Constant Site (Buttonhole) Method of Needle Insertion for Hemodialysis

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"Available data are suggesting that insertion of the hemodialysis needles in exactly the same spot for consecutive dialyses (the "buttonhole method) may be associated with fewer complications as compared with using different needle insertion sites for each dialysis. The buttonhole method is becoming popular among home hemodialvsis patients. This paper will describe the origin of the method, early results, and the reasons why the method has not gained widespread popularity in U.S. hemodialysis centers.

In 1962, Cimino and Brescia reported on the successful use of a simple venipuncture method for hemodialysis; however, it was most suitable only with patients who had exceptionally well-developed peripheral veins and when they were fluid overloaded.(1,2) In 1966, Brescia et al.(3) reported their early experience with dialysis carried out through the puncture of veins which were distended after the creation of arteriovenous fistulas. Their results were superior to those achieved with the arteriovenous shunt designed by Wayne Quinton and Belding Scribner in 1959,(4) and within a few years, the Cimino-Brescia fistula superseded the shunt as the basic method of blood access for hemodialysis.

Initial results with the fistulas were excellent, with one-year survival probability exceeding 90% and five-year survival probability exceeding 86%.(5) However, in later years, the results were less impressive because the patients who were being accepted for hemodialysis had arteries and veins of poor quality which thwarted the creation of good fistulas. In an increasing number of patients, it proved to be impossible to create an arteriovenous fistula at all. Therefore, instead of a direct connection between artery and vein, a bridge was made through use of grafts from either the saphenous vein,(6) specially prepared bovine carotid artery,(7) Sparks mandrils, or porous polytetrafluoroethylene (PTFE).(8)

ACCESS

Overall fistula and graft survival depends not only on the quality of the vessels used and the surgical technique, but also on the method of using the access. However, there is no generally accepted method of access puncture.

An early recommendation was to change the site of the puncture for each dialysis treatment in order to allow for healing of the puncture wound and, therefore, to avoid complications such as hematoma at the puncture site, dilatation, stenosis, infection, and pseudoaneurysm. But to the contrary, some data indicate that insertion of the hemodialysis needles in exactly the same spot for consecutive dialyses may actually be associated with fewer complications when compared with using different needle insertion sites for each dialysis treatment.

The first paper describing this method was published in the Polish literature in 1977 as part of a review of experiences with arteriovenous fistulas.(5) The method was referred to as the "constant-site" method of needle insertion and was described in more detail in 1979.(9) The discovery of the advantages of this method was somewhat serendipitous. As described in the paper, there was "one patient who had a very limited area for puncture, so that the constant site of insertion became a matter of necessity, It was observed that the insertion was not very painful and was accomplished quickly, and that no complications were noted. Eventually, this method came to be used in other patients. In the course of six months it was accepted by all 16 patients under treatment at that time."
The initial comparison of the constant-site method with the multiple-site method, which involved almost 10,000 dialyses, led to the following conclusions:

- Insertion into a previously used site is easier and can be done very quickly, in less than 10 seconds.
- Cannulation is less painful, and anesthetic use may be eliminated
- Reinsertions of needles because of "bad sticks" are virtually eliminated.
- Hematoma formation is reduced more than tenfold.
- The infection rate is not significantly higher than with multiple-site needle insertion.

BUTTONHOLE METHOD

The constant-site method was used in another center in Poland on patients with either Cimino-Brescia fistulas or saphenous vein grafts with similar results.(9) Patients who were dialyzed more than thrice-weekly had two pairs of puncture sites which were used alternately because insertion at the same site on subsequent days was painful. Some of the patients who dialyzed only thrice-weekly also preferred two pairs of sites. Frequent dialyses (up to six times-per week) with the constant-site method not only led to no increased frequency of complications, but in some patients resulted in decreased complications due to improvement of uremic thrombopathy.(5) A few years later, Scribner reported his experience with the constant-site method in patients with Cimino-Brescia fistulas and confirmed all the conclusions of the previous study.(10,11)

In 1984, Kronung presented an analysis of the consequences of single and repeated fistula punctures and the best technique to avoid fistula damage.(12) He found that each puncture causes elongation of the front wall of the fistula due to tissue displacement and the filling in of the hole with a thrombus following needle removal.

According to Kronung, the consequences of repeated needle sticks depend directly upon the puncture technique that is used. If sticks are repeated in circumscribed areas (the "area puncture" technique), aneurysmatic dilatations develop in those areas, and stenoses develop in adjacent regions. Stenotic and aneurysmatic lesions tend to progress due to pressure and velocity distribution in accordance with Bernoulli's law of hydrodynamics. On the converse, if the punctures are equally distributed along the entire length of the fistula (the "rope-ladder puncture" technique), small dilatation occurs over the length of the fistula but without aneurysmatic dilatations.

The best technique, however, proved to be the repeated puncture of the same site (the "constant-site" method) because it does not cause dilatation or stenosis. Kronung renamed the method the "buttonhole puncture" technique.

GAINING WIDESPREAD ACCEPTANCE

The buttonhole puncture technique enables long-term use of a fistula. In 1993, while visiting Poland, I saw the original patient on whom the method was first tried some 20 years earlier. The method was still being used on that patient and with the original fistula.

There have been no publications refuting the superiority of the buttonhole technique; however, the method has never gained widespread acceptance in U.S. dialysis centers. The method is more frequently used by home hemoodialysis patients.(13) It is possible that the method has been tried in this country without success, but the results have not been published.

Why has the method been successful in only a few centers and never gained widespread popularity? I believe that it is due to the type of fistulas currently used as well as the details of the technique.

The Fistula

All authors reporting results with the buttonhole method have used it exclusively in patients with primary fistulas or saphenous vein grafts. In recent years, however, primary fistulas are created only in a small proportion of patients. Most patients today have porous PTFE graft fistulas, and perhaps this type of fistula is not suitable for the buttonhole technique because of its thinner and weaker construction.

Details of the Technique as Established in the Original Study

Needle placement during the break-in period:
In the original study,(9) following a period of several weeks of fistula maturation, the fistula was punctured by the same experienced sticker, using sharp needles, until the best site was determined. Only after good puncture sites were established were less-experienced stickers allowed to puncture the sites.

Needle placement by the same experienced person during the initial period might be crucial for success. Each person has a distinct technique that uses the same direction and angle of needle insertion and the same depth of penetration. The good results demonstrated in home hemodialysis patients using the buttonhole method may be related to the "single sticker" practice.

The Needles

Following the break-in period during the original study, the needles used for the buttonhole method had a somewhat dull edge and surface. Needles with a dull edge tend to go through the established path, whereas sharp needles tend to cut adjacent tissues, enlarge the hole, and cause bleeding along the needle's path.

It is very important that the needle goes through the established puncture tunnel and does not cut the adjacent tissue. The needles that have the best results did not have a siliconized outer coating and did not have a very smooth surface. Blood oozing alongside the needles was more likely to occur with the use of siliconized, smooth needles.(9)

Puncture direction:
In the original study, both needles were inserted in a centripetal direction that facilitated hemostasis after dialysis and decreased the chances of hematoma formation. Long dialyses with blood flows of 200 ml/min were then used.

Centripetal direction of the arterial needle may not deliver the high blood flows currently used for short dialysis. Retrograde needle direction may deliver high blood flow but will require application of absorbable gelatin sponges and/or longer pressure on the puncture site after dialysis.

CONCLUSION
The buttonhole needle insertion method deserves revival and further clinical trials. With expanded use, I believe that it may become increasingly popular and successful among home hemodialysis patients because of the"single sticker" practice. Somewhat duller needles than those currently manufactured would be beneficial.
The method may not enjoy comparable success or popularity in dialysis centers because of the "multiple-sticker" practice. It is also doubtful that the method can be used with conventional PTFE graft fistulas. It would be desirable to test the buttonhole method in the new thicker and stronger grafts such as Diastat' or those made of hybrid PTFE.(12)

To order a video tape demonstration of the Buttonhole Technique:
Dialysis Clinic, Inc.
Buttonhole Video
ATTN: Ellen Stelzer
3300 Lemone Industrial Blvd.
Columbia, MO 65201
Phone: 573.443.1531

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