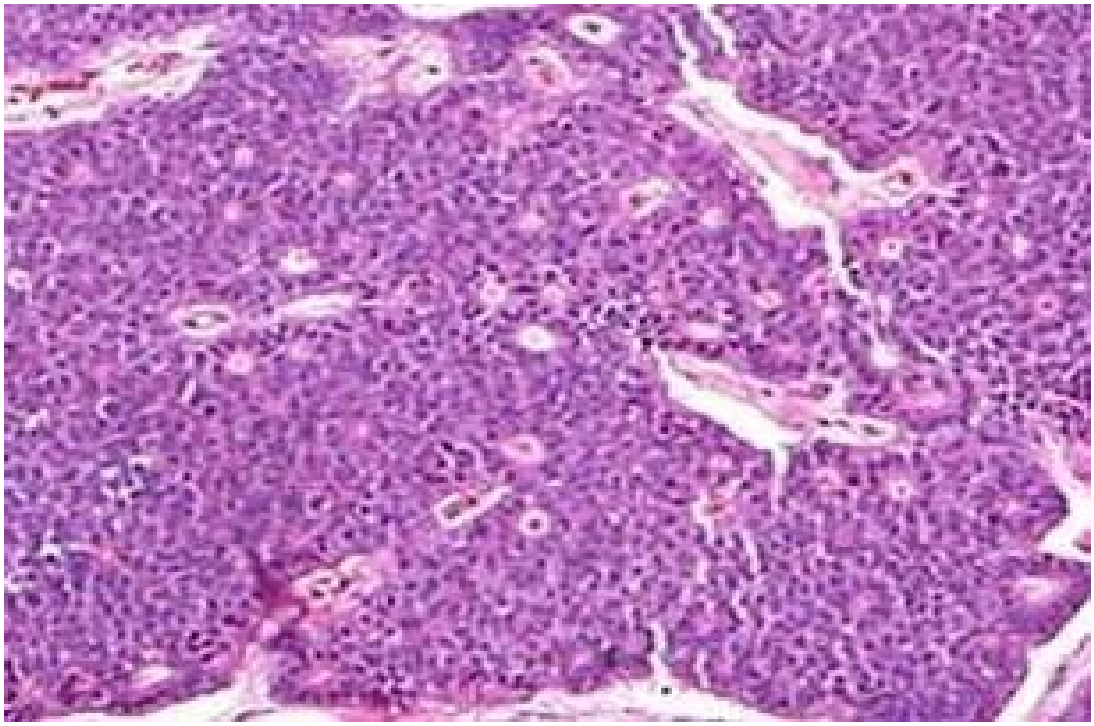

Fig. 12. LPF(100x): H & E: Nests of round to oval cells with clumped chromatin - Carcinoidtumour

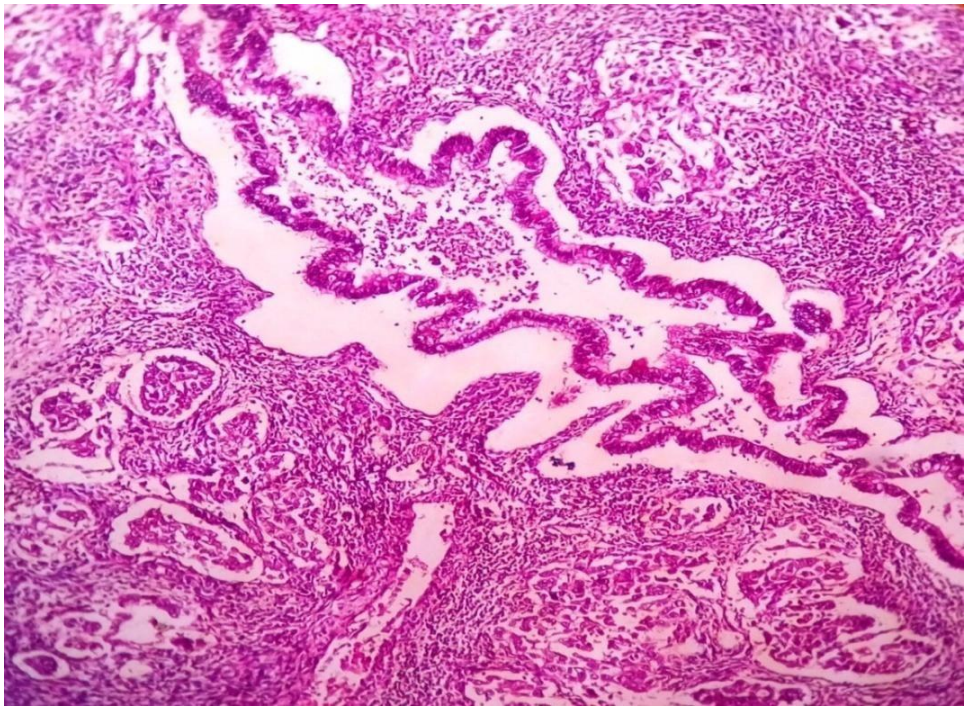

Fig. 13. HPF (400X): H & E: Neoplasm composed of pleomorphic cells arranged in glandular pattern

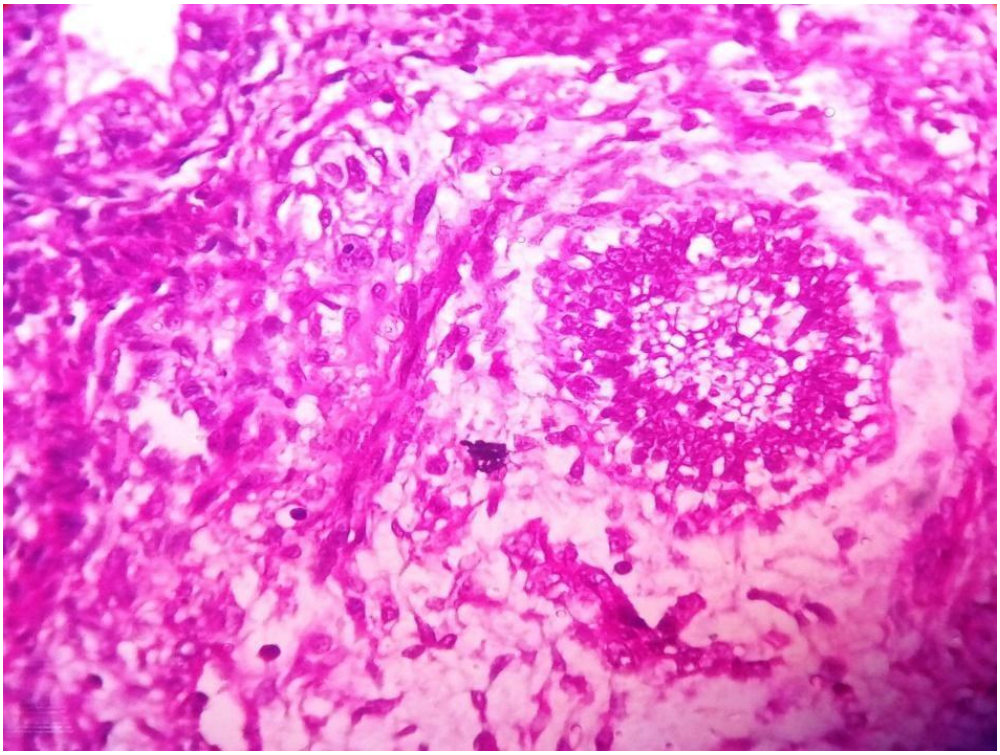

Fig. 14. HPF (400X): H & E: Immature myxomatousstromasurrounding tubular structure in immatureteratoma

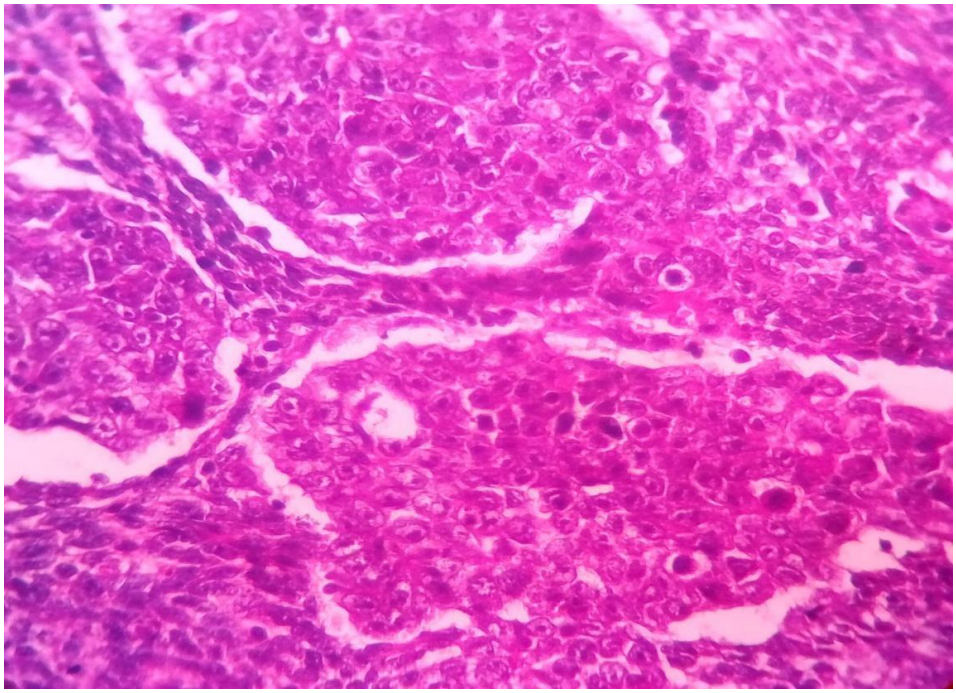

Fig. 15. HPF (400X): H & E: Islands of round to oval tumour cells with large vesicular nuclei and atypical mitotic figures.

3.3 Gender Distribution

Out of 30 cases of gonadal germ cell tumour present in this study, 25 cases occurred in females and 5 in males.

4. DISCUSSION

A total of 30 germ cell tumours of gonads were included in the study. The ovarian tumoursin the study comprised of 86 cases. Among these 25 germ cell tumours, 19 benign cystic mature teratoma, 2 immature teratoma, 1 yolk sac tumour, 2 dysgerminoma and 1 carcinoid tumour were observed.

Out of 58 orchidectomy specimens received, 5 cases were found to be testicular germ cell tumours. 2 cases were classical seminoma and 3 cases weremixed germ cell tumours, with a combination of yolk sac tumourwith seminoma, embryonal carcinoma with yolk sac tumour and embryonal carcinoma with immature teratoma.

Clinical history, routine investigations, radiological findings and serum tumoursmarkes were noted. Immunohistochemical staining is done at places.

In the current investigation, 6 cases of malignant ovarian germ cell tumours, 2 cases (33.3%) of dysgerminoma, 2 cases (33.3%) of immature teratoma, 1 case (16.7%) of yolk sac tumour and 1 case (16.7%) of carcinoid tumour were observed.In this study, 33.3% (2 cases) were seminoma and 3 cases (50%) were mixed GCT Abubaker et al 37 reported similar results.

4.1 Age Distribution of Ovarian Germ Cell Tumours

Ovarian germ cell tumours are predominantly found in the 14 years to 58 years age group. Jadhav et al 103 observed that the age group range of ovarian germ cell tumours varied from 13 to 50 years and also observed 3 cases of malignant ovarian GCTs were between 13 to 22 years which is similar to this study. In the present study, the majority of the benign tumourswere for the most part seen in the early adulthood (3rd decade) of life butalso involving a wide range of age groups.

The malignancies predominantly occurred at younger age i.e. < 30 years in this study, followed by 4th decade.

Out of 5 cases of testicular germ cell tumours, 2 cases (33.3%) were classical seminoma and 3

cases (50%) were mixed germ cell tumours. In the testis, the 3 cases of mixed germ cell tumours comprises of yolk sac tumour and seminoma (case 1), embryonal carcinoma and yolk sac tumour (case 2) and embryonal carcinoma and immature teratoma (case 3).

Out of 2 casesof classical seminoma, 1 case presented at the age of 28 years, which is younger than the normal. This case had history of orchiopexy done at 12 years of age for undescended testis. All the malignant ovarian and testicular germ cell tumours had raised serum tumours markers preoperatively.

Majority of the testicular tumoursincluded in the study were malignant germ cell tumours (5/6cases) which belong to 30 – 40 years of age group. In this study, out of 25 ovarian germ cell tumours, 17 patients were parous (14 benign, 3 malignant) and 8 cases were nulliparous (5 benign and 3 malignant). Out of 5 cases of testicular germ cell tumours, 1 case had history of infertility [23-28,22].

3 cases of benign cystic mature teratoma were found was incidental finding during appendicectomy, hysterectomy and Emergency LSCS.

The most common presenting symptom of ovarian germ celltumours were abdominal mass with pain (44%), followed by abdominal pain (20%).The most common presenting symptom of testicular germ cell tumours were scrotal swelling, followed by scrotal pain.

Out of 25 ovarian GCTs, 22 cases were unilateral and 3 cases were bilateral. Majority of the unilateral cases occurred in right side. Out of 5 testicular GCTs, all were unilateral, 4 cases were right and 1 case was left side. No bilateral cases were seen. The ovarian germ cell tumourshad a mean age of 30. 08 years with peak incidence noted in 3 rd decades. The testicular germ cell tumourshad a mean age of 35.4 years with peak incidence noted in 4 th decade.

Among the ovarian tumours, the ovarian germ cell tumoursrank second and affects young women. Among the testicular tumours seen in the early and later adulthood of life (3rd and 4th decade), the testicular germ cell tumoursexhibit the highest percentage. The people of reproductive age group are most vulnerable to gonadal germ cell tumours.Curing this age group without affecting their fertility is a challenging task. The risk of malignancy increases in existence of cryptorchidism/ undescended testis as in our study, 1 case of classical seminoma presented with undescended testis.

Karki S et al. [18] 96 reported 40% (2cases) of mixed GCT of testis of all testicular tumours, 1 case comprised of teratoma with embryonal carcinoma, which is similar to this study. M. T. Zvetkov et al reported mixed germ cell tumour of the testis with four different types of tumours, Teratoma, seminoma, embyonal carcinoma and yolk sac tumour in a 15 year old male.

Naseer et al reported 2 cases of mixed GCT of testis in old patients, one case comprised with components of seminoma + teratoma with malignant transformation+ yolk sac tumour and another case comprised with components of teratoma + yolk sac tumour. Rankawat et al 89 6 cases (17.64%) of mixed GCT, out of it 5 cases were found to be teratocarcinoma and 1 case comprised with components of yolk sac tumour with embryonal carcinoma.

In this study, 3 cases of mixed germ cell tumours were reported, 1 case were found to be with components of seminoma and yolk sac tumour, 1 case of teratocarcinoma and 1 case of embryonal carcinoma with yolk sac tumour.

In this study, the incidence and distribution of germ cell tumours of gonads were noted according to age, parity, mode of presentation and also the many fold raise in serum tumour markers like CA 125, AFP, beta hCG and immunohistochemistry is done to find out the histological types in both pure form and mixed germ cell tumours .[27,28-33]

5. CONCLUSION

The careful clinical evaluation with other investigations like serum tumour markers, radiological findings and immunohistochemical study will be helpful in order to arrive at possible definitive diagnosis.Thus Histopathological examination plays essential role in confirming the diagnosis in these tumours.

CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee.

ACKNOWLEDGEMENTS

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Amitabh Jena. Potpourri testicular tumour-combination of seminoma, teratomaand yolk sac tumourof testis in a young adult male, Departments of Surgical Oncology, SriVenkateswara Institute Of Medical Sciences,Tirupati; 2014.
2. Talerman A. Germ cell tumors of the ovary. In: KurmanRJ, ed. Blaustein"s pathology of the female genital tract. 5th ed. New York, NY: Springer. 2002;1391.
3. Bouquet de Jolinière J1*, Ben Ali N1, Fadhlaoui A1, Dubuisson JB1, Guillou L2, Sutter A2, Betticher D.3, Hoogewoud HM4, Feki A1. Two case reports of amalignant germ cell tumor of ovary and a granulosacell tumor: Interest of tumoralimmunochemistry in the identification and management, Frontiers in oncology. 2014;4:97.
4. Akram M Shaaban, Maryam Rezvani, Khaled M Elsayes, Henry Baskin MD, Jr MD Amr Mourad, MD Bryan R Foster, MD Elke A. Jarboe MD Christine O. Menias MD. Ovarian malignant germ cell tumors: Cellular classification and clinical and imaging features , RSNA; 2013.
5. Phuong L Mai, MD, MS. The international testicular cancer linkage consortium: A clinicopathologic descriptive analysis of 461 familial malignant testicular germ cell tumor kindred_ Urologic Oncology: Seminars and Original Investigations xx (2009) xxx; 2008.
6. Ferlay J, Bray F, Pisani P, et al. Globocan 2002: Cancer incidence, mortality, and prevalence worldwide. Lyon:IARCPress; 2004.
7. Katherine A. McGlynn, Susan S. Devesa Barryl. Graubard, Philip E Castle. Increasing incidence of testicular germ cell tumors among black men in the United States, Journal of clinicaloncology. 2005;23(24).
8. Coleman MP, Estève J, Damiecki P, Arslan A, Renard H. Trends in cancer incidence and mortality . IARC SciPubl.1993;121:1-806.
9. Hemminki K, Li X. Familial risk intesticular cancer asaclue to a heritable and environmental etiology. Br J Cancer. 2004;90:1765–70.
10. Dieckmann KP, Pichlmeier U. The prevalence of familial testicular cancer. Cancer. 1997;80:1954–60.
11. Nicholson PW, Harland SJ. Inheritance and testicular cancer. Br J Cancer. 1995;71:421–6.
12. Heimdal K, Olsson H, Tretli S, et al. A segregation analysis of testicular cancer based on Norwegianand Swedish families. Br JCancer. 1997;75:1084–7.
13. Harland SJ, Daugaard G, Horwich A, et al. Thefamilial influence onbilateral testicular germ cell cancer. Proceedingsof the Medical Research Council Study TER2 Annual Meeting. J ClinOncol; 2006.
14. Cancer Incidence in Five Continents, VolIX. CuradoMP, Edwards B, Shin R, et al eds. IARC, Scientific Publication. 2007;160.
15. Aparicio J, Garcíadel MuroX, Maroto P, et al. Spanish germ cell cancer cooperative group(GG). Multicenter study evaluating a dual policy of post orchidectomy surveillance and selective adjuvant single-agent carboplatin for patients with clinical stage I, seminoma. Ann Oncol. 2003;14(6):867-72.
16. Colecchia M. Pathology of testicular and penile neoplasms. Springer international publishing Switzerland; 2016.
DOI: 10.1007/978-3-319-27617-5_6
17. Isaacs H Jr. Tumors of the fetus and infant, 5. Springer-Verlag Berlin Heidelberg; 2013.
DOI: 10.1007/978-3-642-31620-3_2
18. Karki S, Bhatta RR. Histopathological analysis of testicular tumours. Journal of Pathology of Nepal. 2012;2:301-304.
19. PhillipoL Chalya1*, Samson Simbila1,2, Peter F Rambau3, Ten-year experience with testicular cancer at a tertiary care hospital in a resource-limited setting:asingle centre experience in

Tanzania, World Journal of Surgical Oncology. 2014;12:356.
20. Mahesh B. Patel HM. Goswami UR Parikh, Mehta N. Histo-Pathological study of testicular lesions, Gujarat Medical Journal. 2015;70(1).
21. Mongkol Benjapibal MD, Piengchai Vichaidith BN, Wipa Paholpak, Thitiwan Kongprasit, Issaracha Suphanit MT. Primary epithelial cancer and malignant germ cell tumor of the ovary: A Review of 368 Cases. Thai Journal of Obstetrics and GynaecologyMarch. 2001;13:23-28.
22. Smith HO, Berwick M, Verschraegen CF, Wiggins C, Lansing L, Muller CY, et al. Incidence and survival rates for female malignant germ cell tumors. Obstetrics &Gynecology. 2006;107:1075-1085.
23. Jadha V Balaji Jagannath, Shinde Mangala Ashok. Ovarian germ cell tumour: A 3 year study. J Obstet Gynecol India. 2005;55(1):61-63.
24. Lai Chyong-Huey, Chang Ting-Chang, Hsueh Swei, Wu Tzu-I, Chao Angel, Chou Hung-Hsueh, Wang, Po-nan outcome and prognostic factors in ovarian germ cell malignancies. Journal of Gynecologic Oncology. 2005;60(6):364-365.
25. De Backer A, Madern GC, Oosterhuis JW, Hakvoort-Cammel FG, Hazebroek FW. Ovarian germ cell tumors in children: A clinical study of 66 patients. Pediatr Blood Cancer. 2006;46:459–64.
26. Benjamin Piura, Ram Dgani, Yaronzalel, Dan Nermet, IlanaYanai-Inbar, Yoramcohen, MarekGlezerman, et al. Malignant germ cell tumoursof ovary: A study of 20 cases, Journal of surgicaloncology. 1995;59(3).
27. Kurohara SS, Bodib AO, Webster JH, Martin LSJ, Woodruff MW. Prognostic factor in the common testicular tumors; A J Roentgenol. 1968;103:827.
28. Albores-Saavedra J, Huffman H, Alvarado-CabreroI, Avala AG. Anaplastic variant of spermatocytic seminoma. Hum Pathol. 1996;27(7):650-5.
29. Eble JN. Spermatocytic seminoma. Hum Pathol. 1994;25:1035-42.
30. Chhanda M Dasgupta A, Senggupta J. “Ovarian tumours– a ten year study” j Obstand Gynec, India. 199;141:691-696.
31. Sarkar R. Ovarian neoplasms- A14 years study. Obstet&Gynecol. J. India. 1996;46:156-159.
32. Stangjitgamol, Jittihanprasertpong, Sumonmalmanusirivithaya, Virachwootipoom Thaovalaithavaramara and Rakchaibuhachat. Malignant ovarian germ cell tumors: Clinico-pathological Presentation and survival outcomes Acta Obstetriciaet Gynecologica. 2010;89:182–189.
33. Mahalakshmi K, MP. Kanchanathe study of clinicopathological significance of c-kit expression in germ cell tumoursof ovary with special reference to dysgerminoma, institute of pathology and electron microscopy, madras medical college, chennai – 600 003; 2013.

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