Hemodynamic classification of varicoceles in men: our experience

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Abstract

Aim The aim of this work is to propose a new hemodynamic classification of male varicoceles that can improve the accuracy of staging and the quality of the examination report. We retrospectively analyzed data on outpatients referred to our vascular ultrasonography service by general practitioners or urologists for work-up of “varicoceles.” Quantification and characterization of venous reflux is essential for selecting patients who require treatment and for evaluating the latter’s effectiveness, as demonstrated by our experience in a subgroup of 58 patients referred for imaging after surgery on endovascular procedures.

Materials and methods We performed scrotal Doppler sonography on 278 males seen during the period 2009–2011 for doubts raised during clinical assessment of varicoceles or for postoperative evaluation of residual reflux.

Results The diagnosis of varicocele was confirmed on 193 subjects; in 32 patients who had undergone percutaneous or surgical treatment the examination demonstrated the presence of residual reflux, while in 85 cases the presence of pain or a scrotal mass was not associated with venous reflux.

Conclusions Standardized instrumental criteria have been developed for the diagnosis of varicoceles but not for their staging. The classification system we propose provides a simple, hemodynamically accurate method for qualitatively

evaluating venous reflux, and it can be a useful tool for verifying the success of surgical and endovascular procedures for correcting varicoceles.

Keywords Varicocele · Hemodynamic classification · Doppler ultrasonography · Venous reflux · Pampiniform plexus

Sommario

Scopo Lo scopo del lavoro è quello di proporre una nuova classificazione emodinamica che ci sembra idonea ad una corretta stadiazione del varicocele maschile ed al miglioramento della qualità del referto dell’esame. Abbiamo effettuato l’analisi retrospettiva di una casistica ambulatoriale di pazienti afferenti al nostro servizio di ultrasonologia vascolare inviati dal medico di Medicina generale o dallo specialista Urologo col quesito “varicocele”. La quantificazione dell’entità e della qualità del reflusso è un essenziale strumento per la selezione dei Pazienti sia da avviare al trattamento, sia per la valutazione dell’efficacia del trattamento stesso, come abbiamo evidenziato in un sottogruppo di 58 pazienti giunti per controllo dopo trattamento chirurgico o endovascolare.

Materiali e Metodi Abbiamo eseguito un eco-color-doppler scrotale a 278 maschi che si sono presentati nel periodo 2009–2011 per un dubbio diagnostico a seguito di valutazione clinica o per uno studio postchirurgico dell’eventuale reflusso residuo.

Risultati La diagnosi di varicocele è stata confermata in 193 soggetti; in 32 Pazienti precedentemente sottoposti a trattamento chirurgico o percutaneo è stata dimostrata la presenza di reflusso residuo, mentre in 85 casi la presenza di dolore o massa scrotale non erano associate a reflusso venoso.

Conclusioni Attualmente esistono criteri strumentali standardizzati per la diagnosi, ma non per la stadiazione del

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varicocele. La nostra classificazione si propone come una metodica semplice ed emodinamicamente corretta per la valutazione della qualità del reflusso venoso e può essere un utile strumento di valutazione del successo o meno delle procedure correttive chirurgiche o endovascolari.

Introduction

Varicoceles are characterized by abnormal dilation and tortuosity of the veins of the pampiniform plexus in the spermatic cord. The prevalence of this disorder in the general population is around 15–20 %, and it is involved in up to 30–40 % of cases of male infertility [1]. The prevalence increases with age, with an increase in incidence of approximately 10 % per decade of life [2]. The cause of these lesions is not been well defined although several theories have been advanced: varicoceles have been attributed to the absence or incompetence of valves in the internal spermatic vein, obstructed venous drainage [3], and alterations of the pump mechanism at the level of the muscle (the so-called nutcracker phenomenon) [4, 5]. The disorder has even been linked to the size of the penis [6]. Regardless of their cause, varicoceles can cause pain, testicular hypotrophy, and alterations of spermatogenesis leading to sub-fertility or infertility.

Doppler ultrasonography is the gold standard examination for assessing venous reflux, but standardized criteria are lacking for its use in the evaluation of testicular pathology. Thus far, the only significant proposals to this effect are those of Sarteschi [7] and the one made in 2007 by the Italian Group for Vascular Ultrasonology (IGVU), whose practice guidelines have recently been revised [8]. The value of any classification system lies in its ability to standardize the instrumental examination protocol and the quantification of the results obtained. The aim of this paper is to demonstrate the usefulness of a modified hemodynamic classification we have developed based on previously proposed systems for the evaluation of varicoceles and to propose its use as a reference for clinicians involved in the sonographic diagnosis of this disorder.

Materials and methods

We retrospectively evaluated data on a population of 278 males (Table 1), who were seen in the Local Health Unit of Cesena, Italy, between 2009 and 2011. The data were stored in the unit's electronic archives as part of the regional network established by the SOLE (*Sanità OnLine*) project, which provides for the acquisition of patient consent for the handling of sensitive data. After the medical

history had been obtained, each patient underwent ultrasound assessment of testicular volume and color-Doppler studies of the pampiniform plexus. A single physician performed all the sonographic examinations analyzed in this study. The equipment used consisted of a Siemens Acuson Sequoia ultrasound scanner and a multi-frequency (8–15 MHz) transducer (Acuson 15L8W small parts/breast). The unit was set up for the study of slow flow. Each examination was performed in an outpatient clinic at a comfortable room temperature. The patient was examined in the upright and supine positions. The operator explained how to perform the Valsalva maneuver correctly. For the detection of venous reflux, classical longitudinal and axial projections were used with the transducer positioned at the upper pole of the testis, at the level of the inguinal canal. The presence of venous reflux was

Table 1 Characteristics of the study population

Age of youngest patient	4 years
Age of oldest patient	83 years
Mean age	37 years
No. of patients studied	278
No. of patients who had varicocele surgery	58

Table 2 Our classification of the patients with confirmed varicoceles

Patients with confirmed diagnosis of varicocele	193
Grade 1	6
Grade 2	97
Grade 3	56
Grade 4	
Level A	26
Level B	8

Table 3 Dubin and Amelar's classification

Classification	Characteristics
Grade I	Varicocele that is palpable during Valsalva maneuver (retrograde filling of the internal spermatic vein without collaterals to the internal or external iliac vein)—pressure-related variant
Grade II	Varicocele that is palpable without the Valsalva maneuver (massive retrograde filling of the spermatic vein produces a large varicocele with collaterals to the internal or external iliac vein)—shunt-related variant
Grade III	Varicocele that is palpable and visible without the Valsalva maneuver (massive retrograde filling of the spermatic vein produces a large varicocele with collaterals to the internal or external iliac vein)—shunt-related variant

Table 4 The Sarteschi classification

Grade	Features
1	Venous reflux at the emergence of the scrotal vein only during the Valsalva maneuver, hypertrophy of the venous wall without stasis
2	Supratesticular reflux only during the Valsalva maneuver, venous stasis without varicosities
3	Peritesticular reflux during the Valsalva maneuver, overt varicocele with early-stage varices of the cremasteric vein
4	Spontaneous basal reflux that increases during the Valsalva maneuver, possible testicular hypotrophy, overt varicocele, varicosities in the pampiniform plexus
5	Spontaneous basal reflux that does not increase during the Valsalva maneuver, testicular hypotrophy, overt varicocele, varicosities in the pampiniform plexus

Table 5 The authors' hemodynamic classification of varicoceles

Classification	Features
Grade 1	Venous reflux lasting >1 s only during the Valsalva maneuver
Grade 2	Spontaneous, discontinuous venous reflux that is not increased by the Valsalva maneuver
Grade 3	Spontaneous, discontinuous venous reflux that is increased by the Valsalva maneuver
Grade 4	
Level A	Spontaneous, continuous venous reflux that is not increased by the Valsalva maneuver
Level B	Spontaneous, continuous venous reflux that is increased by the Valsalva maneuver

evaluated before and during execution of the Valsalva maneuver. This assessment began with a preliminary and more intuitive color-Doppler analysis, which is also useful for selecting the area where the pulsed-wave Doppler sample volume will be placed. Given the anatomic features of the district and the purpose of the examination (detailed assessment of the presence and duration of reflux rather than flow velocity), the beam steering angle is not a critical factor. As in all assessments of a superficial venous system, the operator should avoid exerting excessive pressure with the transducer.

Results

The study was conducted on a total of 278 males (mean age 37 years) referred by their family physicians for scrotal ultrasonography. Since they were unselected outpatient cases, the indications for the examination were heterogeneous. However, in almost all cases, they could be divided into three groups: (1) evaluation of the success or complications of percutaneous or surgical procedures for a pre-existing varicocele; (2) work-up of scrotal pain or a scrotal mass of non-traumatic origin; (3) investigation of infertility.

In all cases, the examination findings could be easily correlated with our hemodynamic classification (Table 2). In 193 cases, we diagnosed or confirmed the presence of a varicocele; in 97(50 %) of these cases there was evidence of spontaneous, discontinuous venous reflux that was not increased by the Valsalva maneuver (grade 2). In the other

Fig. 1 Grade 1: venous reflux (duration >1") during the Valsalva maneuver

85 patients there was no evidence of venous reflux. In the subgroup of 58 patients who were examined after varicocele surgery, treatment success, defined as the total absence of reflux, was verified in only 45 % of cases. These unimpressive success rates explain the heated debate regarding treatment options in varicocele surgery [9, 10].

Discussion

Over the years, different systems have been proposed for the classification of varicoceles. Table 3 shows the one developed by Dubin and Amelar [11]. Table 4 shows the Sarteschi classification, which was developed thanks to the

Fig. 2 Grade 2: discontinuous venous reflux that does not increase significantly (200 ms) during the Valsalva maneuver

Fig. 3 Grade 3: discontinuous venous reflux that increases significantly (1,500 ms) during the Valsalva maneuver

success of color-Doppler ultrasonography in depicting blood flow. This classification does not emphasize the distinction between spontaneous continuous and intermittent reflux, which is an essential element. It is based on a

combination of instrumental and clinical findings and for this reason, it cannot, in our opinion, be considered a hemodynamic classification. The IGvU guidelines [8] do not propose any type of classification. The Dubin

Fig. 4 Grade 4A: continuous venous reflux that does not increase significantly (400 ms) during the Valsalva maneuver

Fig. 5 Grade 4B: B-mode US image of the pampiniform plexus (a) during spontaneous venous reflux documented by color Doppler (b)

Fig. 6 Grade 4B (same patient shown in Fig. 5): B-mode US with color Doppler: increased venous reflux during the Valsalva maneuver

Fig. 7 Grade 4B (same patient shown in Fig. 5): pulsed Doppler tracing of venous flow (a) that increases during the Valsalva maneuver (b)

classification is based solely on clinical examination of the scrotum: no consideration is given to the physiopathological implications, the extension of vasal damage, or changes produced by surgical procedures. Another classification has been proposed, which identifies the presence of a varicocele based exclusively on the presence of retrograde flow during the Valsalva maneuver [12]. It is clear that a hemodynamic classification system is needed to assess the type and degree of venous reflux, which are essential for assessments of treatment effectiveness. Table 5 shows the classification we propose, and examples of flow-metric and color-Doppler findings are shown in Figs. 1, 2, 3, 4, 5, 6, and 7.

The first step to ensure a high-quality assessment [13] is to estimate the volume of each testis: a difference greater than 20 % indicates testicular hypotrophy. The second step involves assessing the presence, type, and duration of venous reflux in the pampiniform plexus and spermatic cord, before and during the Valsalva maneuver. When the patient is standing, physiological flow in the pampiniform plexus is intermittent, slow (<1 m/s), and centripetal. Continuous venous reflux indicates complete valvular incompetence at

the level of the spermatic cord. Intermittent reflux indicates early-stage valve failure. Reflux lasting more than 1 s that occurs only during the Valsalva maneuver indicates that the valve is incompetent only when abdominal pressure is increased.

Our hemodynamic classification, which incorporates previous indications from the literature, is being proposed as a standardized tool for future research (beyond the scope of the present study) on possible correlations between the characteristics of the reflux, clinical features of the varicocele (subjective symptoms, testicular hypotrophy, fertility), and therapeutic implications (indications for treatment and assessment of effectiveness).

Conflict of interest None.

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