THE USEFULNESS OF PREOPERATIVE DOPPLER ULTRASONOGRAPHIC EVALUATION OF SAPHENOFOEMORAL COMPLEX FOR IMPROVING LOWER LIMB VARICOSE VEINS SURGERY

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The aim of the study was to determine whether detailed preoperative Doppler ultrasonographic examination of saphenofemoral complex can improve the results of the lower limb varicose veins surgery. Two groups of patients (30 people each) were operated due to lower limbs primary varicose veins caused by saphenous vein insufficiency. All patients had a routine duplex examination performed. Group B had additional ultrasound examination before the operation to evaluate the number, diameter, and localization of the tributary vessels in the area of saphenofemoral junction. 30 days after the operation, in both groups control duplex examination was performed to evaluate the sparingness of the surgical procedure. The control ultrasonography showed 8 and 2 tributary vessels overlooked in groups A and B, respectively. The differences were statistically significant. The conformity of the preoperative ultrasound and the scene found during the operation in group B was 83.3%. The chance of overlooking peripheral vessels in group A increased 5.1 times.

Preoperative Doppler ultrasound estimates localization of tributary vessels within the saphenofemoral junction, which makes detecting vessels during the operation much easier. It allows to minimize the number of technical mistakes and improve the lower limb varicose veins surgery results.

Key words: saphenofemoral junction, varicose veins, surgery, duplex ultrasound

Recurrent varicose veins after surgery (RE-VAS) are a complex clinical, social, and economical problem. Some sources claim that recurrent varicose veins occur in 20% to 80% of the operated patients (1, 2). Among many causes of the recurrent varicose veins the most important are those related to the operating surgeon (3, 4, 5). The effectiveness of the surgery is dependent on the technical skills of a surgeon and his knowledge of physiopathology and anatomical changeability of lower extremities venous systems.

The data from available literature show that recurrent varicose veins arise from persistent reflux in saphenous vein or in the area of saphenofemoral junction (2, 6, 7, 8). Most often, pathologic regressive blood flow appears in peripheral vessels which were overlooked during the primary surgery.

A fact that saphenofemoral junction has great anatomical changeability is of vital importance. Characteristic features do not only include many variants of superficial inguinal veins flow but also anatomical varieties of the same saphenous vein (5, 9). During surgery, misinterpretations of some saphenofemoral junction structures happen very often.

Preoperative duplex ultrasound of lower extremities superficial veins has become the most valuable complementation of clinical examination. It gives a possibility of precise localization of a reflux source and also assessment of morphology and the route of venous vessels in the limb. Preoperative detailed ultra-
sonography of all the elements of saphenofemoral complex also appear to be extremely helpful.

The authors think that pre-operative ultrasoundographic evaluation of a number of routes of peripheral veins in the area of saphenofemoral junction improves the surgery and can limit a number of technical mistakes in the primary surgery and decreases the frequency of varicose veins recurrence.

The aim of the study is to present the usefulness of Doppler ultrasound for defining the route and number of tributaries in the area of saphenofemoral junction before varicose veins surgery and to compare the effects of lower extremities varicose veins operative treatment in the patients whose surgery was preceded with a detailed ultrasound evaluation of venous vessels in the area of saphenofemoral junction with the patients who did not have such an examination.

MATERIAL AND METHODS

The study included 60 patients operated in 2003 and 2004 due to primary lower limbs varicose veins in the second degree of clinical advancement, according to CEAP classification. All patients had saphenous vein ostium insufficiency with reflux above 1 s also in the crural part found in the duplex imaging. The patients with deep veins insufficiency were excluded from the study. The patients were divided into two groups of 30 people. Group A consisted of 30 patients operated from October 2003 to April 2004, 22 women and 8 men at the age from 23 to 73 years (mean 50.6). Group B consisted of 30 patients operated from April to August 2004, 21 women and 9 men at the age from 29 to 70 years. Ultrasonographies were done with the use of B-K MEDICAL, model “Hawk 2102”. Mainly linear probes of 6.5MHz to 10MHz frequency were used. All ultrasonographies performed by the same experienced surgeon ultrasonographer.

At the first stage of preoperative examination of the patients from group B the place of saphenous vein junction with femoral vein was localized precisely and saphenofemoral venous angle and saphenous vein arch were visualized. At the same time the saphenous vein ostium valve was demonstrated. The next stage included search for tributaries in the area of saphenofemoral junction. The direction of each tributary and its ostium was determined. During Valsalva trial, with the use of colour Doppler function, the relation with femoral or saphenous vein was confirmed, in case of total conformity concerning origin and route of the vessel, the rough diameter was determined in the phase of calm breathing and was plotted on the prepared chart. The preoperative report of Doppler ultrasound used during the surgery included information about the diameter and final route of peripheral vessels in the area of saphenofemoral junction (fig. 1).

The route of individual tributaries was presented graphically. Each quadrant (superior, inferior, medial and lateral) showed approximate direction of tributaries final part entering saphenous vein or femoral vein (fig. 2).

Moreover, all anatomic variabilities referring to the saphenous vein itself were also noted down in the report. The time of additional preoperative examination in group B was from 10 to 15 minutes.

All patients from both groups had the surgery done according to the same procedure. The saphenous vein was removed by Babcock’s method, demonstrated tributaries in the area of saphenofemoral junction were ligated and cut. Insufficient perforators on the extremity periphery were ligated and cut.

During the operations of the patients from group B the report from ultrasound examination was used. The surgeon had to find the number of tributaries that was consistent or higher than the number found in the ultrasound examination (fig. 3).

Then, the vessels which had not been found in the ultrasound image were measured. A surgical thread of 1mm diameter was used as a standard. The thread was placed next to the vessel and a photography was taken (fig. 4). They were classified according to this model into vessels of the diameter smaller, equal or bigger than 1 mm.

Control ultrasonography was performed 30 days after the surgery in both groups. Again, the area of saphenofemoral junction was evaluated in detail. The tributaries that remained after the primary surgery were looked for. Their diameter and route were observed and marked in the report as in the preoperative examination in group B.

Unilateral, precise Fisher test was applied for statistic calculations. The quotient of chances of leaving the peripheral vessel in group A
was determined and 95 percent trust bracket for the evaluation of dependence power between the number of the left peripheral vessels and the compared groups.

RESULTS

The control ultrasound of group A, 30 days after the surgery, showed the tributary vessels

Fig. 2. A – ultrasonographic image of saphenofemoral junction region – cross-section projection (T – tributaries, CFV – communis femoral vein, LSV – saphenous vein); B – saphenous vein and communis femoral vein divided into quadrants: S – superior, M – medial, L – lateral, I – inferior
Fig. 3. Ultrasonographic image (A, B) and intraoperative picture (A1, B1) (T – tributaries, CFV – communis femoral vein, LSV – saphenous vein)

Fig. 4. Comparison of the tributary diameter of saphenofemoral junction with surgical thread of 1 mm diameter (A – surgical thread φ1 mm, B – tributary)
that were overlooked during the operation in 8 (23.3%) patients. Two tributaries of the diameters 1.5 mm and 2 mm coming from saphenous vein were found in one patient. The first one was located in the superior quadrant and the other one in the medial. Other single tributaries of the diameters: 1.5 mm, 2 mm, 2.1 mm, 2.2 mm, 2.3 mm, 2.3 mm, 2.5 mm were found in the remaining 7 patients. In five cases, the vessels were going into saphenous vein in the superior quadrant, while in the other 2 cases they were localized in the medial quadrant.

In group B, 30 days after the surgery the left tributaries of the diameters 1.5 mm and 2.2 mm were found in two (6.7%) patients. Both vessels were in the medial quadrant.

The number of the tributaries left after the surgery was compared in both groups. Statistically significant increase in frequency of leaving tributaries in the area of saphenofemoral junction in the patients without preoperative ultrasound examination (group A) was found out, (p=0.04 for Fisher test) (tab. 1).

In the view of the above given, the chance quotient of the tributary occurrence 30 days after in group A was 5.1. (95% trust bracket from 0.98 to 26), which means that a chance of leaving a tributary in patients who did not have a preoperative ultrasound increases 5.1 times.

In group B, the discrepancies between the preoperative ultrasound and intraoperative picture occurred in 5 patients.

No tributaries smaller than 1 mm going into the saphenous arch were found in two patients. The tributaries of the diameter bigger than 1 mm going into saphenous vein 1.5 cm above the saphenofemoral junction were overlooked in the preoperative ultrasound in the other two patients. In one case, the saphenofemoral tributary found in the ultrasound appeared to be external vulvar artery. All in all, the number of consistent results in the study group B consisting of 30 patients was 25 (83.3%).

**DISCUSSION**

Radicalness of primary operation of lower limbs varicose veins adjusted to anatomic conditions of the saphenofemoral junction is a problem of great value since incomplete operation is the most common reason of recurrent varicose veins. It leads to the lack of satisfaction and disappointment in a patient, while on the other hand creates enormous costs.

In Great Britain 90 000 varicose vein surgeries are performed annually, of which 18 000 are recurrent varicose vein surgeries (10). Other authors agree that recurrent varicose vein surgeries make 20% of all the procedures relating to lower limbs (2, 10, 11). Their costs are enormous. In Germany, the cost of surgeries related to recurrent varicose vein surgeries exceeds 50 million Euro per year (12).

An interview and subject examination are still of vital importance in the evaluation of the chronic venous insufficiency. Doppler ultrasonography is now a golden diagnostic standard. Routine Doppler ultrasonographic examination includes evaluation of the competence of deep veins and of place where the main superficial trunks join them. Changes within perforators are also assessed (13, 14).

To increase operative treatment efficiency, many surgeons use ultrasonography before a surgery to map precisely the route of varicose veins within leg circumference. We wanted to learn what the value of detailed evaluation of venous vessels within saphenofemoral junction is.

Detailed ultrasonography and Doppler evaluation of saphenofemoral complex performed before a surgery does not prolong, in our opinion, significantly the time of routine examination. In most cases, the observation of peripheral vessels, defining their number and diameter, writing it all down into the form did not exceed 10-15 min. Finding tributaries in slim patients was much faster than in obese pa-

<table>
<thead>
<tr>
<th>Tributaries found 30 days after</th>
<th>Number of patients (%)</th>
<th>Fisher test</th>
<th>Chance quotient (95% trust bracket/frame)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>group A</td>
<td>group B</td>
<td>ZS**</td>
</tr>
<tr>
<td></td>
<td>8 (26,7*)</td>
<td>2 (6,7)</td>
<td>(p=0.04)</td>
</tr>
<tr>
<td>No</td>
<td>22 (73,3)</td>
<td>28 (93,3)</td>
<td>5,1 (0,98-26)</td>
</tr>
</tbody>
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* podane wartości średnie zaokrąglono do pierwszego miejsca po przecinku
** znamienne statystycznie
Doppler ultrasonographic evaluation of saphenofemoral complex for after varicose veins surgery

patients. Apparently, identification of tributaries of bigger diameter was also easier and faster. The number of tributaries and their localization noted down in the report made the tissue preparation much easier and was an incentive for a surgeon. While, the diameter of each tributary defined in the report did not have any clinical value. However, it can be of some help for a surgeon when he knows what diameter he is looking for. Graphic presentation of the vessels in the saphenofemoral complex does not lose value even when an operation has been postponed for some time.

It must be assumed that preoperative ultrasonographic evaluation of a route and ostium of each tributary is not always exact. In our material, the intraoperative picture was different from the result of ultrasonography in 5 patients from group B. In two patients, vessels of the diameter under 1 mm flowing into the saphenous vein arch were not recognized. In the other two, the vessels of the diameter over 1 mm flowing into femoral vein were not revealed. The conformity of ultrasound examination with intraoperative picture was 83.3%. I seems that despite all the experience, the mistakes are difficult to avoid.

Bradbury et al. (15) evaluated, with the use of ultrasonography, the reasons of recurrences within inguen in 36 patients and then verified their findings during a reoperation. In 20 cases (72.2%) the intraoperative picture was consistent with ultrasonography results. In 16 cases the ultrasonographic image was difficult to interpret, which was caused by tissue cicatrization after the primary surgery. Perrin (16) obtained the 77% conformity between colour duplex and intraoperative picture in the evaluation of anatomic relation of popliteal fossa.

In ultrasound examination with Doppler performed before a surgery, the attention should be paid to the whole saphenous trunk. Detailed ultrasonographic examination of saphenofemoral junction and peripheral part of saphenous vein before a surgery in group B allowed avoiding one (3%) mistake. A duplication of saphenous vein within the upper leg with double flow into femoral vein were found.

To determine the effectiveness of crossectomy, control ultrasonography was done 30 days after the surgery. Incomplete crossectomy was found in group A in 8 patients, which makes 26.7% of all. The diameter of the left tributaries ranged from 1.5 mm to 2.5 mm. They were all connected to the saphenofemoral arch. Each tributary ran through superior and medial quadrant. The route of the remained vessels indicates wrong exposure of the upper and medial wall of saphenofemoral vein arch by a surgeon.

In group B during the first control ultrasonography, only two patients (6.7%) had overlooked tributaries in connection with saphenofemoral vein arch which ran from medial direction. In the first case, a vessel of 1.5 mm diameter and in the other of 2.2 mm diameter were remained. Similarly as in group A, medial surface of saphenofemoral vein arch was not prepared sufficiently. The observations show that Doppler ultrasonography managed to limit considerable amount of mistakes in operation technique. While, the results after statistical analysis showed that a lack of preoperative Doppler ultrasound of saphenofemoral junction influence significantly an increasing number of patients whose operations were not complete. A quotient of chances of leaving a tributary without preoperative Doppler USG is also high.

The authors did not try to name the tributaries left after a surgery intentionally. The reason for this was that the vessels have changeable routes, can create arches or divide. Therefore, there is a great chance of making a mistake. For that reason, we only defined a quadrant where tributaries were left most often. The analysis of the examination reports 30 days after the surgery showed that the remained tributaries ran in the superior and medial quadrant. These vessels can originate from abdomen or perineum wall.

Many researchers think that the most common cause of recurrences was inaccurate surgery within perineum; no ligation and removal of all the tributaries (3, 4, 5, 17, 18, 19). Only few publications describe early postoperative control ultrasonographic examinations which aim at explaining the causes of recurrences. In Bradbury’s study (20) from 1986, 93% patients had inaccurate operations where the stumps of sapheous vein were not removed. Stonbridge et al. (21) analyzed the results of 128 varicographies of lower limbs in patients who had recurrent varicose veins diagnosed. They found out that in 82 (65%) cases the reason of recurrence was a left saphenous vein trunk or tributaries in the area of saphenofemoral junction. The statistics on frequency of
recurrent varicose veins from Great Britain are slightly better. Farrah et Shami (17) examined with duplex 1254 lower limbs. In their final report they showed that about 50% of recurrences could be ascribed to inappropriate surgical treatment during the first operation. A peculiar “quality control” of operated patients was done by Ciostek et Michalak (22). To evaluate the effectiveness of Babcock operations they performed photopletyzmography shortly after the surgery. They found at least one venous reflux point in 34% of the patients.

It is difficult to state whether and when any significant clinical changes appear as a result of a reflux in the tributaries remained in the operation. It is obvious that the process will appear soon in cases of the left big tributaries running in the direction of the tight or additional saphenous veins (21). Similar situation will happen when only one trunk of duplicated saphenous vein is ligated (5).

In literature, there are opinions that the vessels left after the incomplete operation running from abdomen and pelvis wall are rarely causes of clinically significant recurrences in lower limbs (23). To make it happen the tributaries where regressive blood wave in surface veins within the thigh will appear must be present (24). The importance of those connections grow in cases of varicose veins appearing within the thigh as a result of a reflux of pelvic origin (24, 25). Jiang et al. (24) performed 1022 duplex examinations in order to define the sources of reflux in inguen of the patients with varicose veins of lower limbs. They found a presence of reflux in inguen which did not have a connection with saphenous vein ostium in 101 cases (9.95%). In 71 limbs a presence of regressive outflow from lower abdomen veins (from the basin of inferior epigastric vein) was found in 30 cases from vulvar and/or gluteal veins. Bradbury et al. (26) characterized a site of reflux origin in 30 patients with recurrent varicose veins of lower limbs. They used Doppler ultrasosnography and varicography in their study. They found out that after 17 years after the surgery saphenous vein ostium was a source of a reflux in 26 (72.2%) patients, and in the remaining 10 (27.3%) cases a reflux came from epigastric veins, vulvar veins or thigh perforator.

**SUMMARY**

In our study an early self-control of surgical treatment effects was performed. We think that ultrasonography with double imaging has great potential. Preoperative diagnostics of venous structures in the area of thigh triangle was very useful. The evaluation of a number and localization of venous tributaries in the area of saphenofemoral junction made finding individual vessels much easier for a surgeon, which resulted in minimizing numbers of technical mistakes and in improvement of effectiveness of lower limb varicose veins operative treatment. Preoperative ultrasound examination can also decrease frequency of recurrent varicose veins occurrence.

**CONCLUSION**

Preoperative ultrasound examination of vessel structures within the saphenofemoral junction allows to minimize the number of technical mistakes during the first operation and can decrease frequency of recurrent varicose veins occurrence.

**REFERENCES**

Recurrent varices of lower limbs after primary surgical procedure (REVAS) pose a very serious problem, as it is rightly noted by the authors of this work, of both clinical and socioeconomic character. Decreasing the recurrence rate depends mainly on radicality of the primary surgery preceded by meticulous diagnostics. Current diagnostic methods for lower limb venous system provide clinicians with wide range of tools for precise determination of pathologies in both superficial and deep veins. Clinicians performing sonographic examinations are expected not only to determine venous pathologies precisely, but also evaluate anatomic conditions, especially in those sites of the venous system where significant anatomic variability is expected. Saphenofemoral junction (SFJ) might be an example of such site. It is characterized with numerous tributaries connecting saphenous vein bulb and many openings of those tributaries. I believe that every attempt aiming at precise determination of the anatomy of saphenofemoral junction before surgical removal of lower limb varicose veins must be noticed and may add to the decrease in recurrence rate, therefore improve long-term therapeutic outcomes.

Authors rightly report that "technical skills of a surgeon comprise the main factor determi-
ning the effectiveness of surgical procedures. However, operator’s knowledge concerning physio-pathology and anatomical variability of lower limb venous system is also of a great importance”. Sonography is expected to help the operator but it is not possible to replace clinician’s experience and right orientation in the surgical field, also fields of significant anatomical variability, with this examination. Therefore, the Authors rightly maintain that reflux occurs in the tributaries, which weren’t ligated properly during the primary surgical intervention.

I’m deeply convinced that this statement is the key to successful surgical intervention of the saphenofemoral junction (SFJ). The following technical elements decide whether removal of varices is successful. First, the incision in the groin area must be done adequately high in order to allow the evaluation of the whole arch and bulb of saphenous vein. In my opinion, the fact that a tributary in the medial quadrant goes unnoticed results from too low cut and difficulties in reaching the saphenous vein arch. Second, the site of saphenous vein opening to femoral vein must be exposed. Correct dissection and exposure of saphenous hiatus (hiatus saphenus) gives almost 100% certainty that no tributary, even the smallest one, connecting to the bulb will be missed. Abovementioned technique requires from the operator precise knowledge of surgical site anatomy, therefore also it is a possible variability. Total and correct crossectomy becomes very difficult in obese patients where thick fat tissue layer limits visibility in the surgical field. Furthermore, when the incision is too small difficulties may occur as far as precise and proper dissection of the SFJ is concerned.

The Authors show in their work that in both groups of patients i.e. A and B, missed tributaries were located in the upper and medial quadrants. Therefore, once again it might be assumed that the saphenous vein arch wasn’t totally exposed and the dissection of the opening wasn’t full. The Authors are very critical as far as sonographic diagnostics is concerned. They believe these methods are imprecise when pre-operative evaluation of tributaries is necessary. Their experience showed that sonographic examinations didn’t reveal any vessels smaller than 1 mm. And again, this fact confirms previous thesis that proper surgical technique is of a key value.

I cannot agree with the conclusion that sonographic examinations resulted with the decrease in surgical failures. As it was mentioned before, technical failure might be avoided with correct incision and precise exposure of the saphenofemoral junction area. The Authors also report that “medial surface of the saphenous vein arch wasn’t dissected radically”, and this statement concerns both studied groups.

The following part of discussed work describes technical characteristic of examinations. But there is no information about patient’s position and it is obvious that sonographic venous imaging gives different picture as the patient is standing or lying. Tributaries were measured here according to the pattern of 1 mm surgical thread, which suggest default lying position. I believe that this kind of evaluation of tributaries connecting to the SFJ bulb provides one with information about the efficacy of sonographic examination and nothing more.

When summarizing, the Authors say they performed “specific early self-control of surgical treatment outcomes”. It is a valuable and critical evaluation of surgical therapy outcomes in their experience with lower limb varicose vein treatment. However, one must notice that the following elements would significantly increase the value of this work. First, there should be an information what kind of therapy was offered to those patients in whose cases some tributaries were missed and this fact was confirmed during control examinations 30 days after the surgery. Second, therapeutic results for both studied groups four-year after surgery should be discussed as presented material included patients who underwent surgical removal of varices in 2003 and 2004.

I believe the Authors deserve to be congratulated for they undertook a difficult task of evaluation of SFJ anatomical variability and accuracy of sonographic examinations. Presented results enrich our knowledge about SFJ anatomy. The sensitivity of discussed sonographic examinations was 83.3% and it didn’t exceed general guidelines for sonographic procedures in the lower limb vascular system. Therefore, these results cannot significantly influence surgical techniques as far as SFJ radical intervention is concerned, which comprises a difficult part of surgical procedure. As we all know the success of a surgical intervention in a difficult operational field depends on surgeon’s experience, patience and skills. Additional sonographic
diagnostics of the SFJ might be justified when the standard sonographic examinations give different pictures of saphenous opening. The examination performed directly before surgical intervention should aim at precise description of the SFJ anatomy so the surgeon may choose proper site of incision and therefore expose the entire arch of the SFJ and saphenous opening.

Finally, one more remark. The Authors say that sonographic examinations were performed by “the specialist in the field of surgery and sonography”. I truly hope that this isn’t an announcement of new specialization but unfortunate description of a surgeon who has knowledge and skills in the field of lower limb ultrasonographic examinations.

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