

Received: 2016.02.18
Accepted: 2016.03.03
Published: 2016.07.26

Ultrasonography in Diagnosis of Congenital Absence of the Vas Deferens

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
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Source of support: This study was funded by the National Natural Science Foundation of China (No. 81370749)

Background: Congenital absence of the vas deferens is an important cause of obstructive azoospermia, and the lack of an imaging diagnostic test is a critical problem. The aim of this study is to discuss the use of ultrasonography in congenital absence of vas deferens, including dysplasia of the epididymis and the seminal vesical.


Material/Methods: Five fresh spermatic cord specimens were detected by ultrasonography (US) to evaluate the image of the spermatic cord segment of the vas deferens. Fifty normal males had scrotal US to confirm whether the normal spermatic cord segment of the vas deferens can be detected and to measure the internal and external diameter on the long axis view. Forty-six males clinically diagnosed as having congenital absence of vas deferens underwent scrotal US to evaluate the spermatic cord segment of the vas deferens and the epididymis. The seminal vesicals were detected with transrectal ultrasonography. We evaluated images of the vas deferens, epididymis, and seminal vesical.

Results: Scrotal ultrasonography can distinguish the vas deferens from the other cord-like structures in the spermatic cord, and the vas deferens has a characteristic image. Scrotal ultrasonography detected all 50 normal males and measured the diameter. No statistically significant difference was found between the left and right measurements. In the 46 patients, the following anomalies were observed: 1) 42 cases of congenital bilateral absence of vas deferens; 2) 2 cases of congenital unilateral absence of the vas deferens; and 3) 1 case of congenital segmental absence of the vas deferens. All 46 cases were accompanied with epididymis and seminal vesical anomalies.

Conclusions: The spermatic cord segment of the vas deferens can be detected by US, which is a valuable tool in diagnosis of congenital absence of the vas deferens. Seminal vesical and epididymis anomalies often associated with congenital absence of the vas deferens were revealed by ultrasonography.

MeSH Keywords: **Diagnosis • Ultrasonography • Vas Deferens**

Full-text PDF: <http://www.medscimonit.com/abstract/index/idArt/898109>

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Background

Congenital absence of the vas deferens (CAVD) is a rare disease. Approximately 1.3% of all infertile men have congenital bilateral absence of the vas deferens (CBAVD), and 1% of all men have congenital unilateral absence of the vas deferens (CUAVD) [1], but data on morbidity statistics in China are sparse. In our department, 1631 infertile men were detected by US during 2014-2015 and 46 CAVDs were diagnosed combined with physical examination and semen analysis. The diagnostic rate increased gradually with greater experience.

Some studies have established an association between CAVD and a presence of a cystic fibrosis transmembrane conductance regulator [2]. The vas deferens (VD), seminal vesical (SV) and epididymis (EP) have the same embryological origin, so CAVD is often associated with SV and EP anomalies. The status of SVs for men with CAVD detected by transrectal ultrasonography (TRUS) indicates a large variability of the morphology reported in the literature [3] and the classification has not been established. The dysplasia of EP in azoospermia has been described in the literature [4]. However, the images of EP in CAVD were not fully studied.

Scrotal US and TRUS have been widely used as convenient and cheap methods for evaluating male reproductive system obstruction. US is capable of visualizing VD and the sonographic appearance has been described [5], but there has been little research on use of US to evaluate CAVD. The aim of this retrospective study was to evaluate the usefulness of US in CAVD by describing the imaging characters of CAVD and the correlation with EP and SV anomalies.

Material and Methods

The VD in scrotum was divided to 2 segments: the epididymal-deferential loop (EDL) and the spermatic cord segment [6].

Five patients were detected by scrotal US before orchiectomy. During the surgery, 5 spermatic cord specimens were cut out. We were careful to obtain specimens contained with complete spermatic cord structures. The specimens were scanned immediately through ultrasound gel after surgeries. We evaluated the ultrasonographic features of the VD and compared them with the preoperative US.

Fifty males 19–46 years old and without any history of infertility or scrotal disease were enrolled as the normal group. All the spermatic cord segments of the VD could be cleared palpated during scrotal examination. The spermatic cord segment of the VD was scanned in both transverse and longitudinal planes by US. We measured the internal and external diameter of the VD

in longitudinal planes of the segment above the testicle because this segment is easy to palpate and is not usually covered by the testicle and EP. Doppler imaging was performed to distinguish the VD from the vessels in the spermatic cord. In some cases, the VD, especially the lumen, could not be clearly detected because of the inappropriate location. We used 2 fingers of 1 hand to hold the VD. Right and left size measurements were compared using the *t* test. The means and SDs were calculated in millimeters.

We enrolled 46 male patients who visited the clinic of the Infertility Department in our hospital between 2013 and 2015. These patients were presumptively diagnosed as having CAVD based on the physical examination and semen analysis. The physical examination was performed by 2 different doctors. If 1 or 2 sides of the VD could not be palpated in the scrotum, further semen analysis was performed, including examination of semen volume, pH, and fructose. All 46 patients had hemospermia, low semen volumes, low pH, and were fructose-negative. The semen could not have solidified spontaneously. Then, TRUS was used to evaluate the existence of and the morphologic changes in SVs. High-resolution ultrasonography was used to evaluate the existence of and the morphologic changes in VDs. Color Doppler imaging was performed to distinguish the vascular structure. We diagnosed CAVD if the spermatic cord segment of the VD could not be found by high-resolution ultrasonography. The anomalies of EP and SV were classified into 3 following categories: normal, hypoplasia, and absence. “Hypoplasia” was defined by their maldevelopment and abnormal morphology including the ectasia. “Absence” was defined by the partial and complete absence of the EP and SV.

A TOSHIBA medical ultrasound scanner model APLIO 500 was used to perform TRUS and high-resolution studies. A linear-array transducer model PLT-805AT was used for all scrotal examinations, with center frequency 8 MHz and dynamic range 90 dB. An intraluminal transducer model PVT-661VT was used for all TRUS with center frequency 6 MHz and dynamic range 90 dB.

Results

Five specimens from orchiectomy showed the ultrasonographic feature that was identical with the VDs *in vivo* before surgery and the diameter was also the same. The image of the VD was a cord-like structure with 2 parallel linear reflectors representing the internal walls of the lumen surrounded by a thick, hypoechoic, and mostly muscular wall in the longitudinal plane. In the transverse plane, the VD showed a “target-like” appearance (Figure 1).

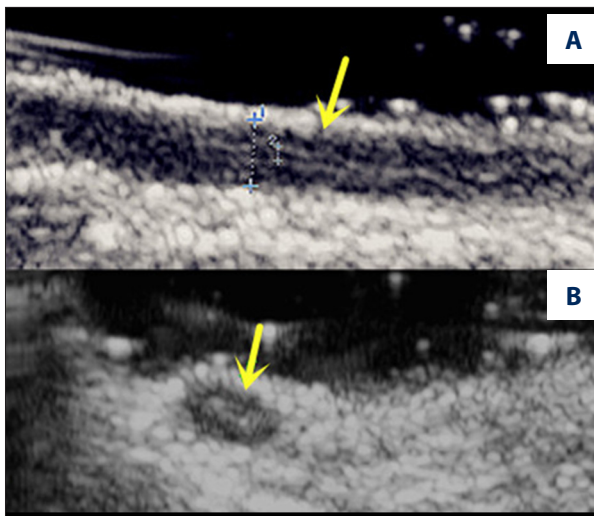


Figure 1. Image of the spermatic cord specimen and evaluation of the VD in the spermatic cord. (A) Longitudinal view of the VD shows its lumen and thick hypoechoic wall (arrow). (B) Transverse view of the VD shows its “target-like” appearance (arrow).

All spermatic segments of VDs could be identified bilaterally in the normal group. The VD showed a straight and very hypoechoic tube located laterally in the spermatic cord. The sonographic features were different from other cord-like structures such as arteries and veins, including the following points: 1) The VD was located in an individual fiber sheath positioned laterally in the spermatic cord. 2) The image of vessels showed more anechoic, irregular, and bent tubes compared to the VD. 3) The vessels collapsed during external compression by the transducer, whereas the VD did not change, due to the thick muscular wall. 4) We could detect Doppler flow in the vessels, but the VD showed no flow.

The external diameter on the right side was 2.15 ± 0.26 mm (range 1.6–2.7 mm) and the left side was 2.16 ± 0.23 mm (range 1.7–2.6 mm). The internal diameter on the right side

was 0.39 ± 0.09 mm (range 0.2–0.5 mm) and the left side was 0.41 ± 0.09 mm (range 0.3–0.6 mm). No statistically significant difference was found between the left and right measurements in the 50 normal cases.

Of the 46 cases with a presumptive diagnosis of CAVD, 42 were found to have an absent VD bilaterally by high-resolution ultrasonography, and 3 cases were found to have absent VD unilaterally. In the remaining 1 case, the spermatic cord segment of the VD was absent bilaterally, but the epididymal VD loop could be detected bilaterally with a dilated lumen; we diagnosed it as congenital segmental absence of the VD. All these cases were accompanied with the anomalies of EPs and SVs, including hypoplasia and absence (Table 1).

Discussion

CAVD was present in 12% of infertile man with azoospermia [7]. It is currently diagnosed by physical examination and semen analysis. An experienced doctor can make the diagnosis with high reliability by the inability to palpate the spermatic cord segment of the VD. Nevertheless, palpation can be problematic in males that are obese or who have a high-riding scrotum, and the semen analysis can provide a proof of obstructive azoospermia instead of CAVD. In a study with surgical proof, palpation misdiagnosed 5 of 47 proven cases of CAVD, for an error rate of 10.6% [3].

US is a widely used imaging modality for scrotal diseases. It has been reported that Scrotal US is effective in distinguishing obstructive azoospermia from nonobstructive azoospermia [4]. The etiologic classification of obstructive azoospermia can also be suggested by US [8]. However, CAVD is a rarely studied aspect of obstructive azoospermia using US. The diagnosis of CAVD is based on the image of the normal VD. Some studies have indicated that the VD is reliably visualized sonographically, and its appearance is characteristic and reproducible [9].

Table 1. US findings of EP and SV.

Anomalies classification	EP			SV		
	Short EB and ET Bilateral/ unilateral	Absent EB and ET Bilateral/ unilateral	Net-like ectasia Bilateral/ unilateral	Total absence Bilateral/ unilateral	Hypoplasia Bilateral/ unilateral	Absence Bilateral/ unilateral
CBAVD n=42	36(85.7%) 38/1	5(11.6%) 3/2	19(45.2%) 12/3	1(2.4%) 0/1	12(28.6%) 10/2	30(71.4%) 28/2
CUAVD n=3	3 0/3	0	0	0	1 0/1	2 0/2
CPAVD n=1	0	0	0	0	0	1 1/0

Data are numbers of cases, with percentages in the parentheses. EB – epididymal body; ET – epididymal tail.

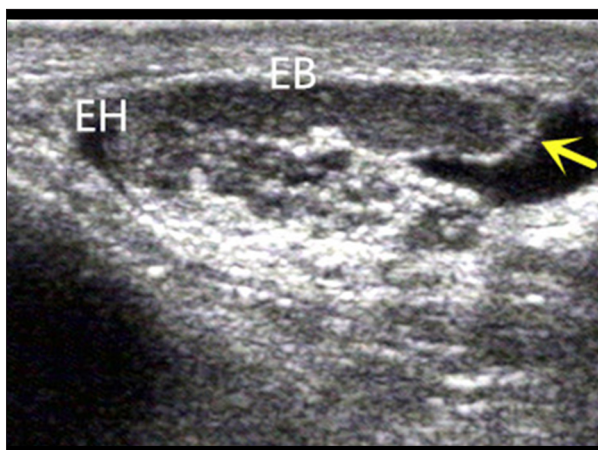


Figure 2. Image of the EP shows the normal EH, the thin and short EB, and the absence of ET (arrow).

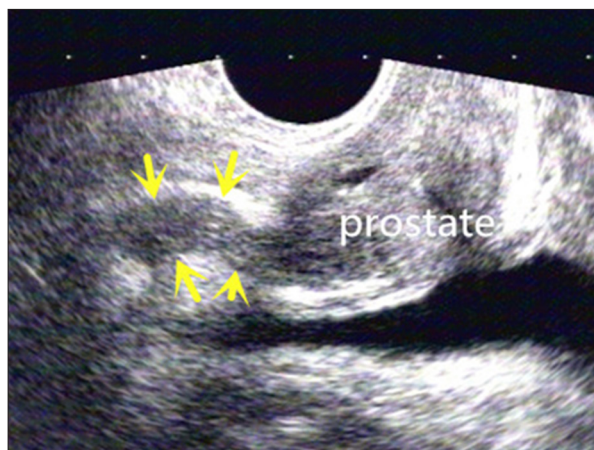


Figure 4. TRUS scan above the prostate shows a hypoplastic SV as a thin and short structure with hypoechoic appearance (arrows).

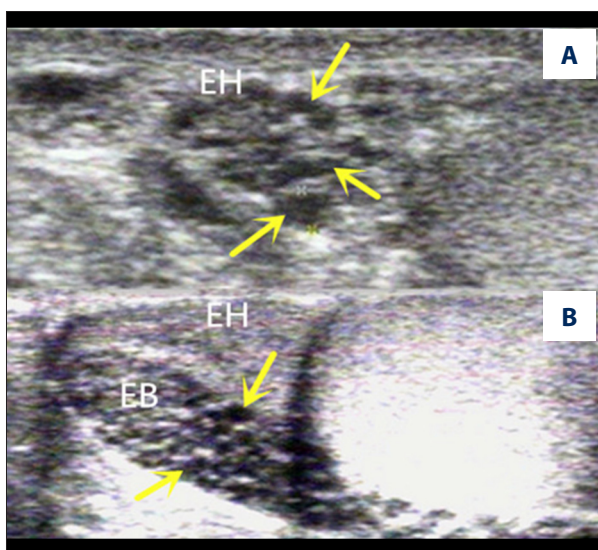


Figure 3. Image of 2 different ectasias. (A) The tube-like ectasia in the EH (arrows). (B) The thin net-like ectasia in the EB (arrows).

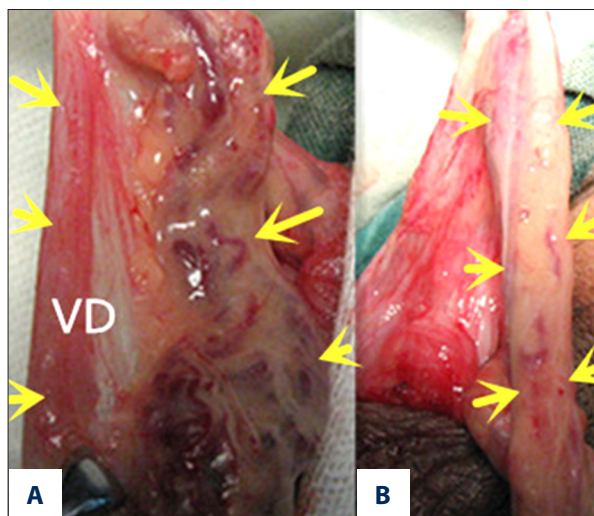


Figure 5. (A) separation of the spermatic cord (arrows) during orchidectomy. The VD lies laterally in the spermatic cord. (B) Separation of the spermatic cord (arrows) during scrotal exploration. The spermatic cord is thin and without a VD.

Some researchers scanned the VD specimens through a water bath [9]. In our study, we scanned the fresh specimens of spermatic cord through gel to evaluate the images of VD and other cord-like structures in the spermatic cord. This method has more advantages in distinguishing among all the cord-like structures. The images of VD are consistent with other studies [5,9]. We chose the spermatic cord segment of 50 males to establish the measurements because this segment is closest to the skin and easy to palpate. The measurement of the internal and external diameter was smaller than in other studies [5,9] probably due to the racial difference.

Results of our study indicated that most CAVD cases diagnosed by palpation and semen analysis show the images of absent VD in the spermatic cord, raising the question of whether it

is necessary to use US in addition to the clinical tests. As discussed above, palpation is not a reliable method for diagnosing CAVD. The doctors who palpated often turned to US to confirm the existence of the VD in daily work. The VD is a continuous cord in the scrotum, which is connected to the ET with an irregular thick loop [10]. We can scan the VD continuously from the EP to the loop to the upper segment, and with this method we diagnosed a case with segmental absence which showed the absence of the spermatic cord segment but the existence of the loop.

Embryologically, the SVs and EPs originate from the same part with the VD. Many studies have indicated that most cases

with CAVD have abnormal SVs or EPs [11]. A normal EP shows the typical image of the EH located above the upper or lower pole of the testis. The epididymal body (EB) and epididymal tail (ET) are located laterally, close to the testis. The EDL is located below the other pole of the testis relative to the epididymal head (EH) [5]; therefore, the EP is longer than the testis in longitude view and any part of EP can be easily located by US. In our study, most cases of CAVD had obvious EP hypoplasia. The remnant of EP mostly showed a full EH and a thin EB, and the ET and EDL could not be detected (Figure 2). In some cases, we also found the interesting phenomenon of ectasia: the tube-like ectasia always appeared in the EHs and the thin net-like ectasia always appeared in the remnant EBs and ETs (Figure 3). Some researchers have reported this phenomenon in obstructive azoospermia [4] and the thin net-like ectasia might be associated with cystic fibrosis [12]. The role of TRUS has been firmly established in evaluation of SV diseases [4,13]. Most CAVD cases showed the absence of SVs in our

study, and the others showed a thin and short structure with a hypoechoic image instead of the normal image of SV (Figure 4).

Conclusions

US is a reliable supplement to the diagnosis of CAVD, especially for the evaluation of the EP and SV. The absent image of VD can diagnose CAVD. Admittedly, the limitation of our study is the limited number of cases and the lack of verification. Only 9 patients agreed to undergo scrotal exploration. After the spermatic cord was separated, we found it was thinner than normal and without the VD (Figure 5).

Acknowledgement

We thank all the patients who participate in this study. The support of all the other institutions is gratefully acknowledged.

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