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ANATOMY OF THE BASILIC VEIN IN THE ARM AND ITS IMPORTANCE FOR SURGERY

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ABSTRACT

The anatomy of the basilic vein in the arm is described. Twenty-six arms from 13 cadavers were studied. A comparative analysis, which included the number of valves and measurement of the diameter of the basilic vein at three different points in the arm, was done. The basilic vein was always present and single. In its superficial segment, this vein was joined by the intermediate cubital vein in 69.8%(19/26) of the cases, by the intermediate basilic vein in 23.1% (6/26) and by the intermediate vein of the forearm in 3.8% (1/26). The basilic vein perforated the brachial fascia in the lower or mid third of the arm. The deep segment of the vein ran alone up to the inferior border of the *m. teres major* in 23.1% (6/26) of the cases, and joined the medial brachial vein in 53.8% (14/26), on the brachial vein in 23.1% (6/26) before forming the axillary vein. The valves were predominantly bicuspid (89.3%) and were equally distributed between superficial (48.5%) and deep (51.5%) segments of the basilic vein. These findings indicate that the basilic vein of the arm is anatomically compatible for use in arteriovenous fistulas for hemodialysis. The superficial segment of this vein may also be used in general, vascular and endovascular surgery to introduce a catheter above the cubitus.

Key words: Arm veins, arteriovenous fistula, basilic, brachial, catheter, hemodialysis, valves

INTRODUCTION

Vascular access for chronic hemodialysis has classically been initiated by the creation of a primary radial artery–to–cephalic vein arteriovenous fistula (RCAVF). This procedure was first described by Brescia *et al.* [1] in 13 patients with end-stage renal failure caused by chronic glomerulonephritis and polycystic kidney disease. There is no question that for the majority of patients who start hemodialysis RCAVF remains the procedure of choice [1,5,24]. Between 1977 and 1989, published reports of 823 RCAVFs demonstrated a 2-year primary patency rate of 67%, with a combined early thrombosis or nonmaturation rate between 11% and 27% [18,32-34]. Interestingly, only 6% to 13% of the patients had a history of diabetes mellitus.

Transposed basilic vein arteriovenous fistulas (TBAVF) have also been considered as secondary procedures after exhaustion of distal sites. Collectively, 130 TBAVFs have been created in children and adults who required chronic hemodialysis [3,4,17,24]. Like all angioaccess procedures, the transposed basilic vein fistula is not a panacea for all long-term access problems, but should be considered a valuable component in the surgeon's repertoire. Issues of patient age, arm preference, previous short-term access experience, and comorbid conditions require flexibility in the selection of a therapeutic option. However, in devising a strategy for long-term hemodialysis access, one must consider not only the complexity and patency of a procedure but also its impact on the feasibility of a future access procedure. Most of the patients in this series who required subsequent surgery for a failed basilic vein transposition were able to undergo placement of an ipsilateral polytetrafluoroethylene (PTFE) graft. Conversely, the placement of a PTFE graft above the cubitus generally precludes the subsequent transposition of the basilic vein. The concept that an angioaccess procedure should "burn no bridges" provides a strong argument for the use of the transposed basilic vein in preference to prosthetic grafting [24].

The basilic vein begins in the ulnar part of the dorsal venous network, runs up the posterior surface of the ulnar side of the forearm, and inclines forward

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to the anterior surface below the cubitus, where it is joined by the median cubital vein. The vein then ascends obliquely in the groove between the *mm. biceps brachii* and *pronator teres* and crosses the brachial artery, from which it is separated by the bicipital aponeurosis. Filaments of the medial antebrachial cutaneous nerve pass both anterior and posterior to this portion of the vein which then runs upward along the medial border of the *m. biceps brachii*, perforates the deep fascia a little below the middle of the arm, and ascends on the medial side of the brachial artery to the lower border of the *m. teres major*, where it joins with the brachial veins and continues onward as the axillary vein [20,22,30].

A bilateral study was done to assess the pattern of the cubital fossa veins in 300 voluntary Hindus found that the basilic vein was absent in 0.5% of the cases [29]. A similar study in 200 voluntary Nigerians described the absence of the basilic vein in 1% of the cases [27]. The intermediate basilic vein of the forearm is present in 60% of the cases [22]. The term accessory axillary vein is attributed to the collateral vein channel found in 56.7% of 60 dissected cadavers, and represents the continuation, in the axillary fossa, of the lateral (55.9%), common (32.4%) or deep (11.8%) brachial veins [7]. Shima *et al.* [26] reported the diameter of the basilic vein in the arm to be 2.6 mm in the fold of cubitus and 3.6 mm near the axial.

The aim of this study was to describe the anatomy of the basilic vein in the arm. A knowledge of this anatomy should be helpful in constructing arteriovenous fistulas for hemodialysis, as well as in general, vascular and endovascular surgery.

MATERIAL AND METHODS

This work was done in the Department of Morphology (Human Anatomy) at the Federal University of São Paulo, in São Paulo, Brazil, and was approved by the local ethics committee. Twenty-six arms of 13 adult male cadavers kept in formalin were dissected. The 13 cadavers were from individuals between 25 and 79 years old (mean age of 47.8 ± 16.9 years). The cadavers were kept in a supine position with the arms in abduction and the palms forward. The basilic vein was dissected in both upper extremities from the hands up to the lower border of the *m. teres major*, as suggested by Latarjet and Ruiz [16], Paturet [22], Putz and Pabst [23] and Toldt [30]. The basilic veins on both sides were compared with regard to number, course, syntropy, anastomosis, diameter, valves and cusps.

The internal diameter of the veins was measured as described by Shima [26]. After opening the basilic vein longitudinally, a transverse segment was collected and placed between two glass plates so as to allow the perimeter (p) of the vein to be measured with a pachymeter. The diameter (d) was calculated by dividing the perimeter by π ($d = p/\pi$). Statistical comparisons were done using Student's t-test, with a value of $p \leq 0.05$ indicating significance.

RESULTS

The basilic vein was always present and single and began in the ulnar part of the dorsal venous network. The vein ran up the posterior surface of the ulnar side of the forearm and curved forward to the anterior surface below the cubitus, where it was joined by the intermediate cubital vein in 69.2% (18/26) of the cases, by the intermediate basilic vein in 23.1% (6/26), and by the intermediate vein of the forearm in 3.8% (1/26). In the fold of the cubitus, the basilic vein was anterior to the medial epicondyle of the humerus and medial to the tendon of the *m. biceps brachii*. The vein then ascended obliquely in the groove between the *mm. biceps brachii* and *pronator teres* and crossed the brachial artery, from which it was separated by the *lacertus fibrosus (bicipital aponeurosis)*. At this point, the vein was crossed by the filaments of the medial antebrachial cutaneous nerve.

The basilic vein maintained syntropy with the medial antibrachial cutaneous and ulnar nerves, and ran close to the medial nerve before moving upwards along the medial border of the *m. biceps brachii* to perforate the deep fascia (oval opening) a little below the middle of the arm. At its deep segment, the basilic vein ascended the medial side of the brachial artery to the lower border of the *m. teres major* in 23.1% (6/26) of the cases, joined the medial brachial veins in 53.8% (14/26), and joined the brachial vein in 23.1% (6/26), after which it continued onwards as the axillary vein. When the basilic vein joined the brachial or medial brachial vein, it was referred to as the brachiobasilic trunk vein (Fig. 1A).

The number of valves in the basilic vein varied, with the right side having 0 to 6 valves (mean: 3.9 ± 1.6) and the left side having 2 to 6 valves (mean: 4.1 ± 1.4). The valves were predominantly bicuspid (89.3%), but also unicuspid (9.7%) and tricuspid (1%); and were distributed equally between the superficial (48.5%) and the deep (51.5%) segments of the basilic vein (Fig. 1B). The average internal diameter of the basilic vein in the fold of the cubitus was 1.90 ± 0.63 mm on the right side and 2.24 ± 0.73 mm on the left side. The average internal diameter of the basilic vein or of the brachiobasilic trunk vein, at the midpoint between the cubitus fold and the inferior border of the *m. teres major*, was 3.26 ± 1.15 mm on the right side and 3.46 ± 1.41 mm on the left side.

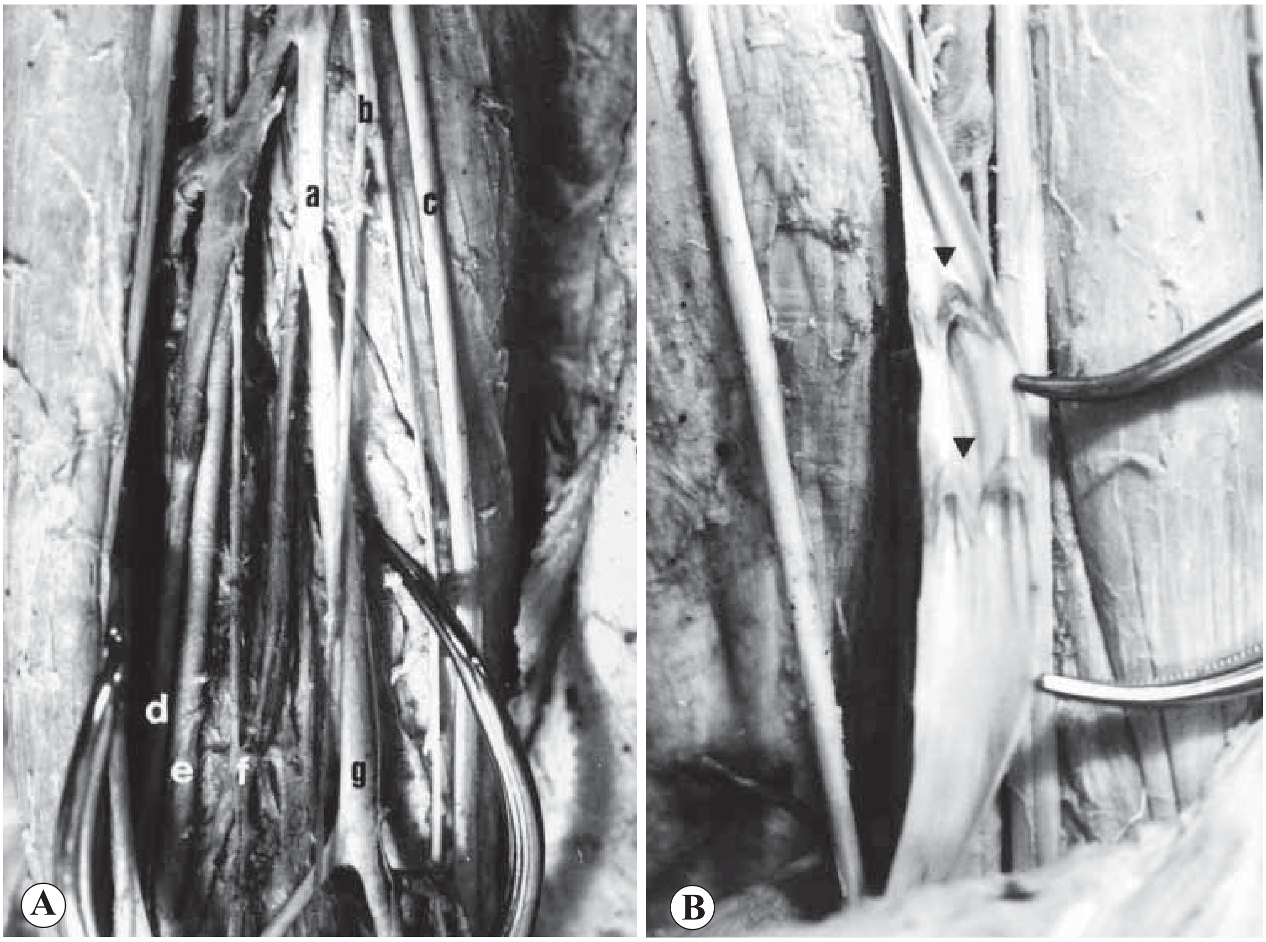

Figure 1. In **A**, anatomy of the basilic vein and its syntropy in the right arm. **a** and **g** – basilic vein, **b** – medial cutaneous nerve, **c** – ulnar nerve, **d** – lateral brachial vein, **e** – brachial artery, **f** – medial brachial vein. In **B**, the cuspids vaqlves (**arrowheads**) of the basilic vein.

The average internal diameter of the basilic vein or of the brachiobasilic trunk vein, along the inferior border of the *m. teres major* was 4.96 ± 1.84 mm on the right side and 5.09 ± 1.28 mm on the left side (Fig. 2).

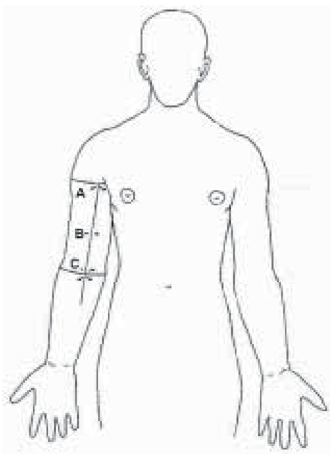

Figure 2. The points (**A**,**B**,**C**) in the right arm where the diameter of the basilic vein was measured.

DISCUSSION

In its superficial segment the basilic vein receives lateral tributaries from the intermediate cubital vein in most of the cases, as well from the intermediate basilic vein and, rarely, the intermediate vein of the forearm. In its deep segment, the basilic vein establishes anastomoses with the brachial veins and receives tributary veins from the *mm. brachialis, biceps brachii* and *triceps brachii,* before its termination. Our findings in Brazilian cadavers were compatible with those reported by others [18,20,22]. The basilic vein was present and single in all of the cases studied. This agrees with reports indicating that this vein is rarely absent or double [20,22-25].

The trajectory of the basilic vein in the superficial and deep segments was syntropic with the same structures described by Paturet [22], Putz and Pabst [23] and Shier *et al.* [25]. The basilic vein frequently joined to one of the medial brachial veins to form the brachiobasilic trunk vein, but also joined the brachial vein in about one fourth of the cases. This variation was also observed by others [6,14,22,23,25,26]. At its termination, the basilic vein may join one of the brachial veins, although this union may also involve the medial brachial vein to form the axillary vein [6,16,22].

The number of valves in the basilic vein did not vary significantly between the right and left sides. The valves in the vein were mainly bicuspid and probably distributed in the superficial and deep segments, as also mentioned by Shima *et al.* [26] and Iimura *et al.* [14]. Latarjet and Ruiz Liard [16] and Paturet [22] stated that the basilic vein was the most voluminous superficial vein of the arm, with the diameter of the vein depending on genetic factors, age, and physical activity [25].

Hakaim *et al.* [8] suggested that the diameter of the vein used for an arteriovenous fistula in the forearm or upper arm should be at least 2 mm. The size of the formalin-fixed veins studied here was compatible with the introduction of a catheter of at least 2 mm internal diameter, if the vein was distended. This finding agrees with of others who used the basilic vein as an arteriovenous fistula, as a peripheral placement for aphaeresis catheters and for the placement of a *vena cava* filter, and as an arterial substitute, in adults and children [2,3,5,9-13,15,19,21,28]. An arteriovenous fistula using a transposed basilic vein is also indicated in chronically hypotensive hemodialysis patients because of this vein has high flow capacity and its lower risk of thrombosis [5,31].

In conclusion, the basilic vein was single in the arms studied, with most of them containing valves. These veins were syntropic with the brachial artery and brachial vein, and also with the ulnar, the medial antibrachial cutaneous and the median nerves. The basilic vein had a diameter appropriate for the arteriovenous fistulas needed for hemodialysis in adults, thus justifying its use and eliminating the need for non autogenous material or a graft prosthesis. This vein can also be used in general surgery, vascular and endovascular surgery by introducing a catheter mainly in the superficial segment above the cubitus.

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