

Infrared digital thermography of scrotum in early selection of progressive varicocele

T. Kulis^{a,*}, M. Knezevic^b, K. Karlovic^b, D. Kolaric^c, S. Antonini^d, Z. Kastelan^a

^a Department of Urology, University Hospital Centre Zagreb, Medical School, University of Zagreb, Zagreb, Croatia

^b Department of Urology, General Hospital "Dr. Josip Benčević", Slavonski Brod, Croatia

^c Ruder Boskovic Institute, Centre for Informatics and Computing, Zagreb, Croatia

^d Department of Radiology, Primary Health Care Zagreb – Center, Zagreb, Croatia

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ABSTRACT

Varicocele is frequent but correctable cause of male infertility. Varicocelectomy is the most commonly performed operative procedure for varicocele. Majority of varicocele patients do not have fertility problem, therefore surgical correction is not recommended in all prevalent cases. On the other hand, varicocele is a progressive condition in some cases and individual with varicocele is at risk for developing impairment which can ultimately lead to semen deterioration and consequent infertility.

Selection of patients with varicocele that will progress and cause infertility is beyond our current diagnostic capabilities. Diagnostic assessment of varicocele depends on physical examination and scrotal ultrasound/doppler. Infrared digital thermography of scrotum is a non-invasive and objective diagnostic method for early varicocele detection by means of temperature measurement on the scrotal skin surface. The criteria for diagnostic use of scrotal thermography were recently presented. We hypothesize that the infrared digital thermography of scrotum could be the cornerstone in detection of varicoceles that tend to progress with impairment of semen quality and will require surgical correction, among all prevalent varicocele cases.

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Introduction

Varicocele is a dilatation of pampiniform venous plexus within the spermatic cord. A clinical varicocele is found in about 15% of all adult males [1]. It is associated with male infertility and can be identified in 40% of men with primary infertility and in 75–81% men with secondary infertility [2]. Elevated scrotal temperature and consequent heat stress are considered as a prime pathophysiological determinant that impacts testicular function and spermatogenesis [3,4]. Varicocele is a common, but also correctable cause of male infertility. Surgical correction, known as a varicocelectomy, is standardized operative procedure for varicocele [5]. Nevertheless, considerable debate on varicocele surgical treatment is still present. Most men with varicoceles are able to father children. Therefore, operative ligation of the spermatic vein is not recommended for treatment of all prevalent varicocele cases. Current guidelines propose surgical correction in infertile men with palpable lesions and semen abnormalities [6]. However, recent studies reviewed these proposals and concluded that sur-

gical treatment of varicocele does not improve the chances of conception when present as the only proven explanation of infertility [7].

Arising problem that requires solution is well-timed selection of men with varicoceles that tends to progress and to impair semen quality. These are progressive deterioration of semen quality (PDSQ) varicoceles. Selected PDSQ varicoceles that will develop infertility would clearly require surgical treatment. Diagnostic proposal for that kind of selection is still absent [8]. Semen quality analysis is not considered as a screening method. Currently, diagnostic assessment of varicocele depends on physical examination and scrotal ultrasound/doppler [9].

Infrared digital thermography of scrotum is sensitive non-invasive diagnostic tool for early varicocele detection by means of temperature measurement on the scrotal skin surface. Despite the fact that it is an objective and short diagnostic method, it was sporadically used in clinical practice during past. Lack of complete diagnostic parameters and high cost were considered as the main reasons. Recent study suggested diagnostic criteria for thermography of scrotum for varicocele detection [10]. Thermography of scrotum also proved as a useful diagnostic method in low-grade varicocele and as a follow-up method after the operative treatment [11].

* Corresponding author. Address: Department of Urology, University Hospital Center Zagreb, Kispaticeva 12, 10000 Zagreb, Croatia. Tel.: +385 1 238 8504; fax: +385 1 237 6026.

E-mail address: tkulis@gmail.com (T. Kulis).

The hypothesis

We hypothesize that the infrared digital thermography of scrotum could be the main diagnostic tool in detection of varicoceles that tend to progress and impair semen quality, among all prevalent varicocele cases. Thermography of scrotum could provide well-timed selection of varicocele that will require surgical correction.

Evaluation of hypothesis

Varicocele is a progressive lesion in some men, resulting in the loss of previously established fertility [12]. Scrotal hyperthermia is considered as a predominant cause of semen impairment in varicocele [13]. Detection of scrotal temperature is a part of varicocele diagnostic assessment. Infrared digital thermography of scrotum uses highly sensitive infrared camera to detect and measure temperature in scrotal area [14]. Points of interest are temperature rates at right and left sided pampiniform plexus and testicle. Image analysis of points of interest provides typical thermographic patterns [10]. Bilateral uniform scrotal normothermia is considered normal. The varicocele is thermographically characterized by the presence of an area with increased temperature. There are two essential patterns that can be distinguished [15]. First pattern is described as asymmetric thermal distribution at pampiniform plexus, or hyperthermia limited to the upper part of affected hemiscrotum. Second pattern includes asymmetric thermal distribution at pampiniform plexus with stretching to ipsilateral testicle, or entire hemiscrotal hyperthermia. Complete scrotal, bilateral hyperthermia is rare but definite sign of advanced varicocele. As shown, localization and extension of the hyperthermic area is crucial for thermographic interpretation.

During our research we took notice of a described temperature distribution patterns in men with varicocele. Highly elevated scrotal temperature, in some cases, is restrained only to pampiniform plexus, with no great temperature elevation on ipsilateral testicle (pattern A – Fig. 1). On the other hand, there are cases with high temperature elevation on pampiniform plexus with high thermal propagation to ipsilateral testicle (pattern B – Fig. 2). Last-mentioned pattern could be the focus of interest when selecting and predicting cases with early propagation. These patients have elevated hemiscrotal temperature that could heavily influence testicular function (PDSQ varicoceles) [16].

Currently, varicocelectomy is proposed in infertile men with palpable varicoceles and impaired semen quality. Surgery in-

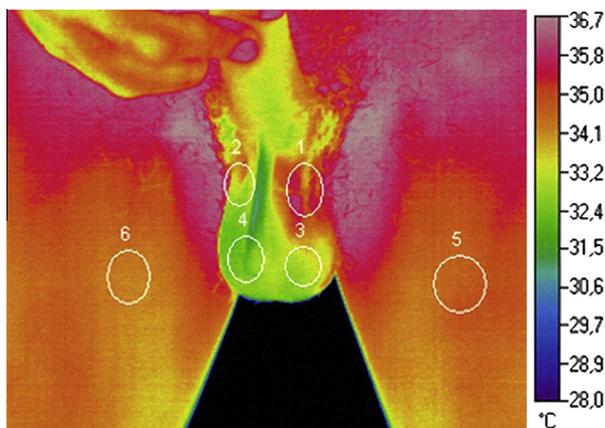


Fig. 1. Elevated scrotal temperature is restrained to left pampiniform plexus (pattern A).

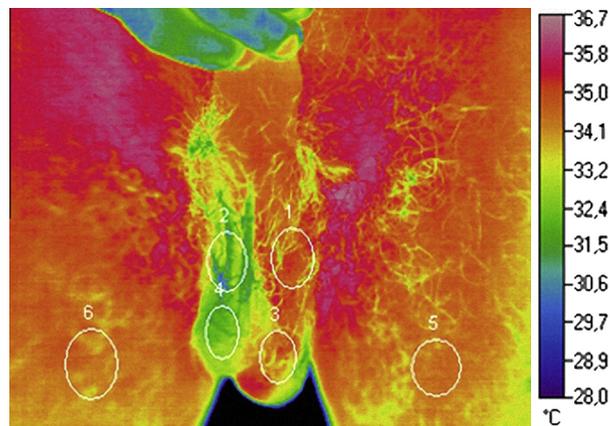


Fig. 2. Elevated scrotal temperature on left pampiniform plexus with thermal propagation to ipsilateral testicle (pattern B).

creases odds of spontaneous pregnancy and improvements semen quality [17]. If varicocelectomy is performed in the early stage of disease and early years of life, it has better outcome on fertility [18]. We believe that above described thermographic sign could be the main diagnostic tool while deciding which patients to treat surgically. Selected cases with complete hemiscrotal hyperthermia could benefit from surgery.

Varicocele causes defects in the early spermatid development and affects especially the key parameter of progressive sperm velocity [19,20]. Recent study showed that patients with initially abnormal semen quality have a higher risk of PDSQ than in those with initially normal semen quality. Furthermore, varicocele patients with initially normal semen quality who have higher scrotal temperature might have a greater risk of PDSQ [21].

To confirm our hypotheses, we propose comparison of sperm quality in three groups of similar age patients. First group would include varicocele free men, second group would include patients with pattern A varicocele and third group would include patients pattern B varicocele. Significant sperm quality deterioration is expected in pattern B group.

Thermography of scrotum is performed with the patient in the upright position, with undressed lower part of the body, after 10 min spent in a climatized room (22–23 °C) [22]. Patients legs are stretched and scrotum hanging freely. Tip of a penis is held against the abdominal wall. Thermographic camera is placed in front of the patient with distance of around 40 cm. Three images are taken: in basal condition, during the Valsalva maneuver, and shortly after the Valsalva maneuver. All images are analyzed on described points of interest: left and right pampiniform plexus, testicle and thigh. Temperatures are measured and compared. Temperature of left pampiniform plexus higher than 34 °C is described as pattern A. Hyperthermia partially stretching from pampiniform plexus to ipsilateral testicle, with testicle temperature higher than 32 °C is described as pattern B [23].

Conclusion

Understanding and predicting of varicocele behavior in an individual patient is still beyond our diagnostic capabilities. Current diagnostic assessment has limitations and does not provide accurate selection of progressive varicocele that will require definite surgical treatment. We believe that infrared digital thermography of scrotum, with typical diagnostic patterns, could provide that kind of selection. Thermography of scrotum is presented as non-

invasive, objective, feasible, short and low-cost method in varicocele detection.

Conflict of interest

We certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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