Medical practice and surgery seem to have been highly developed during the early Byzantine period, from the fourth century to the sixth century of the common era. Byzantine doctors were exposed to and greatly influenced by the knowledge of the physicians of antiquity. They were also able to acquire personal experience through study and practice, which resulted in the description of new techniques and innovations. Surgery during the Byzantine era was so greatly developed that skillful surgeons dared to carry out complex procedures such as lithotripsy in the bladder, undertake the separation of Siamese twins, and apply special techniques for plastic and reconstructive surgery of the face.

It seems that these operations were carried out under difficult circumstances, though the use of some analgetic or hypnotic drugs, such as *Papaver somniferum*, *Hyoscyamus*, and mandrake, was well known from Dioscorides (first century CE), and these were used by Byzantine physicians. Aetius (sixth century CE) supplied wine to women before gynecologic operations. But some literary sources reveal that the operations and cauterizations were extremely painful because the anesthesia was very primitive.

In addition, the eminent physician of early Byzantium, Oribasius of Pergamum (c 325-405 CE), described the first techniques of surgery on aneurysms, derived from the lost work of the ancient Greek physician Antyllus (second century CE). These remained unchanged until the 16th century. However, this was not the only topic concerning the specialty of angiosurgery with which Oribasius dealt. His famous book *Synagoge Medicae*, a complete medical encyclopedia of his era, contained special chapters dealing with surgery on varices. The techniques of Oribasius represent the first surgical methods in the Byzantine medical literature, and they seem to have influenced all of the later physicians of the medieval era and, later still, the pioneering European surgeons.

Later Byzantine physicians, especially Paul of Aegina (seventh century CE), also dealt with this subject, clarifying the earlier techniques and adding new remarks (eg, on the use of tourniquets in preparation for surgery).

### HISTORICAL MATERIAL

**Oribasius’ contribution**

In his Book XLV, Oribasius (Figs 1 and 2) devotes three chapters (18-20) to the subject of varices. The first and most extensive of these chapters is entitled “On Varicose Veins.” He begins the chapter by defining varicose veins, writing that the condition is a broadening of the veins in such a way that they contain increased blood, and he notes that varices form in the head, abdomen, scrotum, or legs. Most cases are located in the legs, and it is for that reason, he states, that he begins his chapter with varicose veins in the legs.

**Surgery on varices of the legs**

*Preparation of the patient.* One day before the confrontation of the disease, he writes, the surgeon should shave the leg and bathe the patient; then, while the patient...
is still warm from the bath, the surgeon should stand him up so that he is supported only by the varicosed leg and mark all of the swellings with small superficial incisions (Fig 3). “In this way, if during the surgical intervention the veins remain invisible for various reasons, we shall not fail,” as the varicosis sites can be identified from the marks that were made. These incisions are made straight—not parallel to the leg, but rather in the direction taken by the varicosis, because the marks are thus more superficial.

The technique of extraction by pulling up. Oribasius continues his description with the following technique, which we quote in a free English translation of the original Greek text (from Raeder’s edition):

Before starting the operation, we place the patient face-down, bind all his members to the bed with a bandage, except the varicosed member so that the assistants can turn this, sometimes facing down and sometimes up, according the needs of the operation. After that, we take hooks, called cirsules [that is, in Greek, instruments that pull up the varicosis—“varix extractors,” a type of forceps], which have a slight curve like the Greek letter Γ. With those we pierce the surface of the skin on the highest part of the swelling, next to the incision mark. Then we pull the hook along the leg, at the same time turning it so that the skin folds over, becoming tense and curved. Then we make an incision in the skin (Fig 4, A), short in length, and separate the skin without reaching the varicosis, which we can easily recognize because it is smooth and with azure shade, due to the blood it contains. If, after the incision in the skin, white and strong membranes appear, with the hook we previously used, we perforate the membranes and pull them up, separate and tear them until we reach the vein. If there are many membranes, the procedure can be repeated three or four times. Then after we have turned down a hook which has not a sharp point, called by surgeons τυφλήγαιστρον (typhlangistron, “blunt hook”; in Latin, hamus retusus), we lift the varicosis up (Fig 4, B).

If this procedure proves difficult then we pass through a second similar hook in the same way, but proceeding in a contrary direction with the second hook the other way round. After we have encircled the varicosis with the two hooks, we draw it up.

If the vein has not been raised, as often happens because it is located very deep or because it has slipped to the sides of the incision, using the hook we first search along these sides, placing it at right angles. Then, slowly reclining the end of the hook, we bring it to the surface of the skin while from outside, with the little finger of the left hand, we press the skin towards the hook so that it facilitates the secure grasping of the vessel, which often slips due to the pressure. If once again the vein has not been successfully grasped, the hook is turned to the opposite direction and the procedure is repeated in such a direction. If even after this the procedure fails, we take two sharp pointed hooks which we give to our assistants, so that with those we can hold the wounds of the incision open and, with a third extremely curved hook, we cut and separate the membranes until we find the varicosis; then we draw it up with either one or two of the “blind” hooks referred to before.

Then we place under the varicosis a feather or any other soft object or a blunt needle armed with thread (Fig 4, C). This procedure can only be performed if we have already raised the vein with the “blind” hooks; it is otherwise impossible.

After the first incision and isolation of the varicosis, we continue with the remaining incisions in the same way; not, however, from the lowest part of the leg.
If the varicosity is straight, these incisions are made at intervals of no less than two finger-lengths [one finger = 1.8 cm].

Cirsotomy. There follows the main cirsotomy [removal of the varicosity] which starts from the lowest parts of the leg upwards. If we have used only one hook, we then pass through a second from the opposite direction using our hands so that the varix is pressed strongly between the two. The lower hook is turned toward the malleolus, the upper hook towards the calf, and in this way we pull up the varix, which is located in the malleolus, and cut it from the top. Then we proceed to the swelling of the second incision from below, simply pulling the varix, without cutting it. In the same way the third and other incisions follow until the highest one is reached; then we cut all the varicosed vein. If, however, there are ramifications of the varix, two in a γ-shape or three shaped as a ψ, or even more ramifications, we pull each of them separately and then cut each one, and there follows the pulling up of the supply stem of the varix [Oribasius calls it horigos, “supply stem”], as previously.15

Confrontation of the surgical difficulties. In his text, Oribasius also gives details of the difficulties he faced during his operations:

If after these procedures the varix stem cannot be pulled up but shows resistance, we pull the supply stem with greater force. [Oribasius makes it clear that he calls the supply stem in this case not the varix above the popliteal fossa but the vein with a great number of ramifications.] If during this more violent procedure the covering nearby skin appears to be widened, a sign from which we can locate the escaped ramification, then we make an incision to the widened area of the skin. Following the removal of this ramification, we proceed to the pulling up of the supply stem, as above.

If no obvious ramification or widening of the skin appears after pulling and the supply stem cannot in any way be removed, then we make a slight incision above the supply stem, using a blunt hook as a support so that we cut only the upper wall of the varix, and we insert into the opening a double-ended probe [διπυρηνος µυλη, a slender sound with slight olivary enlargement at either end16] and, following the vacuum of the vein lumen, we proceed. As the probe enters deeper, it will come out at the existing lower incisions of the varix, while in certain areas as it proceeds it will lift up the unincised flesh when it meets obstacles. At these points, lifting up and curving the skin and using the probe as a lever, we make an incision to the curved swelling of the skin and thus release the obstacle at the particular point. After that, we pull the supply vein up together with its roots from the beginning of the varix, whether the beginning is in the popliteal fossa or in the thigh. The extraction must be performed extremely violently either with the aid of two clasp hook hooks or with the special instrument called cirulcos, and then we cut the varix. This violent removal is not a cause of hemorrhage when the varix is cut, and it is not necessary to press the vein or tie it with ligatures.15

The technique of straight incision (ευθυοτοµα). In case the varix is very twisted, Oribasius continues, and “resembles a grape,” extraction by pulling up is useless. “Such a varix requires a straight incision to remove the twisted varix; the remaining upper and lower parts of the varix we remove as described earlier [the “pulling up” procedure].”15

The technique of cutting and removal in sections. Oribasius notes that in another form of varix, “called by the surgeons ‘wooly,’ obviously consisting of an accumulation of thin veins resembling a ball of wool,” once again there can be no pulling up, because it is dispersed in fibers and breaks up quickly. He adds that “in cases of the wooly varix, after inserting under it a feather or the blunt hooks or other object previously mentioned, if we succeed in catching the varix, we cut at each incision all the part of the varix which comes out of the incision due to pressure.
of the object placed underneath. We must not simply cut it but remove it, because otherwise the cut ends of the vein will again make contact with each other and a new varix will form.”15

**Postoperative treatment.** After this operation, Oribasius confirms, there is no danger of hemorrhage, either from the area above or below the supplying vein, because the route is obstructed by muscle pressure. He writes:

However, we must strongly press the leg to remove the thrombi much higher than the incision which has been performed on the popliteal fossa. This pressing starts downward toward the bottom of the leg; at the same time we start pressing below the malleolus upward, especially pressing the calf strongly, in such a way as to remove the blood from all incisions. The pressing should be done by the hands, firmly and steadily, assisted by sponges (to absorb the blood).

It is most essential that not even the smallest thrombus of the blood should remain after the operation because it could swell and create pus and cause liquid to appear in the incisions, thus affecting the nerves, and furthermore cause failure of the “enhyme” [ἐναιµός] treatment [a treatment for fresh wounds well known from the *Corpus Hippocraticum*17], which would never fail if the thrombi were removed meticulously. Despite the fact that there are all these fears of complications, the surrounding tissues should not be pressed too violently because there is the additional risk of bruising them. The “enhyme” treatment will be given with the application of a poultice (“emblastron”) of the same name (“énaemon”), on which we put a sponge dipped in oxycraton [a solution of vinegar and milk]; we then bind with a soft bandage or we apply the sponge only and bind with a cloth, soaked in oxycraton.15

**Surgery on varices of the head.** For a varix of the head, Oribasius writes, “the ancient physicians recommended cauterization, because they feared using the pulling up procedure in case it irritated the pericranium and the nervous membranes due to ‘sympathy.’”15

In these cases Oribasius prefers the method of cutting that he describes for cases of “wooly varix” and in a separate chapter (“About Angiology”) of his book.

**Surgery on varices of the abdomen.** “In the varix of the epigastrium, it is impossible to use the method of pulling up,” writes Oribasius, “because the skin also comes out due to its softness and tenseness.”15 The ancient physicians, he notes, made incisions to the skin along the varix at equal intervals and through these they removed the varices. If the varices resemble grapes, he himself prefers the method of ἔυθυοτοµία (straight incision) exactly as he describes it for such varices in the leg. In cases in which the varices are straight or straight and slightly curved, he prefers the method of cutting, as in cases of “wooly varices,” and avoids the straight incision because the remaining scar is no less unsightly than the varices themselves.15

**Surgery on varices of the scrotum (cirsoccele).** The second relevant chapter of Oribasius’s book15 refers to varices of the scrotum and follows the opinions of Heliodorus, a famous Greek surgeon (first century CE) who was responsible for many innovations in surgery (including ligation and torsion of blood vessels, internal urethrotomy, and herniotomy) and the main source of Celsus’ books on surgery.12 For this type of varix, he describes a method of cutting that is similar to that used for the legs, that is, incisions at intervals of a finger, lifting of the varix, tying of the protruding part (obviously using two ligatures), and removal (obviously of the part between the ligatures). Another suggested technique is cauterization with olivary cauteries applied at similar regular intervals of the same length, an eschar of the varix in this way being produced.15

In his third chapter on varices,15 Oribasius conveys Galen’s knowledge of the condition (*Galeni de Atra Bile Liber*).18 According to the definition of Galen, “nature accumulates melancholic blood in the leg veins causing them to extend and become varicose; with the passage of time the covering skin becomes black.”18 In Galen’s view, there is the danger of melancholy if someone attempts to remove the affected veins. Furthermore, if there is a chronic ulcer in the leg over the varicose vein, frequently the preexisting ulcer is treated after the removal of the varix, but the scar of the incision remains unhealed. The chapter15 concludes with a report that Galen’s teacher at Pergamum, Stratonicus, had cured a similar ulcer with venesection in the elbow, suitable diet, and purgatives that emptied the black humour.18
Venesection was, from Hippocratic times, a main therapeutic measure aiming at reduction of the humor of blood by bleeding. The amount of blood was related to the constitutional strength and the seriousness of the disease of the patient; in a case of a strong man with a severe disease, so much blood could be let as to produce fainting.13,19

Oribasius devotes one more chapter to varices; the 37th chapter of his Book XLIII is entitled “About the Difficulty in Curing Ulcers Which Are Above Varicose Veins.”15 In such cases, contrary to Galen, he recommends incision along the vein and meticulous emptying of all of its contents. In this way, obliteration of the veins secondary to inflammation could be expected. He suggests venesection and administration of purgatives after this is carried out.15

Later Byzantine physicians

Aetius provides little information about the topic of varices,20 a fact that may be due to loss of the relevant text. All that has survived of the work of Rufus of Ephesus (first century CE) is an extract; the title is “Twisted Veins Must Be Removed from the Rheumatized Parts of the Body, Such as the Varix; Text Taken from Rufus.” As is apparent from this lengthy title, Rufus recommends removal of varices, mainly those located in the leg; such veins, in cases of inflammation, become red and fill with blood.

Paul of Aegina (Fig 5) devotes a whole chapter to the confrontation of varicoses, entitled “On Varicotomy” (περὶ κυτσοτομίας).13,14 The writer agrees with Oribasius on the location and etiology of varicoses. He notes that the removal of varicoses, usually located on the internal surface of the thigh, is carried out in the same way as removal of the cirses of the scrotum.

In a later chapter (“About the Cirsocele and Pneumatocele”), Paul describes a technique similar to that of Oribasius. In this method, after the vein is located, a needle armed with a double linen suture is passed underneath the varicose vein; a cut is then made through the hooked curve of the stitch, after which the two stitches are bound at the beginning and the end of the varicose vein. A lancet is then used to open the vein vertically, and the concentrated blood is drained. The ligatures (bronchi) and the vein automatically drop with the passing of time.

Paul stresses that it is a difficult operation if the varix is ramified; in this case he recommends a special preparatory test:

After the patient has bathed, a tourniquet is applied to the upper thigh and the patient is ordered to walk. In this way the vein fills with blood; with ink or a collyrium the location and course of the vein is marked on the skin to a length of three or a little more fingers. Then the patient is placed horizontally with the leg extended and a second tourniquet is applied a little above the knee. The vein becomes considerably swollen and the operation proceeds; with a lancet only the skin is incised at the point already marked, care being taken to avoid cutting the vein itself. With a hook the edges of the incision are held open and the membranes are separated to reveal the vein from all aspects with special fine curved surgical lancets, usually used in hydrocele operations; the tourniquets of the thigh are then tied. The procedure continues as before with the use of the double suture. After securing the first ligature at the upper part of the varicose vein, the thigh is lifted up and the area is pressed with the surgeon’s hands to evacuate the blood; then a second ligature is applied to the lower part of the varix, and after that either the area of the vein between the two ligatures is cut and removed or the vein is left as it is until it drops automatically, together with the ligatures.13,14

Paul then applies various medicaments and a piece of cloth soaked in wine and oil and binds it, awaiting the healing of the wound according to the contemporary con-
cepts of “pus producing treatment” (πυοποιῶς αγωγή). The ancient Greeks believed the creation of pus on wounds to be beneficial. This opinion of “pus bonus et laudabile” remained in force until the Renaissance.

Paul13,14 remarks that some earlier physicians had not used ligatures but directly cut the vein that they had revealed, whereas others pulled the vein violently and removed it (he obviously refers to the method described by Oribasius of the pulling out of the varix). Paul considers the safest method of operation to be the one that he describes.

Concluding his chapter, he writes that the varicose veins of the abdomen are operated on in the same way whereas those located in the temples are dealt with according to the method described in his “On Angiology.” In that chapter, Paul describes a clinical picture with pain, thermal increase, and edema in the area of the temporal muscles. In this case, the writer recommends incision to remove the vessel through use of a method similar to that previously described in relation to the veins of the thigh.13,14

Varicotomy is referred to in later Byzantine medical texts. In the ninth century, it was recommended by Leo the Iatrosophist in cases of cirrhotic varices. He, not Aetius (sixth century CE), as has been mistakenly maintained, who was the first Byzantine physician to deal with this topic.15 These techniques are based on even earlier ones, because it is well known that Oribasius studied medicine in the famous medical school of Alexandria, as did all of the eminent later Byzantine physicians, such as Aetius, Alexander of Tralles, and Paul of Aegina.16 Oribasius, in his description of aneurysms, admits that he is copying the now-lost work of the celebrated surgeon Antyllus.17 For a chapter on varices, he refers to the fact that he is copying from a text of Heliodorus, also now lost, and perhaps the rest of Oribasius’ knowledge about the varix and its surgical treatment originates from the same ancient writer or another physician of the same Pneumatic school* of Alexandria, such as Archigenes or Leonides (first century CE), whose works were systematically compiled by the Byzantine physicians.18

It seems that the surgeons of the Hellenistic epoch were the first who dared to remove varices; in earlier times, these operations were unknown. Although the author of the book “On Ulcers,” contained in the Corpus Hippocraticum,19 recognizes the stagnation of the blood in varices of the legs as the etiology of the problem, he does not recommend cutting open the swellings because he believes that this would cause large ulcers. He suggests only punctuation of the varix in many places, as circumstances might indicate.

Celsus (first century CE) displays knowledge similar to that of Oribasius regarding the location of varicose veins but does not recommend exactly the same surgical techniques;20 he prefers cauterization, a method that was used until the 18th century. He writes:

If a vein is straight, or though crooked, is yet not twisted, and if of moderate size, it is better cauterized.

* A school that placed emphasis on the spirit—pneuma—rather than on the Hippocratic humors in the interpretation of pathology.
If a vein is curved and twisted, as it were into intricate coils and involutions, it is better to cut it out.\textsuperscript{24}

Celsus meticulously describes the technique of cauterization of the vein after incision of the skin and discovery of the vein. He also describes a method of removing varices of the scrotum that is similar to that of Oribasius and Paul of Aegina. The similarities between the text of Celsus and those of the Byzantine physicians are due to common Alexandrian medical sources; it is well known that Celsus uses Hellenistic sources in his work.\textsuperscript{12}

It is also worth noting that Oribasius adds personal observations regarding the described techniques, which confirms that he was not merely a compiler but had personal experience and practiced these techniques systematically. The same conclusions can be reached about Paul of Aegina, who recommends a certain tried and personally tested technique on varices.\textsuperscript{12}

The most common locations for varices, according to all Byzantine physicians, are the leg (probably the saphenous vein), the epigastrion and hypogastrion (obviously the testes), and the temple. The vein surgery techniques of the Byzantine physicians, derived from those of ancient physicians of the Alexandrian period, passed into western medieval surgery, influencing and inspiring even modern European surgeons. We have no evidence that Rivlin\textsuperscript{25} was aware of the Byzantine techniques; he has been considered the first to have described the “vein hooks technique” in 1975—a method that has its origins in the Byzantine period. A more characteristic example is that of Friedrich Trendelenburg (1844-1924) who “operated by applying high ligatures to the saphenous, which he divided, thus vindicating the operation described by Paul of Aegina and others of the ancients, as he himself pointed out in his historical review.”\textsuperscript{12} Although Paul of Aegina did not describe reflux, his preparatory tests before surgery for varicosities, in which tourniquets were subsequently applied close to the saphenofemoral junction, bear a striking resemblance to the tests of Benjamin Brodie and, later, Friedrich Trendelenburg.

In conclusion, the surgical techniques for treatment of varices described by Byzantine physicians were based on those of ancient physicians of the Alexandrian period, especially those of Heliodorus, which thus constitute the roots of modern surgery in this area.

\textbf{REFERENCES}