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Clinical study of scrotum scintigraphy in 49 patients with acute scrotal pain: A comparison with ultrasonography

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The significance of scrotum scintigraphy in differentiating acute testicular torsion from acute orchiepididymitis was evaluated. In this report, 49 patients with acute scrotal pain were examined with radionuclide scrotum scintigraphy and ultrasonography in parallel for comparison. Of 37 patients with decreased radioactivity in the abnormal side scrotum, 35 were diagnosed with testicular torsion surgically and the other 2 were diagnosed with indirect inguinal hernia. Only 17 among the 35 patients were diagnosed by ultrasonography as having testicular torsion. The remaining 12 patients with increased radioactivity in the abnormal side of the scrotum were all diagnosed with orchiepididymitis through conservative treatment and clinical follow-up, but only 8 of the 12 were correctly and exactly diagnosed by ultrasonography. In the process of diagnosing acute scrotal pain, radionuclide scrotum scintigraphy has obvious advantage over ultrasonography. It also has the advantage of being simple, fast and accurate but without any detrimental effect on the human body.

Key words: acute scrotal pain, testicular torsion, orchiepididymitis, radionuclide imaging, ultrasonography

INTRODUCTION

BOTH ACUTE TESTICULAR TORSION and acute orchiepididymitis demonstrate acute scrotal pain clinically, but differential diagnosis is difficult and important.[1] The former requires immediate surgery, and in the latter, conservative therapy would be justified. Ultrasonography (US) has been implemented as a routine diagnostic approach for acute scrotal pain.[2] Meanwhile, radionuclide scrotum scintigraphy (RSS) is an easier, faster, non-invasive and much more accurate diagnostic method for the identical purpose.[1] In our study, 49 patients with acute scrotal pain were investigated by utilizing both RSS and US approaches for comparison.

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MATERIALS AND METHODS

Clinical data: 49 patients, with an average age of 23.5 years (7–42), complaining of acute scrotal pain were investigated. Among them, 35 were proved by surgery to be acute testicular torsion and the remaining 2 were indirect inguinal hernia. The other 12 cases were diagnosed as acute orchiepididymitis through conservative therapy or clinical follow-up. Both RSS and US examinations were applied to all these 49 patients. The earliest imaging was undertaken half an hour after onset, and the latest one was 48 hours post onset with an average time slice of 3.1 hours.

Methods: Before RSS, the patients were advised to take 200 mg potassium perchlorate orally. A single photon emission computed tomography (SPECT) gamma camera system (Toshiba GCA-901A/SA) equipped with a low-energy-high-resolution collimator was used. Patients were in the supine position, facing the detector, with the legs separated. The penis was fixed on the synchondroses pubis with tape making the scrotum symmetrically positioned in the center of the collimator. A bolus of 740 MBq

Table 1 Imaging results of RSS and US

	RSS	US
Total cases	49	
Torsion diagnosed	37*	17
Surgery proved torsion	35	
Inflammation diagnosed	12	8
Clinical proved inflammation	12	

*The 2 false positive cases were proved to be indirect inguinal hernia by the follow-up.

Table 2 Sensitivity and specificity of RSS and US for testicular torsion and orchiepididymitis

	Method	Sensitivity (%)	Specificity (%)
Testicular torsion	RSS	100 ┐*	85.7
	US	48.6 ┘	85.7
Orchiepididymitis	RSS	100	100
	US	66.7	100

*: $\chi^2 = 4.22$; $p < 0.05$

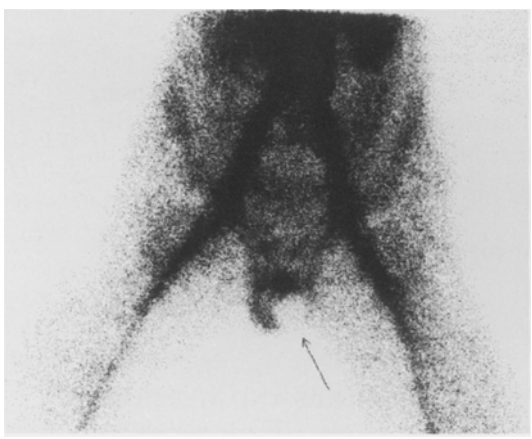

Fig. 1 Radionuclide scrotal scintigraphy (RSS) before surgery in a boy with testicular torsion (Case 1). Typical halo-like appearance is shown in the left testicle (arrow).

of $Na^{99m}TcO_4^-$ was injected and perfusion imaging was acquired immediately, 2 seconds per frame for a total of 120 seconds. Static imaging was acquired 10 minutes later in a matrix size of 512×512 with a total of 2×10^6 counts. The RSS images were evaluated visually and the inner side of the thigh was chosen as a reference. Usually 2 physicians in nuclear medicine department, a residential doctor and the chief doctor, checked the images.

The US examinations were completed by the other physicians with an Aloka SSD-2000 ultrasonoscope and linear transducers with a frequency of 5 MHz.

Description of the imaging characteristics

Normal: The blood vessels in the pubes and spermatic cord are slim, and the iliac artery on each side can only be seen during the perfusion phase. The blood vessels which

Fig. 2 RSS after surgery in the same patient in Figure 1. Perfusion of the left testicle is recovered successfully.

supply the scrotum and testicles cannot be visualized clearly. On static imaging, the distribution of radioactivity in both sides of the scrotum is symmetrical and homogeneous. In US examinations, the testicles showed signs of homogeneous echotexture, surrounded by a thin and bright line representing the tunica albuginea.

Abnormal: In patients with acute testicular torsion, the lesion side demonstrated decreased perfusion in the perfusion phase, and decreased uptake or even a defect (compared with the normal side) in static imaging. In a patient with acute orchiepididymitis, the lesion side revealed increased activity in the perfusion phase and diffusely increased activity in static imaging compared with the normal side. In US examinations, Color-Doppler US findings showed absent or decreased blood flow in testicular torsion and increased flow in orchiepididymitis.

RESULTS

The imaging results of both methods and their sensitivity and specificity are shown in Table 1 and Table 2.

Altogether 49 cases were studied and 35 of them were surgically proven testicular torsion and 12 were clinically proven inflammation. Thirty-seven cases were diagnosed as testicular torsion by RSS and 17 cases by US. Twelve cases were diagnosed as inflammation by RSS and 8 by US. Both the sensitivity and specificity of RSS and US were compared. For testicular torsion, the sensitivity and specificity of RSS and US were 100% and 85.7%, 48.6% and 85.7%, respectively. For orchiepididymitis, the sensitivity and specificity of RSS and US were 100% and 100%, 66.7% and 100%, respectively. A significant difference between the two methods, RSS and US, in

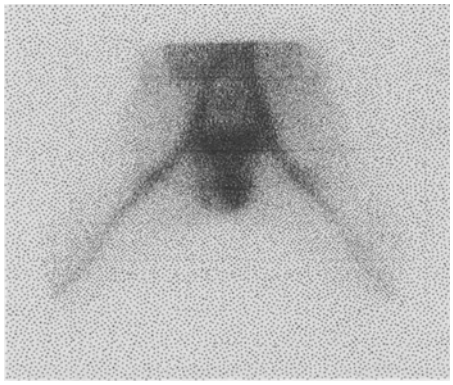

Fig. 3 RSS in a patient with orchiepididymitis (Case 2). Increase uptake is shown in the left testicle.

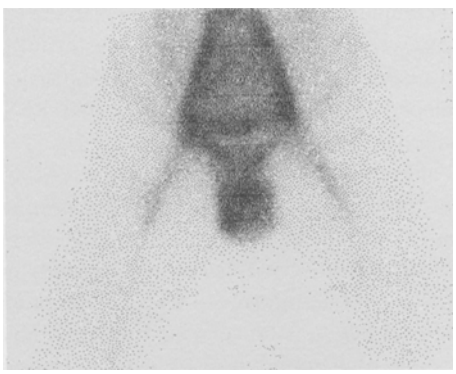

Fig. 4 RSS in a patient with left inguinal hernia. Left testicular uptake is diffusely decreased.

sensitivity for testicular torsion was evident for p values < 0.05 in the chi-square test.

REPRESENTATIVE CASES

Case 1: A 16-year-old patient complained of acute scrotal pain and the orchiepididymitis diagnosis was confirmed by US, but RSS showed a typical halo-like appearance and we diagnosed it as left testicular torsion (Fig. 1). The surgery proved the result of RSS. During the surgery, the testicle appeared florid, and considering the patient's age, the doctor recovered the 360° twisted testicle. Two days after the surgery, RSS was undertaken again and the twisted testicle imaging showed increased perfusion and recovered (Fig. 2).

Case 2: A 38-year-old patient complained of left scrotal pain for 2 days. Physical examination found the left scrotum a little swollen. The static image showed more uptake in the left side of the scrotum than in the right side (Fig. 3). This indicated inflammation but US gave a normal result. After thorough anti-inflammation treatment for a week, the patient was cured.

Case 3: A 21-year-old patient complained of left scrotum pain for 3 hours and his left testicle was swollen. RSS imaging showed decreased radioactivity in the left testicle and the US result suspected it as testicular torsion too, but the surgery proved that this case was indirect inguinal hernia (Fig. 4).

DISCUSSION

RSS has been carried out in many clinical situations, but its most useful, specific and accurate application is when applied to the differential diagnosis of acute scrotal pain. Generally speaking patients with testicular torsion require immediate surgery and those with orchiepididymitis only need conservative treatment. As to the surgery, it has to be done as soon as possible.[3] If the surgical operation is done 5 or 6 hours after the onset of the scrotal pain, the rate of survival of the testicle would be approximately 80–100%, but if the surgery is postponed to 10–12 hours after the onset,[3] the survival rate would be decreased to about 20%. Early, accurate differential diagnosis of acute scrotal pain is therefore critical for its prognosis.

In most cases, RSS imaging showing decreased perfusion on the lesion side of the testes will lead to a diagnosis of testicular torsion. Other pathological procedures seldom give the same result. No more than 8% false positive results have been reported.[1] Accordingly RSS could help most acute scrotal pain patients to avoid unnecessary, troubling surgery. Furthermore, this study proved that RSS is an optimal approach for the diagnosis of acute testicular torsion in clinics for both specificity and sensitivity. In this study, 35 cases of diagnosed testicular torsion were relieved by surgery. A typical "nubbin" imaging was obtained on RSS in patients who had suffered very long periods of testicular torsion (more than 5–7 hours). Since the blood stream was suddenly blocked and the reactivity of the spermatic cord vessel was increased in the torsion site, the augmentation of radioactivity from the iliac artery to the center in the perfusion phase formed a typical "nubbin" image. The testicular blood is supplied by the spermatic cord vessel which was obstructed when the torsion happened, and the dartos which receives its blood supply from the pubic artery showed signs of increased perfusion due to inflammation. The "halo-like" appearance could be distinguished on the static blood pool phase. The more apparent the "halo-like" appearance is, the lower the survival rate of the testicle will be. This should not be underestimated.[1]

The images of two false positive RSS cases showing diffusely decreased accumulation of radioactivity on the abnormal side were finally proved by surgery to be indirect inguinal hernia. The reason for the false positive result was that indirect hernia dropped into the scrotum, making it swollen and oppressing the vessels on the diseased side. Although surgical operation is required for both testicular torsion and indirect inguinal hernia, the

operating approaches are quite different.

It usually happens that epidydimitis involves the scrotum and its contents, but it is difficult to differentiate it from testicular torsion in clinics. Most cases have demonstrated apparently increased perfusion on the lesion side in the perfusion phase and the periphery of the abnormal scrotum showed more radioactivity in the static blood pool phase. If increased perfusion was extended from the outside into the center, it clearly indicated that the inflammation involved the scrotum or orchiepididymitis. If the inflammation caused an abscess, a diffuse increase in perfusion could be found in the abnormal scrotum; but cold radioactivity would be shown in the location of the abscess. Taking the results of perfusion phase imaging into consideration, it would be apt to distinguish it from the halo-like appearance.

Apart from RSS, ultrasonography is frequently used in differential diagnosis of acute scrotal pain, especially in an emergency.[4] Middleton et al.[5] evaluated 28 patients with acute scrotal pain by both US and RSS. The result of surgery confirmed testicular torsion in 7 patients. All cases were correctly diagnosed by US but only 6 by RSS, and the finding was false negative in 1 patient with 180 degrees torsion. One patient had a surgically confirmed scrotal abscess that was correctly diagnosed by US and RSS. The conclusions drawn from clinical follow-up in the remaining 20 patients were consistent with epididymitis, orchitis or torsion of an appendix testis. Both methods provided correct diagnosis in these 20 cases. So the authors suggested that US is at least as accurate as RSS and could be an effective means of evaluating patients with suspected testicular torsion.

In the report by Paltiel et al.,[6] 41 patients with clinically equivocal testicular perfusion underwent both US and RSS. The US demonstrated that 9 of 11 were cases of torsion and 23 of 30 were cases of nontorsion with 1 false positive and there were 8 indeterminate cases. RSS demonstrated that 10 of 11 were cases of torsion and 29 of 30 were cases of nontorsion and there were 2 indeterminate studies (all in patients with inguinal testis). When indeterminate studies were considered positive for torsion, specificity was 77% for US versus 97% for RSS ($p = 0.05$). There were no other statistically significant differences in terms of sensitivities and specificities. The conclusion was that neither US nor RSS demonstrated a statistically significant difference in discriminating testicular torsion in patients with acute scrotal symptoms and indeterminate clinical presentations. Furthermore, owing to its greater specificity, RSS may be helpful in avoiding unnecessary surgery when US reveals equivocal flow.

Chen et al.[7] summarized the comparative usefulness of both US and RSS in 46 patients with scrotal diseases. Amongst the patients with scrotal pain, 3/4 with terminal phase testicular torsion were correctly diagnosed by US, but 1 with the same inchoate symptoms and 11/15 with acute epididymitis or subacute epididymitis were not correctly diagnosed. All of them were correctly diagnosed with RSS except 1 with a scrotal cyst. US was able to discriminate cystic masses ($n = 10$) from solid masses ($n = 9$), but unfortunately it could not discriminate malignant from benign lesions. RSS had difficulty in separating cystic from solid lesions. So it was concluded that US should be available for patients with a scrotal mass to separate solid from cystic lesions but it is unable to differentiate acute epididymitis from early testicular torsion. Therefore, in patients with acute scrotal pain, RSS should still be the first study to be performed.

Karadeniz et al.[8] also compared the effectiveness of US and RSS during the differential diagnosis of acute scrotal pain. Ten patients were studied by both methods. In the findings 3 patients were categorized with acute ischemia and 7 with inflammation. Both methods showed that the correct diagnosis in 3 acute ischemia patients was proved by a series of surgical explorations. For the inflammation group, conservative therapy and follow-up were done. US established a correct diagnosis in 7/7, and RSS in 5/7 of the patients.

As shown in the above references, most authors reported that both methods had similar diagnosing accordance rates for acute testicular torsion and orchiepididymitis, but the conclusions of our study suggested that US should be inferior to RSS for diagnosing acute scrotal pain due to its lower sensitivity in both testicular torsion and orchiepididymitis. The early phase of pathological changes of scrotum due to vessel injury seldom demonstrated an abnormal echo; so that US seemed to be less helpful during this period of diagnosis. But US can differentiate liquid from a solid mass and provide scrotal anatomical information, which could not be accomplished with RSS.

Judging from our cases, we found out that it was extremely important to ascertain which scrotal side is affected. Otherwise, some cases might be misdiagnosed. In early torsion cases (less than 1 hour), RSS showed only a little change or the condition almost normal, and it is difficult to draw diagnostic conclusions. Therefore during the process of imaging, special attention should be paid to obtaining high-quality images. We should position and balance both sides of the scrotum equally in the middle of the detector in order to shield from interference by the scrotum, legs or other sources; otherwise a false negative result could easily occur.

CONCLUSIONS

RSS is an easier, faster and much more accurate way to diagnose acute scrotal pain. As a means of emergency examination in nuclear medicine, RSS had important clinical worthiness and advantages of early diagnosis of acute testicular torsion and acute orchiepididymitis.

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