Testicular tumors; Ultrasonographic and Pathologic correlation

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Learning objectives

The purpose of this exhibit is to correlate the US imaging features of tumors of the testis with their pathologic findings.

Background

Ultrasound of the scrotum is the primary and comfortable image modality and highly accurate in differentiation between extratesticular and intratesticular, and differentiation between solid and cystic lesions. We analyzed correlation of sonographic and pathologic finding of the various testicular tumors.

Findings and procedure details

Introduction

Ultrasound of the scrotum is the primary and comfortable image modality and highly accurate in differentiation between extratesticular and intratesticular, and differentiation between solid and cystic lesions. However, it is not uncommon that differentiation among testicular torsion, hematoma, abscess, benign tumor such as epidermoid tumor, and malignant tumor is impossible (1-7). The purpose of this exhibit is to correlate the US imaging features of tumors of the testis with their pathologic findings. Illustrative cases will include seminoma, mature teratoma, immature teratoma, yolk sac tumor, mixed germ cell tumor, leukemia, lymphoma, and sex cord-stromal tumors (Leydig's cell tumor).

Intratesticular tumors carry a significant risk of malignancy, whereas the vast majority of extratesticular lesions are benign or inflammatory. Primary testicular cancer is the most common malignancy in men aged 15 to 35 years. Testicular cancer causes approximately 10% of all cancer deaths in men of this age group (1, 6). The cause of testicular tumors is unknown, but cryptorchidism, trauma, infections, and genetic and endocrine factors appear to play a role in their development (2). Testicular tumors are divided into two categories; germ cell and non-germ cell tumor (4). Those of germ cell origin make up 90% to 95% of primary testicular tumors and are generally highly malignant. Seminomas are the most common followed by mixed germ cell tumors, embryonal cell tumors, malignant teratoma, and the rare pure choriocarcinoma (6). By contrast, non-germ cell tumors are generally benign.
Classification of testicular tumors

I. Germ cell neoplasm (90-95%)

Tumors of one histologic type

- Seminoma
- Spermatocytic seminoma
- Embryonal carcinoma
- Yolk sac tumor (adult, childhood type)
- Teratoma (Mature, Immature, With an overtly malignant component)
- Choriocarcinoma

Mixed germ cell tumors

- Embryonal carcinoma & mature and/or immature teratoma
- Yolk sac tumor & mature and/or immature teratoma
- Seminoma and teratoma
- Seminoma & embryonal carcinoma
- Choriocarcinoma & embryonal carcinoma
- Choriocarcinoma & teratoma
- Choriocarcinoma & seminoma

II. Sex cord-stromal neoplasms (4%)

- Leydig cell tumor (3%)
- Sertoli cell tumor (1%)
- Granulosa cell tumors (<1%)
- Mixed and indeterminant sex cord-stromal tumors (<1%)

III. Mixed germ cell-sex cord-stromal neoplasms (<1%)

- Gonadoblastoma (0.5%)
- Other tumor

IV. Tumors of "passenger" and non-Leydig, interstitial cells

- Lymphoma
- Plasmacytoma
- Leukemic infiltrates
- Miscellaneous others, including epidermoid cysts, mesenchymal tumors, and metastatic tumors (1-2%)

Traditional model of testicular germ cell tumor histogenesis hypothesizes
Seminomas are the most common type of germinal tumor (40-50%) and the tumor most commonly found in patients with cryptorchidism (Fig. 2). Seminomas are most common in patients aged 30 to 50 years, whereas mixed germ cell tumors and embryonal cell tumors are more frequent in patient's aged 25 to 35 (1, 6). Seminoma is of relatively low malignancy and radio-chemosensitive, and therefore has a favorable prognosis. Seminoma is typically hypoechoic without any calcification or cystic areas. Its margin is either smooth or ill-defined (1, 2). The typical seminoma has a homogeneous, gray-white, lobulated, cut surface, usually devoid of hemorrhages or necroses (2, 6)(Fig. 3).
Fig. 2: Fig. 2. 45-year-old man with seminoma in cryptorchidism. a. Transverse abdominal sonogram shows relatively homogeneous hypoechoic mass (arrow) in the right lower abdomen. b. Contrast enhanced abdominal CT scan shows well circumscribed slightly higher attenuated mass (arrows) than muscle in the right lower abdomen. c. Seminoma with a light tan, lobulated cut-surface. It has a fleshy character and bulges above the surrounding testicular parenchyma.

References: Dept. Of Diagnostic Radiology, Hanyang University Kuri Hospital - Kuri City/KR

Fig. 3: Fig. 3. 38-year-old man with seminoma. a. Longitudinal scan shows a well-circumscribed, lobulated, hypoechoic mass (arrows) within the right testis. b. Cut section of the testis shows lobulated grayish-yellow solid mass, which is near totally replaced the testis except very small peripheral area.

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Embryonal cell carcinoma

Embryonal cell carcinoma often occurs in the mixed type and its peak incidence is in the second and third decade. Yolk sac tumor is known as infantile embryonal and is the most common testicular tumor in infants and children, making up 60% of testicular neoplasms in this age group. In comparison to seminoma, it is more aggressive, less responsive to radiotherapy and chemotherapy (1,2). The aggressiveness of embryonal cell tumors is marked by the frequent findings of a large testicular mass causing a contour abnormality,
occasionally with demonstrable tunical invasion and evidence of distant metastases at
the time of presentation (6). Embryonal carcinoma usually is the smallest of all testicular
tumors, averaging about 50cc in volume. About 20% of them invade the epididymis or
the cord (2).

It is hypoechoic as well, appears inhomogeneous and less well circumscribed in
comparison with seminoma. Grossly, this tumor is nonencapsulated, and on cross
section it presents a homogeneous, yellow-white, mucinous appearance and sometimes
necroses or hemorrhages (1, 2, 6) (Fig. 4).

Fig. 4: Fig. 4. 3-year-old man with yolk sac tumor. a. Longitudinal sonogram of the left
testis shows a large heterogeneous mass with multiple echogenic foci (arrows). b. The
testis shows yellow-white homogeneous, unencapsulated mass.

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City/KR

Teratoma

Teratomas are classified as mature, immature, and with malignant transformation
according to their histology. The peak incidence occurs in infancy and early childhood.
Teratoma is defined as a complex tumor showing recognizable elements of more than
one germ layer in various stages of maturation, often arranged in such a manner as
to suggest abortive organ formation (2). Teratoma displays usually inhomogeneous
mass with well-defined borders and sonolucent as well as hyperechoic components
on sonography. The echogenic foci, resulting from calcification, cartilage, or fibrosis,
produce acoustic shadowing (1,6). Grossly, the testis is usually enlarged, and the cut
surface reveals cysts filled with clear, gelatinous, or mucinous material. Varying amounts
of solid tissue including muscle, cartilage, and bone are interspersed between the cysts
(Fig. 5).
Fig. 5: Fig. 5. 2-year-old man with mature teratoma. a. Longitudinal sonogram of the right testis shows a mixed echogenic mass with calcifications displaying shadowing (arrows). b. A large cyst filled with hair and greasy material.

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Mixed germ cell tumor

Mixed germ cell tumor is about 40% of testicular tumors composed of more than one of the "pure" patterns. The most common mixture is that of teratoma and embryonal carcinoma, which constitutes 25% of all testicular neoplasms. Prognosis and shape are different according to the composition (Fig. 6).
Fig. 6: Fig. 6. 44-year-old man with mixed germ cell tumor (embryonal cell carcinoma and seminoma) and microlithiasis. a. Longitudinal scan of the right testis shows multiple small echogenic foci without posterior acoustic shadowing (open arrows). The right testis contains an inhomogeneous mass with internal hypoechoic lesion (arrow). b. Post-enhanced CT scan shows low attenuated mass (arrow) in the right testis. c. The testicular mass shows lobulated feature with variegated appearance. The largest nodule shows bright yellow color with focal necrosis. Adjacent both nodules show hemorrhage and yellowish necrotic areas.

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Leydig cell tumor

Leydig cell tumors are rare, constituting about 3% of all testicular tumors with approximately 10% being malignant and a further 10% bilateral (2). Although the ultrasound appearances of Leydig cell tumor are described as hypoechoic solid masses typically, it shows rare focal hyperechogenicity due to calcification and fat (3). The tumor may vary from less than 1cm to more than 10cm in diameter (2). On cut surface they can often be recognized by a distinctive, uniform, yellow-brown hue and have well-defined margin, variable size and round or lobulated shape (Fig. 7).
Fig. 7: Fig. 7. 70-year-old man with Leydig’s cell tumor. a. Longitudinal sonogram of the right testis shows a large inhomogeneous echogenic mass with several cystic lesions (arrows). The hypoechoic cystic lesions are correlated with multifocal hemorrhage in pathologically. b. Color Doppler scan shows increased vascularity within the mass. c. Post-enhanced CT scan shows inhomogeneously enhanced large mass (arrow) in the right testis. d. The cut surface shows slightly myxoedematous appearance with focal cystic degeneration. This lesion is relatively solid and yellow-brown hue.

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Epidermoid cyst

Epidermoid cyst accounts for approximately 1% of all testicular tumors and is considered a monodermal development of a teratoma, and has no malignant or metastatic potential. The simple epidermal cyst is lined by keratinizing stratified squamous epithelium.
supported by fibrous tissue. The cyst contains keratohyaline material (2). Careful histologic examination must be performed to confirm the absence of mesodermal or endodermal elements that differentiate epidermoid cyst from mature teratoma (1) (Fig. 8).

**Fig. 8**: Fig. 8. 19-year-old man with epidermoid cyst. a. Longitudinal scan of the right testis reveals a mixed echogenic mass (arrows) with thin hypoechoic rim. b. A cyst filled with grayish squames.

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**Lymphoma & Leukemia**

Lymphoma is the most common secondary testicular neoplasm and makes up 1% to 7% of all testicular tumors. Testicular lymphoma is the most common testicular neoplasm in men 60 to 80 years and the most common bilateral testicular tumor, comprising one half of bilateral testicular neoplasms. Enlargement of the testis, with or without pain, is the chief symptom (2, 5) (Fig. 9). Leukemia is the second most common metastatic testicular neoplasm and infiltrates the testes in 8% of leukemic children (5). Both lymphoma and leukemia behave similar sonographic finding as diffuse or focal regions of decreased echogenicity with maintenance of the normal ovoid testicular shape. The most common pattern is a diffuse infiltration usually involving the entire testicle (Fig. 10). Focal hypoechoic areas are less common (6).
However, these findings are mimic the appearance of inflammatory processes of the testes. Grossly it is similar to the seminomas but extratesticular invasion is more common. The testis is invariably enlarged, and the enlargement is usually diffuse. The cut surfaces show a bulging, firm, grayish-white, usually solid tumor with a granular surface and areas of hemorrhage and necrosis. The tumor is nonencapsulated. Pathologically, lymphoma behaves similarly to leukemia, with abnormal cells diffusely infiltrating the interstitium with compression, but not destruction, of the seminiferous tubules (5).

**Fig. 9:** Fig. 9. 77-year-old man with lymphoma and a palpable mass. a. Longitudinal sonogram shows generalized diminished echogenicity within smoothly contoured right testis. b. Color Doppler sonogram shows increased vascularity in the entire testis. c. The testis shows grayish-white lobulated and relatively well demarcated solid mass with focal hemorrhage.

**References:** Dept. Of Diagnostic Radiology, Hanyang University Kuri Hospital - Kuri City/KR
**Fig. 10**: Fig. 10. 15-year-old man with leukemia. Longitudinal sonogram shows diffuse decreased echogenicity of the enlarged testis without focal lesions.

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**Metastatic carcinoma**

Metastatic carcinoma to the testis is rare. The most common tumor to metastasize to the testis is prostatic carcinoma. The primary sites of the other tumors are lung, malignant melanoma, colon, and kidney (8) (Fig. 11). Pathologically, testicular metastases may be in the form of a focal nodule or diffuse involvement. The tumor often occupies the interstitium, with relative sparing of the seminiferous tubules (8).
Fig. 11: Fig. 11. 1-year-old man with posterior mediastinal neuroblastma and testicular metastasis. a. Longitudinal sonogram of the left testis shows two hypoechoic nodules (arrows) within the testis. After chemotherapy, nodules are decreased. b. Doppler scan of the left testis shows increased vascularity in the nodules. c. Coronal reconstruction of chest CT scan shows large mass (arrows) in the posterosuperior portion of the right hemithorax.

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Images for this section:

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Conclusion

Seminoma, lymphoma, and leukemia revealed homogeneous hypoechoic mass. Leydig cell tumor, teratoma, mixed germ cell tumor, and epidermoid tumor as solid tumor had cystic component, and teratoma, yolk cell tumor, mixed germ cell tumor and epidermoid tumor appeared mass with calcification.

Ultrasound of the scrotum is not able to differentiate testicular mass as the sonographic finding because most testicular tumors do not show definite differentiation in echogenicity and margin, and shows overlapping sonographic finding. However, careful correlation of patient’s age, clinical symptom, tumor echogenicity, presence of cystic or calcified lesion the differential diagnosis will be narrowed.

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