



MRI IN THE CHARACTERIZATION OF SEMINOMATOUS AND NONSEMINOMATOUS GERM CELL TUMORS OF THE TESTIS

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ABSTRACT

Testicular cancer is a rare tumor. It is the most common non-hematological malignancy seen commonly in men younger than 40 years. Germ cell tumors of the testis comprises the major portion of the testicular cancers. There are many diagnostic tools for the germ cell tumors of testis. MRI is not used as investigation of choice. There is a big role of MRI to differentiate seminomatous germ cell tumor from that of non seminomatous tumor. This alters the preoperative initiation of treatment and patient care. We studied the different MRI characteristics of seminomatous and nonseminomatous testicular germ cell tumors and their sensitivity and specificity for detection of these tumors. We identified those features which are helpful in differentiating SGCT from NSGCT preoperatively. So, the objective of this study was to study characteristics magnetic resonance imaging (MRI) of semionomatous and non seminomatous germ cell tumors and to find out whether the distinction can be made preoperatively between these two groups of testicular germ cell tumors.

Keywords: Testicular germ cell tumors, Seminoma, Nonseminoma, MRI.

INTRODUCTION

Testicular GCTs are neoplasms in which imaging plays a vital role in the diagnosis, staging, surveillance of tumors, treatment response, monitoring and detection of residual tumor and treatment relapse. Very few studies have been done in the past to test the effectiveness of MRI for characterization of testicular GCTs. In a study conducted by Johnson et al. [28] to differentiate seminoma from nonseminoma, 15 total cases of testicular germ cell tumors were included out of which 6 were seminomatous tumors and 9 cases were nonseminomatous. The MRI report from formal diagnoses before the operation were compared to the histological reports obtained after orchiectomy. Analyzing the signal intensity of the tumors in T2 and also in T1-weighted imaging the author correctly characterized 13 out of 15 cases (87%) of testicular germ cell tumors. The authors concluded that MRI is useful for preoperative differentiation between seminomatous and nonseminomatous lesions and a testicular lesion with a low signal intensity compared to the normal testicular parenchyma which is relatively homogeneous is suggestive of seminomatous tumor. A testicular lesion which is heterogeneous, with a high signal intensity nearly equal to that of the normal testis, surrounded by a low signal intensity fibrous capsule was suggested to be nonseminoma. Heterogeneous signal intensity was considered the most helpful feature for diagnosing nonseminomatous lesion. Hemorrhage and necrosis though possible in nonseminoma were suggested to be more characteristics of NSGCT because of its propensity to invade blood vessels. MRI may be able to preoperatively differentiate SGCT from NSGCT and it may alter the initiation of treatment or lead to improvement in patient care. In this study we identified different MRI characteristics of seminomatous and nonseminomatous testicular GCTs and their sensitivity and specificity for detection of these tumors and features which are helpful in differentiating SGCT from NSGCT preoperatively.

MATERIAL AND METHODS

Patients:

we randomly included 35 males in this study who presented to our hospital with testicular mass between March 2018 and August 2018. All of them had undergone orchiectomy with accompanying histopathologic reports showing testicular germ cell tumors and all of these patients had underwent MRI examination for testicular mass.

Mri acquisition:

A 3.0-T MR system (Discovery MR750, GE Healthcare, Milwaukee, USA) was used for imaging the scrotum. First the patient was placed supine on the table and a folded towel was placed between the patient's thighs to elevate the scrotum. The penis was then taped to the abdominal wall out of our area of interest. A 17 cm circular surface coil was placed on the scrotum. Axial spin-echo T1 weighted imaging (TR/TE 550/12; slice thickness of 3 mm; gap 0.5 mm; field of view 240×270 mm; and matrix 180×256 mm) was obtained. Axial, coronal, and sagittal fast-spin echo T2- weighted images (TR/TE 3500/101; slice thickness 3 mm; field of view

240×270 mm; and matrix 180×256 mm) were also performed. Additionally, fat suppressed sequences were also obtained if high signal intensity was noted on T1-weighted imaging.

Histopathology findings:

Out of 35 patients of testicular cancer included in our study, 16 of them had SGCT and 19 of the patients had NSGCT. Out of the 19 NSGCT there were 6 cases of yolk sac tumors, 4 cases of embryonal carcinoma, 7 cases of teratoma and 1 case each of choriocarcinoma and 1 case of mixed germ cell tumor containing yolk sac tumor and embryonal carcinoma components.

Statistical analysis:

Statistical analysis was performed using IBM SPSS Statistics 24. We tabulated all the MRI characteristics used in the diagnosis and differentiation of SGCT and NSGCT described above and performed a Fisher's exact test to see if there was any significant association between these imaging characteristics of seminomatous and nonseminomatous testicular germ cell tumors. A significant association was considered if the p value was less than 0.05 ($p < 0.05$). We also determine the sensitivity, specificity, accuracy, positive predictive value and negative predictive value of each imaging characteristics for identification of testicular germ cell tumors as seminomatous or nonseminomatous tumor.

RESULTS

For seminomatous tumor patients, the mean age was 34.62 with a range of 23.0-45.0 years. For nonseminomatous group the median age was 8 years with a range of 0.8-35.0 years. Comparing the preoperative MRI diagnosis to the histopathologic report, MRI was correct in characterizing 34 out of 35 cases of testicular germ cell tumors. All 16 cases of seminoma were correctly identified in MRI. Homogeneous signal intensity was noted in 13 out of 16 cases of seminoma. All 16 cases had predominant short T2 signal. Hemorrhage and necrosis were absent in all 16 cases in our study. A short T2 linear signal which showed greater enhancement than the tumor and represented septa was noted in all 10 cases of seminoma who underwent contrast examination. Capsule was noted in 5 out of 16 cases as a short T2 halo surrounding the tumor.

The statistical analysis showed that signal homogeneity, predominant low signal intensity in T2-weighted imaging, and demonstration of septa and septal enhancement had significant association ($P < 0.05$) with seminomatous tumor and can be used to characterize seminoma. Sensitivity, specificity and accuracy of septa and septal enhancement was all found to be 100%. The sensitivity, specificity, and accuracy of predominant low T2-signal intensity for diagnosis of seminoma were 100 %, 94.7 %, and 97.1% respectively. The sensitivity, specificity, and accuracy of signal homogeneity for diagnosing seminoma was found to be 81.3%. 100% and 91.4% respectively. Alternately we can say signal heterogeneity is suggestive of nonseminomatous tumor.

Necrosis, hemorrhage and heterogeneous enhancement after contrast administration were noted to have significant association ($P < 0.05$) with nonseminomatous testicular germ cell tumors. Presence of necrosis

demonstrated a sensitivity of 31.6%, specificity of 100% and accuracy of 62.8%. Similarly, the presence of hemorrhage for detection of nonseminomatous tumors showed a sensitivity of 68.4%, specificity of 100%, and accuracy of 82.8%. Heterogeneous enhancement after contrast administration had a sensitivity of 100%, specificity of 80%, and accuracy of 90% for detection of nonseminomatous testicular germ cell tumor.

Also, we noted that the presence or absence of capsule had very low sensitivity and specificity and we do not recommend it as a feature for characterizing testicular germ cell tumors. The presence of fat as a criterion for diagnosis of nonseminomatous tumor had a low sensitivity of only 10.5% but had a high specificity of 100%. So, testicular germ cell tumors containing fat can be characterized as nonseminoma according to our study.

MRI features	Seminomatous n (%)	Nonseminomatous n (%)	Total n (%)
Signal homogeneity	13 (81.3)	0	13 (37.1)
Predominantly low signal in T2-weighted	16 (100)	1 (5.3)	17 (48.6)
Necrosis	0	6 (31.6)	6 (17.1)
Hemorrhage	0	13 (68.4)	13 (37.1)
Capsule	5 (31.3)	10 (52.6)	15 (42.9)
Fat	0	2 (10.5)	2 (5.7)
Septa *	10 (100)	0	10 (50)
Septal enhancement*	10 (100)	0	10 (50)
Heterogenous enhancement*	2 (20)	10 (100)	12 (60)

Table 1: Frequency distribution table of MRI characteristics in SGCT and NSGCT

*Calculation was done only for the cases with contrast study available (20/35). SGCT: seminomatous germ cell tumor, NSGCT: nonseminomatous germ cell tumor.

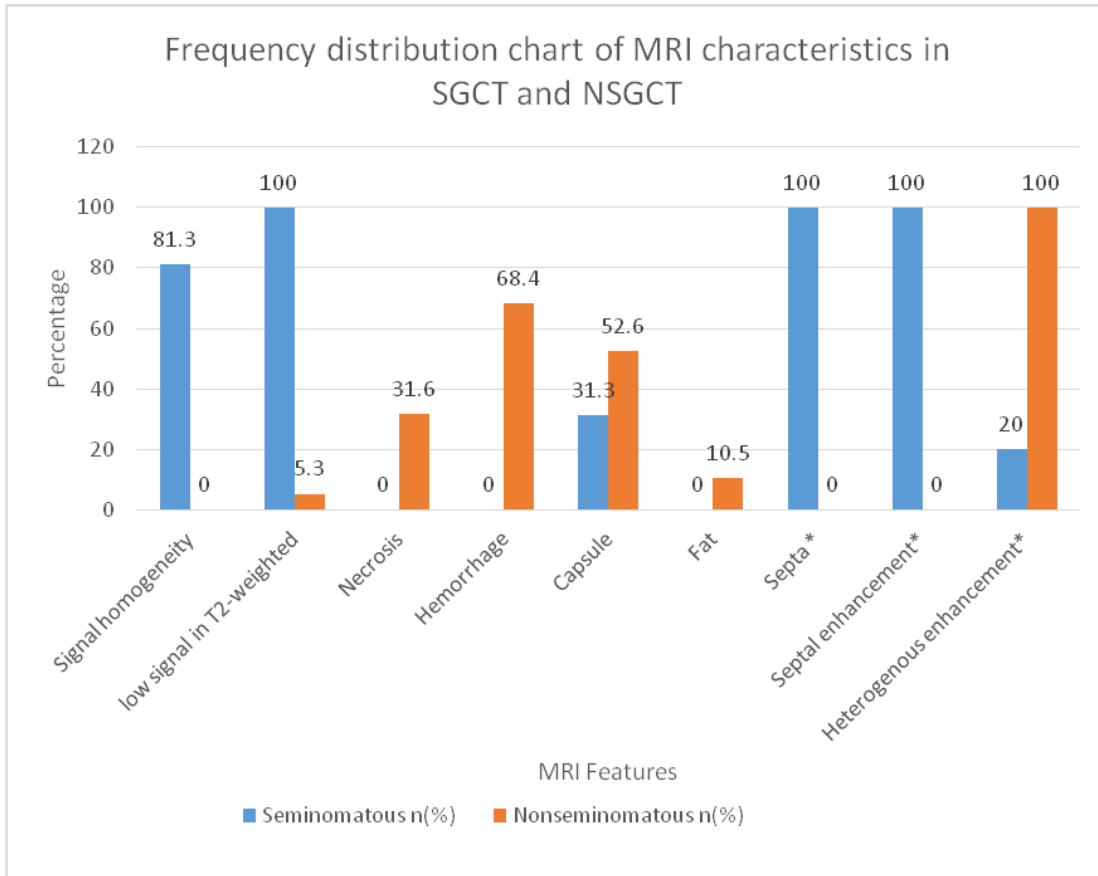


Figure 1: Frequency distribution chart of MRI characteristics in SGCT and NSGCT of testis.

*Calculation was done only for the cases with contrast study available (20/35). SGCT: seminomatous germ cell tumor, NSGCT: nonseminomatous germ cell tumor.

Images:

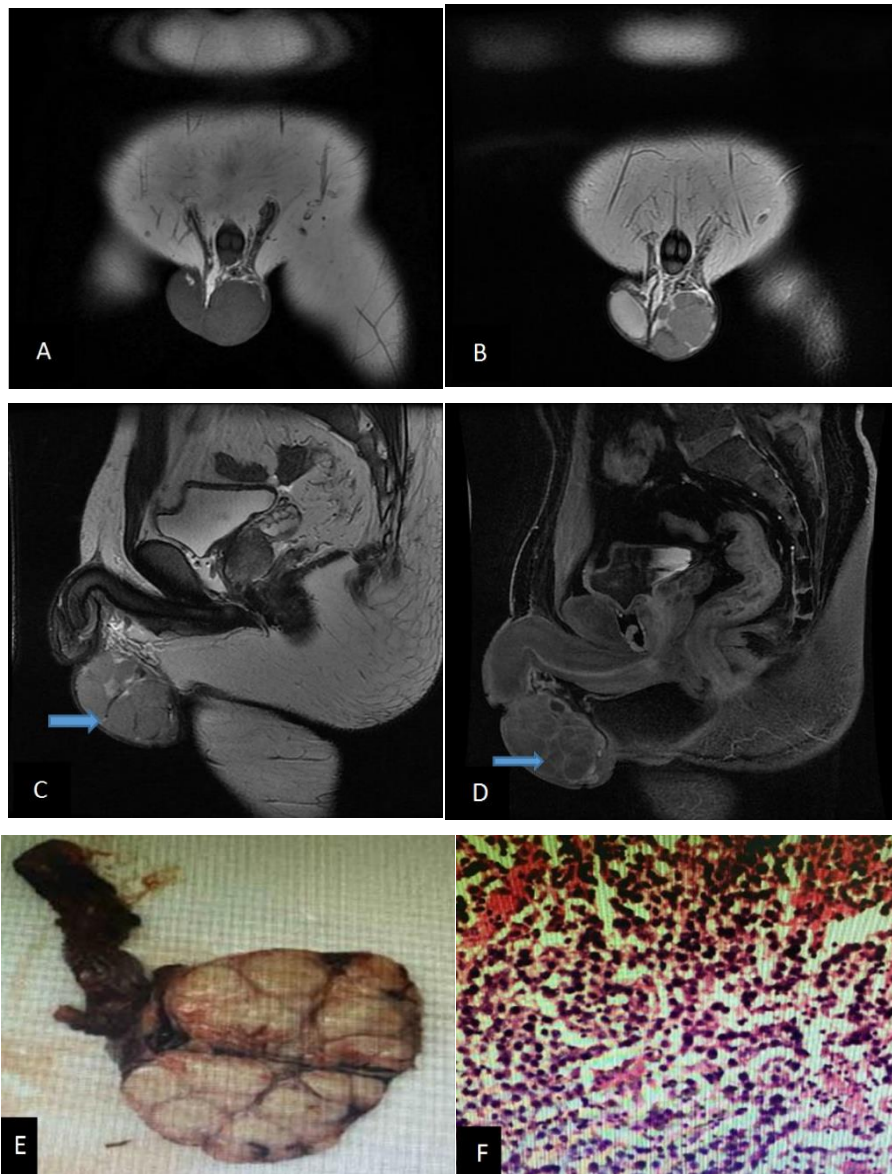


Image 1: Seminoma in a 30 years old male who presented to the surgical department with left sided testicular enlargement.

Figure (A) Coronal T1-weighted MRI shows a left testicular enlargement with signal isointense to right testis. (B) Coronal T2-weighted and sagittal T2-weighted MRI (C) shows a hypointense, relatively homogeneous lobulated mass in the left testis. Also note the linear low signal intensity band like septa (blue arrow). (D) Contrast enhanced axial T1-weighted MRI shows septa (blue arrow) enhancing more than the tumor tissue. (E) Gross specimen after radical orchietomy and (F) Photo of histologic section of seminoma (HE, X40).

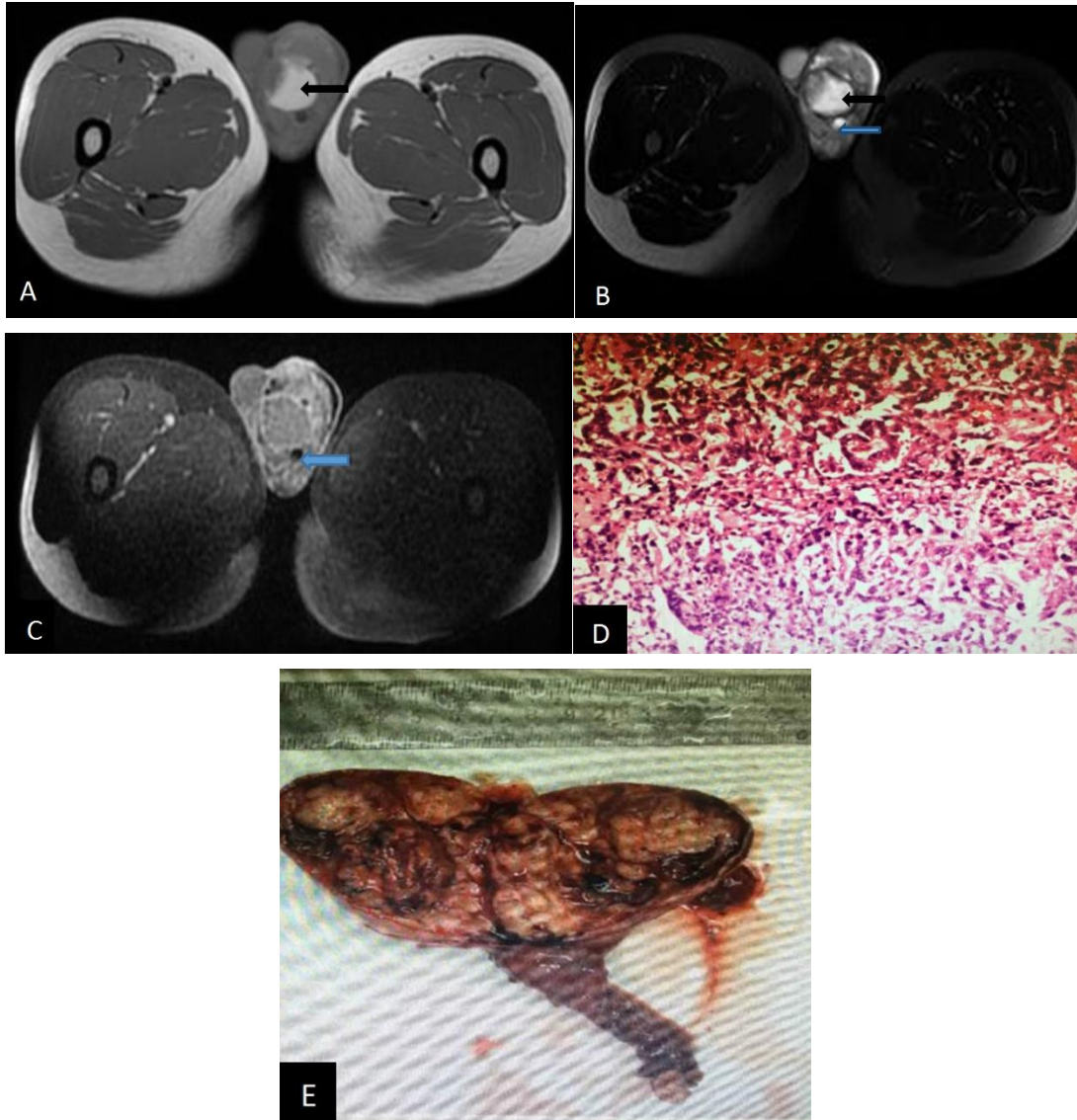


Image 2: Yolk sac tumor in a 35 years old man presenting with left testicular mass

Figure (A) Axial T1-weighted MRI shows enlarged left testicle isointense to normal testicular parenchyma compared to the right side but demonstrate areas of high signal intensity (black arrow) which were present in fat suppressed sequences also suggesting it to be hemorrhage. (B) Axial T2-weighted fat suppressed MRI shows a heterogeneous appearance. The high signal intensity anteriorly (black arrow) which was also present in the T1-weighted sequences in (A) represent hemorrhage, and a small hyperintense focus posteriorly (blue arrow) which is bright on T2-weighted and dark in T1-weighted unenhanced and enhanced images represent necrosis. (C) Contrast enhanced axial T1-weighted sequence shows the heterogeneous enhancement of the tumor. Also note the small hypointense focus (blue arrow) representing necrosis which was bright in (B). (D) Photo of histologic section showing embryonal carcinoma (HE, X40) and (E) Gross specimen after radical orchiectomy showing hemorrhagic necrotic tumor.

DISCUSSION

The histological characteristics of NSGCT are also reflected in its imaging findings in MRI. These tumors show heterogeneous signal intensity on T2-weighted MRI images. Unlike seminoma the predominant signal intensity in T2-weighted images is not low. On unenhanced T1-weighted imaging they are usually isointense to hyperintense compared to normal testicular parenchyma [26]. Hemorrhage and necrosis are more common in NSGCT as compared to SGCT [23]. Fat may be present in cases of teratoma and mixed germ cell tumors with teratomatous component and its presence on imaging indicates NSGCT. A benign lesion epidermoid cyst also may demonstrate fat but unlike in nonseminomatous tumors there is no enhancement post contrast agent administration and also irregular borders of the lesion is suggestive of malignant lesion [1]. These tumors demonstrate heterogeneous enhancement pattern after contrast administration and the heterogeneous appearance both pre and post contrast administration is thought to be due to the presence of associated hemorrhage, necrosis, cystic changes, and fat. In our study all 19 cases of nonseminomatous tumor demonstrated signal heterogeneity T2-weighted imaging. Hemorrhage and necrosis were found to be more common in these tumors than in nonseminoma. Only one case of embryonal carcinoma showed predominantly low signal intensity T2-weighted imaging and was misdiagnosed as a seminomatous tumor. Unfortunately contrast study was not available for this case. Fat was observed in two cases which were histologically proven to be cases of teratoma. All 10 cases of nonseminoma who underwent contrast study demonstrated heterogeneous enhancement. So, heterogeneity of signal in both unenhanced and enhanced images were the most useful MRI findings for characterizing NSGCT in our study.

Compared to this study, we also found that all seminomas cases were of low signal intensity T2-weighted imaging, 13 out of 16 cases were relatively homogeneous. Likewise, in nonseminoma we also found that heterogeneous signal on both unenhanced and enhanced studies is the most helpful feature for diagnosis of NSGCT. Hemorrhage and necrosis were common in nonseminoma and we found that presence of capsule is not a good criterion to characterize nonseminomatous lesion with a very low sensitivity and specificity. This is important as most of the intratesticular masses are malignant whereas most of the extra testicular masses are benign [32, 33]. Furthermore, our study showed that MRI is also useful in preoperative differentiation between seminoma and nonseminomatous tumors.

CONCLUSION

From our study we conclude that MRI can be used as a diagnostic tool in preoperative differentiation between seminomatous and nonseminomatous tumors. The presence of predominantly low signal intensity T2-weighted imaging and the demonstration of septa which enhances more than the tumor after gadolinium contrast administration is a feature of seminomatous tumors. Most seminomas demonstrate signal homogeneity in MRI. Heterogeneous appearance on both unenhanced and gadolinium contrast enhanced images is a feature of nonseminomatous tumors.

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Conflict of interest:

There are no conflicts of interest

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