TREATMENT OF CLOTTED QUINTON-SCHIBNER ARTERIOVENOUS SHUNTS BY STREPTOKINASE (KABIKINASE®). RESULTS EVALUATED BY ANGIOGRAPHIC AND RESISTANCE STUDIES

C.M. KJELLSTRAND, B. LINDERGÅRD and E. BOIJSSEN

Medical Department B (Renal Clinic) and Department of Diagnostic Radiology, University of Lund, Lund, Sweden

This report concerns the treatment of clotted Quinton-Scribner arteriovenous shunts by infusions of streptokinase directly into the clotted cannula. We use this treatment when conventional declotting procedures have failed to remove the clot. The result was evaluated by angiographic and resistance studies. Hegstrom et al. (1961) reported that fibrinolysin during declotting procedures yielded inconclusive results and they abandoned this technique.

In November 1965 one of our patients on chronic intermittent haemodialysis had repeated clotting episodes on the venous side of the shunt. The flow through the shunt after the last episode became so low that it was impossible to use the venous part during dialysis. The usual declotting procedures failed to improve the flow. After infusion of streptokinase into the venous part of the shunt good flow was re-established, the shunt functioning for another six months. This result was so encouraging that it was decided to try similar infusions on other cases.

Streptokinase, a purified streptococcus enzyme, activates plasminogen, directly or through a proactivator, converting it to plasmin. Plasmin is an active proteolytic enzyme which breaks down fibrin. The process takes place in circulating blood as well as locally in a formed clot (Schmutzler and Koller, 1965). Plasmin acts only on recently formed clots; an effect can be expected only if the clot is not older than 3 to 6 days. After this period of time, organization of the clot with infiltration of fibrous tissue no longer allows complete lysis to occur (Ludin et al., 1965).

TECHNIQUE

When a patient is admitted with a coagulated shunt, we follow the usual described methods (Hegstrom et al., 1961)—trying to remove as much as possible of the clot by aspiration with polyethylene catheters and injection of a heparin-saline solution under moderate pressure. If good flow is established the patient is given anticoagulant therapy for a few days. If flow cannot be re-established the shunt is replaced. In some patients it is possible to reopen the clotted shunt but the flow is slow due to high resistance. In order to define the reason for this high resistance an angiography, called shuntography, is performed. Ten to twenty ml of 40% Urografin® are injected directly into the shunt. Both the arterial and venous halves of the shunt are demonstrated in AP and lateral projections.

If the reason for malfunction is found to be a clot, a streptokinase infusion is started; 250,000 units of Kabikinase® in 250 ml 5.5% glucose are infused directly into that half of the shunt that is to be treated. The other part of the shunt is kept open by injection of a few ml of heparin-saline solution every other hour. The streptokinase solution is infused over a period of 6 hours. The solution can usually be administered as an intravenous drip. The high resistance on the arterial side necessitates the use of a slow infusion roller pump. When the infusion is over, “softened” clots are released either by immediately dialysing the patient (the clot being swept away by the rapid flow created by the blood pump) or by rapidly injecting 50-100 ml heparin-saline solution into the clotted cannula. In one case the shunt was
shortcircuited with a tubing, that was placed in a roller pump. The speed of the pump was gradually increased to increase the mechanical force on the clot. The results of streptokinase infusion were evaluated in two ways: radiological examination and flow-resistance studies.

The morphological result was evaluated by injection of contrast medium into the shunt (Fig. 1).

The effect on shunt function was evaluated by flow and resistance studies before and after streptokinase infusion. The resistance was calculated using the formula: \[ \text{Resistance} = \frac{\text{Pressure}}{\text{Flow}} \]

On the arterial side an increase in flow after streptokinase infusion signifies a decrease in resistance if the patient’s blood pressure is the same before and after the infusion.

Results of streptokinase infusion into the venous half of the shunt are evaluated by calculating resistance during dialysis before and after treatment. Flow is read in ml/min on

Fig. 1. Contrast medium injected into the venous half of the shunt. Left: after conventional de-clotting but before streptokinase infusion. Clot obstructing lumen at the teflon tip. Right: one day later after streptokinase infusion. Complete disappearance of clot.
blood pumps and pressure is read in mm Hg on manometers on the venous side of the dialyser. Resistance will then be expressed in mm Hg/ml/min (Fig. 2).

RESULTS

Arterial infusions

Arterial infusions were used in 2 patients. In one patient the flow increased satisfactorily. After conventional declotting there was very poor flow from the shunt, after streptokinase it was excellent. Arteriographic examination revealed a decrease in size of a clot at the teflon tip in the artery. In the other patient there was no improvement after infusion. Arteriography was not performed before infusion. An arteriogram after infusion showed a defect in lumen that was interpreted as an intimal fold. In the first case the shunt was replaced after 40 days because of bleeding; in the second after 27 days because of clotting.

Venous infusions

Venous infusions were used on 12 occasions. Eight infusions are regarded as successful, four as unsuccessful.

a. Successful streptokinase infusions: In these patients shuntography after the infusion revealed a complete disappearance or a marked reduction of existing clots. In all cases there

Fig. 2. (Same case as in Fig. 1.) Diagram of resistances during dialysis. Marked increase in venous resistance after conventional declotting failed to remove a clot satisfactorily and fall to previous low resistance after streptokinase infusion.
<table>
<thead>
<tr>
<th></th>
<th>Days in place</th>
<th>Clotting episodes</th>
<th>Treatments per shunt</th>
<th>Patient</th>
<th>Days between treatments</th>
<th>State of shunt after treatment</th>
<th>Clotting episodes</th>
<th>Fate of shunt</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Successful</strong></td>
<td>482</td>
<td>19</td>
<td>2</td>
<td>EA</td>
<td>98</td>
<td>104</td>
<td>6</td>
<td>Functioning</td>
</tr>
<tr>
<td>venous</td>
<td>93</td>
<td>2</td>
<td>2</td>
<td>CH</td>
<td>25</td>
<td>30</td>
<td>1</td>
<td>Functioning</td>
</tr>
<tr>
<td><strong>infusions</strong></td>
<td>522</td>
<td>11</td>
<td>1</td>
<td>IPF</td>
<td>172</td>
<td>30</td>
<td>1</td>
<td>Replaced, bleeding and clotting</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>182</td>
<td>2</td>
<td>1</td>
<td>IPF</td>
<td>354</td>
<td>187</td>
<td>1</td>
<td>Functioning</td>
</tr>
<tr>
<td><strong>Sum - mean</strong></td>
<td>1371</td>
<td>38</td>
<td>8</td>
<td>6 (5)</td>
<td>742</td>
<td>6 = 124</td>
<td>41</td>
<td>Replaced, clotting</td>
</tr>
<tr>
<td><strong>Unsuccessful</strong></td>
<td>452</td>
<td>3</td>
<td>1</td>
<td>SP</td>
<td>21</td>
<td>3</td>
<td>3</td>
<td>Replaced, clotting</td>
</tr>
<tr>
<td>venous</td>
<td>102</td>
<td>12</td>
<td>1</td>
<td>SP</td>
<td>123</td>
<td>140</td>
<td>28</td>
<td>Replaced, clotting</td>
</tr>
<tr>
<td><strong>infusions</strong></td>
<td>306</td>
<td>10</td>
<td>2</td>
<td>KE</td>
<td>19</td>
<td>69</td>
<td>11</td>
<td>Replaced, clotting</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>860</td>
<td>25</td>
<td>4</td>
<td>3 (2)</td>
<td>230</td>
<td>3 = 77</td>
<td>42</td>
<td>Replaced, clotting</td>
</tr>
<tr>
<td><strong>Arterial</strong></td>
<td>45</td>
<td>6</td>
<td>1</td>
<td>BS</td>
<td>40</td>
<td>3</td>
<td>3</td>
<td>Replaced, bleeding and infection</td>
</tr>
<tr>
<td><strong>infusions</strong></td>
<td>92</td>
<td>1</td>
<td>1</td>
<td>AN</td>
<td>27</td>
<td>3</td>
<td></td>
<td>Replaced, clotting</td>
</tr>
</tbody>
</table>
were large decreases in resistance. The mean value of resistance before treatment was 1.86 mm Hg/ml/min and after treatment 0.63 mm Hg/ml/min. The eight infusions were given into six shunts in five patients. (Two patients each had two treatments on the same shunt, one patient had two different shunts each treated once.) The mean survival time after streptokinase infusion was 124 days; three shunts are still functioning. After treatment another 41 cloting episodes occurred, an average of 1 every 18 days.

b. Unsuccessful venous infusions: Four infusions were regarded as unsuccessful. Shuntography showed no decrease in existing clots and there was no fall in resistance. The four infusions were given into three shunts in two patients. (One patient had the shunt treated twice; one patient had two different shunts treated each once.) The mean survival time after streptokinase treatment was 77 days. There were 42 clotting episodes, an average of 1 every 5 days.

It thus seems that the immediate results judged by roentgen and resistance studies have a bearing on the long-term results. There was no apparent difference in the conditions of the shunts before treatment with streptokinase that can explain this. In the successful group the shunts had been in place an average of 229 days, in the unsuccessful group an average of 287 days. In the successful group there had been an average of one clotting every 36 days, in the unsuccessful group there had been an average of one every 34 days.

The data are summarized in Table I.

Side effects of streptokinase treatment

The side effects reported with streptokinase treatment are bleeding, and febrile reactions. The latter can be diminished by premedication with steroids. One case of bleeding was encountered, the patient developing large haematomas in the calf and around the waist. When treated a second time 25 days later, there were no complications, and plasma fibrinogen levels were normal before and after treatment. No febrile reactions were encountered, not even in the six patients who received no premedication. There were no allergic reactions in any patient, including one patient with asthma who was given two treatments one year apart.

DISCUSSION

The present investigation suggests that streptokinase infusions are effective in lysis of clots not removed by the ordinary declotting procedures. The results of angiography studies and resistance measurements support this. Ordinary declotting procedures tried for hours had failed to remove the clots satisfactorily and on several occasions the choice was between replacement of the shunt and a trial with streptokinase infusion.

Why the streptokinase infusions were successful in some cases and not in others is not clear. It is obvious that the longer the clot remains in the vessel, the more organization takes place and the less susceptible the clot is to fibrinolysis. No significant difference was noted in the age of the clots in the successful and unsuccessful groups. In one instance angiography revealed an intimal fold as the cause of obstruction. Another reason for failure of streptokinase treatment could be that the concentration and amount of streptokinase was insufficient. This then must be explained by individual differences between the patients, as there was no actual difference between the doses used in the successful and unsuccessful group of patients.

We plan in the future to continue streptokinase infusions with higher concentrations if there is no improvement in the vascular lesion observed at angiography. Shuntography causes some discomfort to the patient when the contrast medium is injected into the arterial side, but injections into the venous side are painless. In one case an urticarial rash developed after shuntography. Shuntography is very important since it will reveal the reason for malfunction of the shunt. A more detailed analysis of the vascular changes observed will be presented in the future.
SUMMARY

Infusions of streptokinase, an enzyme initiating fibrinolysis, were used to improve the flow in clotted Quinton-Scribner shunts, where conventional declotting procedures were insufficient. The results were checked by angiography, the contrast medium being injected directly into the shunt, and by flow and resistance studies. In 1 of 2 treatments given on the arterial side, and in 8 of 12 given on the venous side good effect was encountered. There was a decrease in size of the clots seen on angiography, and a fall in resistance. There was one episode of bleeding. No febrile or allergic reactions were encountered.

Our studies suggest that streptokinase is an effective and safe tool in the treatment of clotted Quinton-Scribner shunts.

REFERENCES

