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Histopathological Profile of Germ Cell Tumors in Kinshasa: About a Series of 30 Cases at the University Clinics of Kinshasa and Review of the Literature

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Abstract

Context and objective: The term (Germ cell tumors) designates a polymorphic group of neoplasms all deriving from primordial germ cells in both sexes. They belong to the group of embryonal tumors. These tumors are frequently studied in gonadal locations. Given the paucity of literature on all of these tumors in our country, we initiated this study in order to clarify their epidemiological and histological profile. **Methods:** Our study is descriptive, based on the archives of biopsies (blocks and slides) recorded in the laboratory of the pathological anatomy department of the University Clinics of Kinshasa. **Results:** In the period of our study, 3168 cases of tumors were diagnosed among which 30 cases were germ cell tumors, with a frequency of 0.94%, the sex ratio of 0.5, the average age of 22 years, the standard deviation of 17.56 and the minimum age of 0 and maximum 71 years. The P-value was very significant (0.0015%) and the confidence interval for the mean is between 16 and 29 years old. The non-seminomatous histological subtype was the most represented (83.3% in both sexes). Benign teratoma was represented at 60% and gonadal locations 53% compared to 47% for extragonadal locations, where the sacrococcygeal location predominated with 36%. **Conclusion:** TG is more frequent in gonadal locations, but our study shows a frequency of 47% of extragonadal locations, which is not negligible. This should challenge us to improve the diagnosis and management of TG.

Subject Areas

Clinical Medicine

Keywords

Germ Cell Tumors, Epidemiological and Histopathological, Kinshasa

1. Introduction

Embryonic tumors constitute a very heterogeneous group of tumors whose overall incidence is difficult to estimate due to the lack of comprehensive studies due to their low frequency; germ cell tumors are considered rare tumors [1] [2]. But certain studies which approach them individually report that seminomatous germ cell tumors (TGS) and non-seminomatous germ cell tumors (TGNS) are rare but their incidence is increasing [2] and can reach up to more than 25% of genito tumors in pediatric urinary tract after Wilms tumor according to certain studies [3].

The incidence varies throughout the world, with even a large geographical and ethnic variation: it is high in the Scandinavian countries, Switzerland, Germany and New Zealand, average in the United States and Great Britain, very low in Africa. In the USA, it remains low in African-Americans and high in the Caucasian population [4]. There is also a very wide variation in locations. These tumors are more frequent in gonadal locations and less in extra-gonadal locations. And even in those here, they are very rare in the ovaries compared to the testicular location which is more common [5]. These variations are also observed in other epidemiological and topographical parameters such as age, sex and others.

It should therefore be noted that the incidence of germ cell tumors peaks around the ages of 15 and 40 and represents up to 95% of testicular tumors [6] [7]. Faced with a paucity of literature in our country and the fact that in our Department no study has addressed germ cell tumors overall, we initiated this study to determine the epidemiological and histopathological profile of germ cell tumors in CUK [7] with a view to identifying trends, reducing diagnostic errors and, above all, improving their management.

The term (*Germ cell tumors*) designates a polymorphic group of neoplasms all deriving from the primordial germ cell in both sexes [8]. They form a large group with blastematous tumors called "embryonal tumors". These tumors certainly present common characteristics, but with great diversity in their topographical distribution, which makes this group one of the most complex. Germ cell tumors have a frequency inversely proportional to age, that is, their frequency decreases with age [9]. They are very often studied with pathologies of the gonads where they are more frequent although they have other extra gonadal locations such as the pineal gland, the mediastinum and the peritoneal region [10] [11].

Patients with TG can have a 5-year survival rate of 95% with good treatment [12], which requires diagnosis and appropriate staging for better management. This is why in this work these tumors will be studied taking into account their

common characteristics and their embryonic origin. Understanding germ cell tumors requires good embryological knowledge to better understand their origin and distribution.

In the DRC, few studies are available that have addressed the epidemiological and histopathological profile of germ cell tumors, hence the interest of our work. Our objective was to describe the epidemiological and histopathological aspects of germ cell tumors in the Pathological Anatomy laboratory of CUK.

1.1. Embryological Reminders

The genesis of embryonic tumors is attributable to primordial germ cells (PGC = primordial germ cells) intended to form gametes (spermatozoa and oocytes). These germinal cells are of epiblastic origin on the one hand and on the other the somatic or nourishing cells which will surround the germinal cells. These somatic cells constitute the somatic gonadal blastema, the exact origin of which remains debated. The most common hypothesis has them coming from at least three sources: the mesonephros, the local mesenchyme, and the coelomic epithelium [13] [14].

Thus by considering the path of migration of germinal cells from the yolk sac towards the lumbar region (10th dorsal vertebra), passing through the primitive intestine, the mesentery and the existence of undifferentiated gonad, we can easily understand the different Probable locations of germ cell tumors: yolk sac, testicles, ovaries, midline of the body, lumbar region, etc.

1.2. Epidemiology of Embryonal Tumors

Embryonic tumors (ET) are uncommon in the general population, but their incidence remains high in children where they represent the second most common type of cancer in children and adolescents after leukemia. Few studies have been carried out on ET due to their rarity (around 400 cases/year diagnosed in people < 15 years of age in mainland France) [1]. The histological type of childhood cancer is very particular since carcinomas, which represent the vast majority of adult tumors, are practically rare in children. In this case, in addition to leukemias and lymphomas which represent 45% of malignant conditions, we mainly find so-called embryonic tumors and then sarcomas more similar to adult tumors. Most studies address embryonal tumors separately, by system, age group such as in children or simply malignant tumors. A study showed a proportion of 4.7% and sex ratio M/F of 0.9 of embryonal tumors for all tumors of the nervous system of children, while extra-gonadal and extra-cranial germ cell tumors have a proportion of 0.9 and sex ratio M/F 0.2 and 1.1 and 0.2 for gonadal malignant germ cell tumors [15]. Others report a frequency of 1% - 5% of extra gonadal germ cell tumors out of all germ cell tumors [10]. Germ cell tumors represent 20% of ovarian tumors, occupying second place after epithelial tumors [16]. While they represent 3% to 15% of malignant ovarian tumors in East Asian countries [17]. Seminoma is the most common testicular germ cell tumor and often occurs between the ages of 15 and 35 years [18].

1.3. Germ Cell Tumors

1.3.1. Classification

Germ cell tumors can be classified according to topography, according to their grades (SIOP) and according to histological subgroups (WHO). *Topographic classification*: Intracerebral germ cell tumors, extragonadal and extracerebral germ cell tumors, intragonadal germ cell tumors, other tumors [15]. *Germ cell tumors of gonadal location*: Testicular and ovarian. *Germ cell tumors of extra-gonadal location*: Sacrococcygeal, mediastinal, vaginal, other locations [19]. Furthermore, the WHO classification is the reference classification and it regularly undergoes updates, including that of 2004, 2016 and now that of 2022 (5th edition) (**Table 1**).

1.3.2. Morphological Study

1) Germinomas (Seminoma and Dysgerminomeovary)

Germinomas, formerly called seminomatous germ cell tumors (TGS), constitute the most common pure germ cell tumors of the testis, 44% of testicular tumors and 58% of all TG which represent 95% of testicular tumors overall. Age groups between 25 and 40 are the most affected. They constitute 80% of TG observed beyond 60 years of testis [15] [21] [22].

Table 1. WHO classification of testicular tumors 5th edition, 2022.

Germ cell tumors derived from germ cell neoplasia in situ	
Non-invasive germ cell neoplasia	Germ cell neoplasia in situ
	Specific forms of intratubular germ cell neoplasia
	Gonadoblastoma
Germinoma family of tumors	Seminoma
Non-seminomatous germ cell tumors	Embryonic carcinoma
	Yolk sac tumor, postpubertal-type
	Choriocarcinoma
	Placental trophoblastic site tumor
	Cystic trophoblastic tumor
	Teratoma with somatic-type malignancy
Mixed germ cell tumors of the testis	Mixed germ cell tumors
Germ cell tumors of unknown type	Regressed germ cell tumors
Germ cell tumors unrelated to germ cell neoplasia in situ	Spermatocytosis tumor
	Teratoma, prepubertal type
	Yolk sac tumor, prepubertal-type
	Testucular neuroendocrine tumor, prepubertal type
	Mixed teratoma and yolk sac tumor, prepubertal-type

WHO classification 2022 [20].

Macroscopy: the tumor presents the appearance of a single, well-circumscribed nodule or more or less confluent, homogeneous, pinkish-white or grayish, beige or creamy-white and firm nodules. Necrotic changes are unusual [22].

Nucleolated nucleus, associated with lymphocytic stroma (T lymphocytes).

It is composed of large cells (15 to 25 mm) with a clear or discreetly eosinophilic cytoplasm, a large nucleus, with pale chromatin, containing one or more rarely 2 prominent nucleoli, presenting variable mitotic activity without prognostic implication.

The architecture is massive or cordial. A lymphocytic infiltrate is practically constant. It can take the form of lymphoid follicles with a germinal center or be accompanied by plasma cells and eosinophils. In approximately 50% of cases we can observe a granulomatous reaction, composed of clusters of epithelioid cells, but rarely multinucleated giant cells of the Langhans type. Syncytiotrophoblastic cells can be observed in approximately 20% of cases, without associated cytotrophoblastic contingent. This should not lead to the diagnosis of associated Choriocarcinoma [22]. Immunohistochemistry: Tumor cells express PLAP (placental alkaline phosphatase) and C-KIT. β-HCG is expressed by syncytiotrophoblastic cells which can be associated with it in certain cases. Pure seminomas are very sensitive to radiotherapy and chemotherapy.

2) Non-seminomatous germ cell tumors [6] [19] [20]

a) Embryonic carcinoma (EC)

It is part of non-seminomatous germ cell tumors and consists of embryonic masses at a still very poorly differentiated stage. From a macroscopic point of view, the EC sectors appear heterogeneous, poorly defined, made up of solid territories, areas of necrosis, hemorrhages and are very friable. Histologically, it is made up of cohesive groups of undifferentiated cells suggestive of carcinoma and of compact, adenoid or tubulo-papillary architecture. Vascular emboli are common. The stroma is not very specific, although there are often large necrotic foci. Immunohistochemically, these tumors are generally non-secreting, but the serum αFP level may be discreetly increased. This expression must, however, raise the question of an association with a yolk tumor (endodermal sinus tumor).

b) Yolk tumor

It presents the morphology of the endodermal sinus or the yolk sac. Ma croscopically, these are often encapsulated tumors, half-solid, half-cystic with hemorrhagic areas, variable volume, forming a honeycomb appearance, with a smooth external surface, gray/yellow in color with necrotic areas.

From the histological point of view, they are often encapsulated tumors, semi-solid, semi-cystic with hemorrhagic areas, variable volume, forming a honeycomb appearance, with a smooth external surface, gray/yellow in color with necrotic areas. Proliferation of clear cells with very atypical nuclei arranged in a network and forming papillary structures, associated with areas of microcystic appearance [23]. The presence of Schiller-Duval bodies which are endoluminal papillary formations, with hyaline globules (balls), reminiscent of the morphol-

ogy of a fetal glomerulus, is decisive for the diagnosis.

Immunohistochemistry: Based on the secretion of alfa-feto-protein which is uniformly positive. The study of cytokeratin 7 (CK7) and epithelial membrane antigen (EMA) is negative and useful for the differential diagnosis with adenocarcinomas.

1.3.3. Choriocarcinoma (CC)

This is a non-seminomatous germ cell tumor with trophoblastic differentiation. Macroscopy: very hemorrhagic solid tumor. It reproduces the structure of the placenta with bizarre non-cohesive cytotrophoblastic and syncytiotrophoblastic cells and interstitial hemorrhage, but does not present placental villi. It is a very aggressive tumor with pulmonary, hepatic and brain metastases… or even vaginal metastases for uterine CC. Immunohistochemistry: Beta-HCG (detected in serum and on histological section) has an orientation value. SALL 4 is the most sensitive and specific of CC.

1.3.4. Teratoma

First described by Wilms in 1896. Etymologically, the word "dysembryoma" derives from the Greek word "embryo" meaning embryo and "dys" meaning difficulty. The suffix "ome" means body, tumor, and swelling. It is the non-seminomatous germ cell tumor with somatic differentiation, composed of tissue deriving from the three embryonic layers: ectoderm, endoderm and mesoderm [24] [25] [26] [27] [28].

1.3.5. Classification

Teratoma can be classified into several groups:

1) *According to location*: Gonadal teratomas are those of the testicle and ovary and are far more common, while the second includes axial, internal teratomas which are median or paramedian, and are represented by: Epiphyseal, mesocephalic teratomas; Mediastinal teratomas; retroperitoneal teratomas. External axial teratomas: are visible at birth and adhere to one end of the vertebral axis, in contact with the integuments. They are often bulky. They are found in the pharynx, neck, umbilical cord and sacrococcygeal level.

2) *According to the macroscopic aspects*: Cystic teratoma (dermoid cyst) and very often benign, with a more or less thin pearly wall containing a grayish pasty material and hairs. Solid teratoma is often malignant, made of irregular mass and heterogeneous content with necrotic-hemorrhagic rearrangement [27] [28].

3) *According to tissue heterogeneity*:

Complex multi-tissue teratoma Simple single-tissue teratoma

4) *According to the anatomoclinical behavior and the state of tissue maturity*): Benign (mature) teratoma is the most common benign germ cell tumor of the ovary, formed of well-differentiated tissues made of cells which do not present atypia, and its secondary cancerization remains exceptional. It can be simple composed of a single tissue (epidermal cyst) or complex composed of several tissues (dermoid cyst). Malignant (immature) teratoma was first described in

1960 by Thürlbeck and Scully. It accounts for 3% of teratomas, 1% of all ovarian cancers, and 20% of malignant ovarian tumors of germ cell origin (immature teratoma) [24]. Contain immature, incompletely undifferentiated tissues resembling embryonic tissues (especially neuroepithelial and glial structures). It is classified according to Thurlbeck and Scully prognostic grade, modified by Norris and O'Conner to better guide management [24].

1.3.6. Mixed or Complex Germ Cell Tumors

Finally, mixed tumors consist of combinations in varying proportions of the above histological types. These are macroscopically heterogeneous tumors. They include a mixture of different histological types within the same tumor: Malignant Teratoma + Choriocarcinoma + Embryonic Carcinoma and Vitelline + Seminoma tumors.

2. Materials and Methods

2.1. Type of Study and Period of Study

This is a retrospective descriptive study, based on the archives of biopsies (blocks and slides) recorded in the laboratory of the Department of Pathological Anatomy of the University Clinics of Kinshasa. Our study covered a period of 21 years, from January 2000 to December 2021.

2.2. Study Sample

2.2.1. Population of Study Cases

From the CUK Pathological Anatomy laboratory registers, we listed all the cases of cancer received during the study period, while selecting the cases for which the diagnosis of germ cell tumor was retained. The use of registers, analysis request forms and analysis reports allowed us to identify the age, sex and histopathological diagnosis. We then brought together the slides and tissue blocks from the selected cases, already fixed and embedded in paraffin. For any case where the slides were damaged or not found, new histological sections were made on the corresponding blocks.

2.2.2. Selection Criteria

Case inclusion criteria: Any block and slide for which the diagnosis of germ cell tumor was retained after rereading by at least two pathologists.

Criteria for non-inclusion of cases: Any block or slide with a diagnosis other than germ cell tumor.

Case exclusion criteria: Any biopsy where the block or slide was lost or of poor quality not allowing good histological analysis.

2.2.3. Sample Size

Our sampling being exhaustive or without replacement, we considered all biopsies for which the diagnosis of germ cell tumor was retained and meeting our inclusion criteria. Our sample size was 30 cases who met the inclusion criteria and drawn from our study population of 3168 tumor cases.

2.3. Variables of Interest

Demographic parameters: age; gender;

Clinical parameters: collection site (organ); clinical information.

Pathological parameters: histological nature; histological type; under histological type.

Figures 1-7 illustrate the different pathological entities encountered during our study.

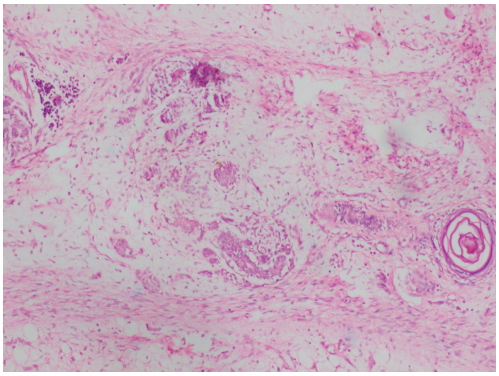

Figure 1. Appearance of a teratoma (dermoid cyst) showing the appendages of the skin, hair and keratin.

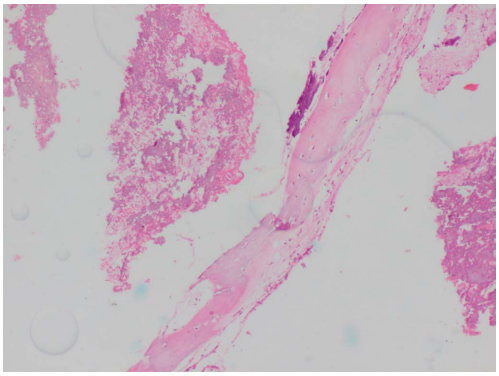

Figure 2. Appearance of a teratoma (dermoid cyst) showing the appendages of the skin, hair and keratin with bone differentiation (very eosinophilic bone trabecula on the left).

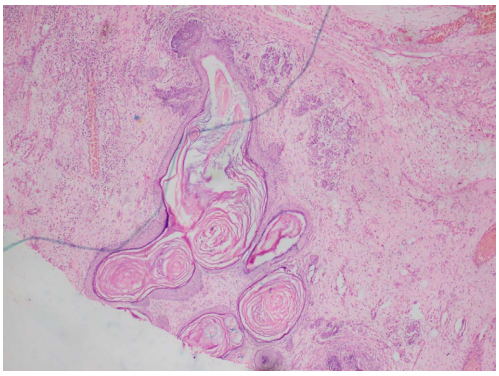

Figure 3. Appearance of a teratoma (dermoid cyst) showing the appendages of the skin, hair and keratin showing bone tissue in the center.

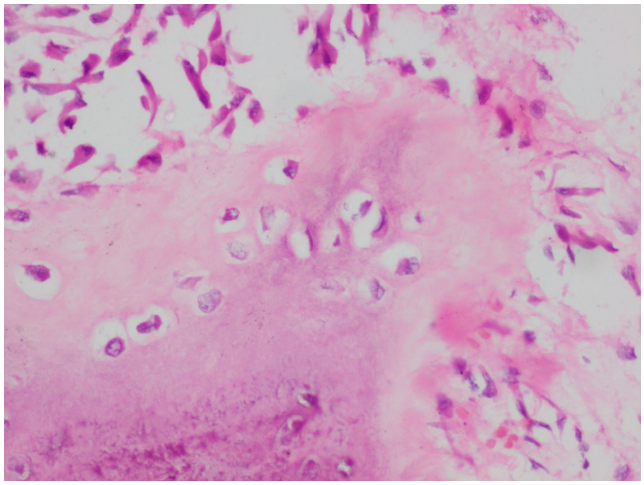

Figure 4. Appearance of a teratoma (dermoid cyst) showing the appendages of the skin, hair and keratin showing chondroid differentiation.

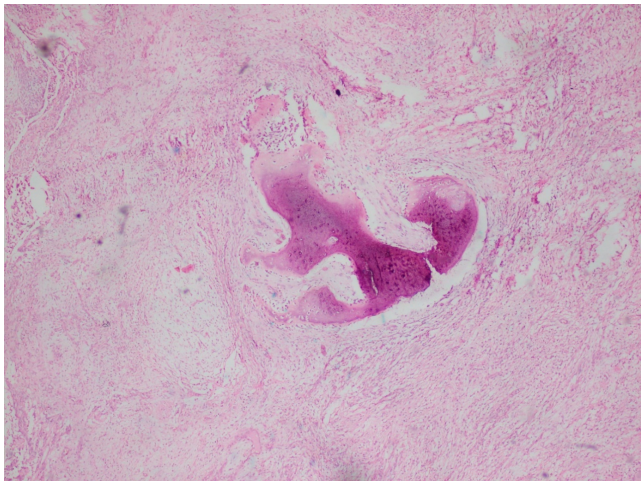

Figure 5. Appearance of a teratoma (dermoid cyst) showing the appendages with the appendages of the skin (hair follicles, keratin lamellae and epidermis).

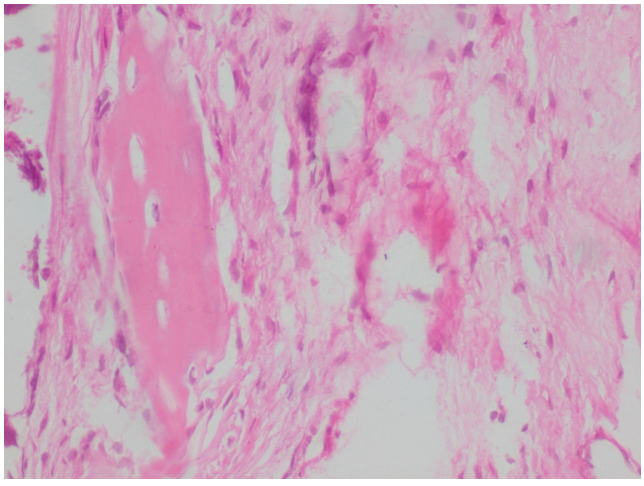

Figure 6. Appearance of a teratoma (dermoid cyst) showing the appendages with osteoid differentiation large bone trabecula in the center.

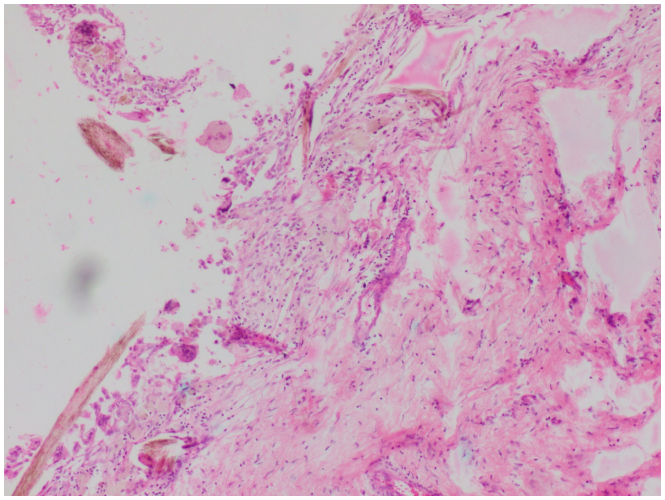

Figure 7. Appearance of a teratoma (dermoid cyst) showing the appendages showing an epidermis with its appendages (globus cornea).

2.4. Conduct of the Histological Examination

All specimens had been fixed in 10% formalin, dehydrated and cleared, embedded in paraffin, cut with a microtome at 3 - 5 microns and stained with EO. The general architecture of the tissues was observed at low magnification (×4). To highlight tumor cells and clarify their histological type, we used medium and high magnifications (×10 and ×40). The participation of connective fibers was highlighted using trichrome staining. The slides were read again using an OLYMPUS BX41 co-observation microscope. The final results were retained after rereading all the slides by two examiners as independent readers; in the event of discrepancy in the results, a third examiner was used. **Table 2** shows the materials used in this study.

2.5. Statistical Analysis

The data were entered into an Excel spreadsheet, then exported into R software version 5.26 for processing and statistical analysis. Categorical or qualitative variables were described using frequency tables (simple or crossed). Dependencies or connections between qualitative variables were tested using the Chi-square association test or logistic regression. The central tendency and dispersion parameters were used to summarize the information from the quantitative variables. A nonparametric test was used when the assumptions for using a parametric test did not allow it. All tests were carried out at the 5% significance level, the p-value was preferred to confidence intervals for the significance of statistical differences.

2.6. Ethical Consideration

Given its documentary nature, the study respected anonymity and did not require the prior consent of patients, given the usual practice of biopsies, operating specimens from the operating theater, paraffin blocks and archive slides.

Table 2. Materials used.

1. Materials		
- Registers and data sheets		
- Anatomopathological reports		
- Data collection sheets		
- Slides carrying histological sections		
- Paraffin-embedded tissue blocks		
- Slides		
- Coverslips		
- Microtome		
- Oven		
- Hotplate		
- Water bath		
- Bins		
- Medical gloves		
- Pipettes		
- Eukitt aqueous glue		
- Fridge		
- OLYMPUS BX 41 co-observation microscope		
- Microscope trinocular with digital camera LEICA DMRB		
- HP laptop		
2. Reagents and stains		
Standard coloring	Special colors	Observation
Hematoxylin and Eosin	Trichrome	
- Xylene		
- Ethanol		
- Methanol		
- İsopropanol	Blue trichrome	
- Hematoxylin	Green trichrome	
- Eosin		
- Lithium carbonate		
- Alcohol-acid		

3. Results

3.1. Frequency

In our study, 3168 cases of tumors were diagnosed among which 30 cases were germ cell tumors. N = 3168, n = 30. The frequency of germ cell tumors for our study is 0.94%.

3.2. Sociodemographic Characteristics

The average age is 22 years with a standard deviation of 17.56 which shows us a strong dispersion around the average whose minimum age is 0 and the maximum is 71 years. The student test (t-test) shows that the p-value is very significant (0.001 < 5%) and the confidence interval for the mean within the study population is between 16 and 29 years. The female gender was the most represented with more than 66.6% of cases. **Sex ratio = Number of men/Number**

of women (Sex ratio = 10/20 = 0.5). The male/female sex ratio was 0.5, which shows a strong female predominance. We note a predominance of benign TG in women at 70% compared to 30% in men. On the other hand, we observe a perfect equality of 50% in both sexes for malignant TG. However, there is a 100% predominance of seminomatous TG subtypes in the male sex.

3.3. Histopathological Aspects

Table 3 shows a predominance of benign TG in women at 70% compared to 30% in men. On the other hand, we observe a perfect equality of 50% in both sexes for malignant TG. However, there is a 100% predominance of seminomatous TG subtypes in the male sex.

Table 4 shows a predominance of benign TG with 60% of cases, while malignant TG 40% on the one hand and on the other hand, a predominance of non-seminomatous subtype at 83.3%.

Table 3. Distribution of sex according to histological nature and histological subtype according to sex.

	Histological nature		Histological subtype		
	Benign	**Clever**	**Mixed germinal**	**Non-seminomatous**	**Seminomatous**
Women	**14 (70%)**	**6 (50%)**	0	20 (80%)	0
Man	**4 (30%)**	**6 (50%)**	1	5 (20%)	4 (100%)
Total	**18 (100%)**	**12 (100%)**	1	**25 (100%)**	4 **(100%)**

Table 4. Distribution of diagnoses according to histological nature and histological subtype.

Diagnostic	Histological nature		Histological subtype		
	Benign	Clever	Mixed germinal	Non-seminomatous	Seminomatous
Embryonic carcinoma of the ovary	0	1	0	1	0
Embryonic carcinoma of the right testicle	0	1	0	1	0
Uterine choriocarcinoma	0	2	0	2	0
Cervical choriocarcinoma	0	1	0	1	0
Benign teratoma of the ovary	1	0	0	1	0
Vaginal choriocarcinoma	0	1	0	1	0
Seminoma	0	4	0	0	4
Mature ovarian teratoma	1	0	0	1	0
Benign cystic teratoma of the ovary	3	0	0	3	0
Mature teratoma	6	0	0	6	0
Mature multi-tissue teratoma	3	0	0	3	0
Mature ovarian teratoma: dermoid cyst of the ovary	2	0	0	2	0
Immature and cystic multi-tissue teratoma	0	1	0	1	0
Mature sacrococcygeal teratoma	2	0	0	2	0
Teratoma, embryonal carcinoma	0	1	1	0	0
Total	18 (60%)	12 (40%)	1 (3.3%)	25 (83.3%)	4 (13.3%)

Table 5 shows a predominance of benign TG and the non-seminomatous histological subtype in the age group from 0 to 10 years with 56% and 36% respectively.

Table 6 shows a slight predominance of gonadal localization of TG which represents approximately 53% of cases.

Table 7 shows that extragonadal TG is respectively more found in the sacrococcygeal region with 36% of cases.

Table 5. Distribution of age groups according to nature and histological subtype.

age range	HISTOLOGICAL NATURE			HISTOLOGICAL SUBTYPE	
	benign	Clever	Mixed germinal	Non-seminomatous	Seminomatous
0 to 10 years	**10 (56%)**	**2**	**0**	**9 (36%)**	0
11 to 20 years old	2	1	1	2	0
21 to 30 years old	3	3	0	6	2
31 to 40 years old	2	4	0	6	1
41 to 50 years old	1	1	0	1	1
50 years	**0**	**1**	**0**	**1**	**0**
Total	18	12	1	25	4

Table 6. Distribution of cases according to TG locations.

Location	NOT	%
Gonadal	16	53
Extragonadal	14	47
Total	30	100

Table 7. Distribution of cases according to the extragonadal location.

Extragonadal location	n	%
Intracranial	0	00
Mediastinal	1	7
Forearm	1	7
Mesenteric (epiploic)	2	14
Sacrococcygeal	5	36
Uterine	3	21
Vaginal	1	7
Intestinal	1	7
Total	14	100

4. Discussion

4.1. Epidemiological Characteristics

Our study found a low frequency of TG of 0.94%. The sex ratio is (M/F = 0.5), which shows a predominance of females. Our results differ from those of Kripa Varghese *et al.* who found a M/F sex ratio of 1.22 [3] and Jankowski *et al.* 1.2 [15]. This can be explained by the fact that they studied urogenital tumors in children and adolescents for the first and the second all tumors of children and adolescents, while we considered TG in the general population.

The average age at the time of diagnosis was 22 years with a standard deviation of 17.5, which shows a strong dispersion around the average, the minimum age of which is 0 and the maximum is 71 years.

These results are similar to those of Nisrine Mamouni *et al.* [29]. Who found 22 years as the average age for malignant germ cell tumors, while this age for us is for malignant and benign TG.

They are a little closer to those of Cano Garcia *et al.*, who found an average age of 28 years [30]. On the other hand, our results are different from those found by Bastos *et al.* and Monagel *et al.*, who found respectively 30 years as the median age (study on testicular TG) [31] and 4.71 as the mean age in his (study on extracranial TG) [32].

This difference could be explained for the first by the fact that he worked on testicular TG only, while the second studied TG in children aged 0 to 14 years. We also note that TG are not only the prerogative of the gonads, but gonadal locations represented 53% while extragonadal locations only 47%.

We found a male/female sex ratio of 0.5, which shows a strong female predominance. This result is contradictory with AB Effi *et al.* in Ivory Coast who found a sex ratio of 1.5 (male predominance) [33]. This can be explained by the fact that he worked on a large sample of 556 cases but above all that he worked on all solid tumors in children, leaving aside adults. These results also differ from Hsieh *et al.* who found a sex ratio of 1.09) [34]. This can be explained by the fact that his study focused on children.

4.2. Histological Nature

Our study shows a predominance of benign TG overall with 60% and malignant TG with 40%. However, benign TG in females accounted for 70% compared to 30% in males. On the other hand, we observe a perfect equality of 50% in both sexes for malignant TG. However, there is a 100% predominance of seminomatous TG subtypes in the male sex.

These results are different from those found by Kripa Varghese *et al.* who found 13% of benign teratomas [3]. This can be explained by the fact that they studied urogenital tumors in children under 18 years of age, while we took into account all germ cell tumors in the general population.

The seminomatous subtype represented 13% in our study. These results are different from those found by Bastos *et al.* who found up to 47.1% of the semi-

noma subtype in their study on male TG in Brasilia [31]. This can be explained by the fact that they worked exclusively on male patients with a larger sample of 1232 subjects.

4.3. The Location of TG

We found a predominance of TGs in the gonadal location at 53% and for extragonadal TGs the sacrococcygeal location predominates with 36%, while we did not find any intracranial locations (intracranial TGs 0%). These results are similar to those of Dania A *et al.* who found a predominance of gonadal TG while in extragonadal locations the sacrococcygeal region was the most found [32].

These results differ from those of Jankowski M *et al.* who rather found a predominance of intracranial TG and Hsieh *et al.* found a predominance of patients with intracranial TG in (53%) of cases [34]. This discrepancy can be explained by the larger sample size of the first (662 patients and a longer period of 31 years, compared to 30 cases in a period of 22 years for our study) but above all because of our limited means and difficult access to brain biopsies [15].

De Felici M *et al.* reports frequencies of germ cell tumors ranging from 1% to 5% [10]. While our study shows up to 47% extragonadal localization of germ cell tumors, this clearly illustrates the variability of results on the subject.

5. Conclusions

TG are certainly rare tumors affecting the gonads, but intracranial and extracranial (extragonadal) locations are also well represented. Most studies address TG either in children or adults but in both sexes separately. Our study addresses the subject throughout the general population and shows the need to deepen the subject in all structures of our country. We recommend a good completeness of data registers and extend this study throughout the Democratic Republic of Congo.

Limitations of the study: The small sample size in our study and the absence of cases of intracranial TG, but especially the non-use of immunohistochemistry make this its weaknesses.

Strengths: Its strength is to be original and takes into account all TG in the general population (men, women, adults and children) by revealing a general trend overall.

Perspectives and wishes: We recommend a good filling of the data registers and to extend this study throughout the Democratic Republic of Congo by carrying out immunohistochemical and molecular biology analyses.

Conflicts of Interest

We declare that we have no conflict of interest regarding our subject of study.

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