ALTERNATIVE VASCULAR ACCESS IN PATIENTS LACKING VEINS FOR STANDARD ARTERIOVENOUS FISTULAE

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Summary

We have evaluated the Hickman catheter and Hemasite access port as means to re-establish vascular access in patients lacking veins for conventional arteriovenous fistulae. The Hemasite is more convenient, but is also costlier, requires more surgical skill to implant, and is more frequently associated with major infections. One-half of the Hemasites have failed because of infection. As a result, the long-term survival rate is lower for Hemasite graft, although the differences noted have not yet reached statistical levels of significance.

Introduction

The vascular access needs of most patients requiring long-term haemodialysis will be adequately met by the creation of a standard arteriovenous fistula of the type described by Brescia and Cimino [1]. Unfortunately, not every patient needing chronic haemodialysis will have veins adequate to develop or maintain a functional fistula. When obesity, prior scarring or small vessel size precludes suitable venous maturation for useful access, alternative forms of access will be necessary if haemodialysis is to continue as a therapeutic option.

Over the past three years, we have evaluated two new forms of vascular access as means of maintaining haemodialysis in problem patients. This report details our experience with each device at the University of Maryland Hospital.

Materials and methods

The Hemasite access port (Renal Systems, Minneapolis, MN, USA) consists of a T-shaped titaneum tube which is covered externally with Dacron velour to promote tissue ingrowth for implant stabilisation and inhibition of bacterial entry [2]. Each end of the tube is connected to polytetrafluoroethylene (PTFE) tubing to facilitate arteriovenous incorporation of the implant. The side arm, or button, contains a silastic septum with pre-formed slits which are designed
Figure 1. Top: Hemasite in preferred location. Bottom: (A) Hickman in preferred location. (B) Y-connector used for single needle dialysis
to accept introduction of a blunt-tipped double needle access set. Automatic
closure of these slits upon removal of the needle set assures haemostasis between
periods of haemodialysis. The Hemasite is usually implanted within a subcutaneous
tunnel along the medial aspect of the arm (Figure 1, top), allowing the button to
exit midway between a brachial artery anastomosis at the elbow and a basilic
vein anastomosis just distal to the axilla. Povidone iodine solution is retained in
contact with the septum by a silastic cap when the device is not in use. Operative
time for implantation is 60–120 minutes. Device cost is 3000.00 US dollars.

The Hickman catheter (Evermed, Medina, WA, USA) used for dialysis is a
shorter (26cm), larger bore (26mm internal diameter) version of the right atrial
catheter used for chemotherapy [3]. An enveloping Dacron cuff attached to its
outer surface secures the catheter in place and limits bacterial ingrowth. Implan-
tation is usually via the right external or internal jugular vein (Figure 1, bottom).
Cannulation of the inferior vena cava through the greater saphenous vein can be
used as an alternate route. Single needle dialysis is carried out by attaching a
Y-connector (Figure 1, bottom) to the luer-lok adapter on the external catheter
end as previously described [3]. When not in use the catheter is filled with 2000
units sodium heparin in 2ml normal saline and sealed with a threaded cap.
Operative time for insertion is 15–30 minutes. Device cost is 40.00 US dollars.

Survival curves were calculated by the method of Kaplan and Meier [4].
Data were analysed by the log rank test as outlined by Savage [5].

Results

Since July 1981, 42 Hemasite access ports have been implanted in 32 haemo-
dialysis patients at the University of Maryland (Table 1). Twenty-three patients
received one implant, eight received two and one received three. Twelve Hemasites
continue to function 20–1050 days (mean 364 days) after implantation.

<table>
<thead>
<tr>
<th>TABLE 1</th>
<th>Hemasite</th>
<th>Hickman</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>42</td>
<td>38</td>
</tr>
<tr>
<td>Patients</td>
<td>32</td>
<td>35</td>
</tr>
<tr>
<td>Age-range (mean)</td>
<td>23–78 (54)</td>
<td>26–77 (55)</td>
</tr>
<tr>
<td>Sex (M/F)</td>
<td>17/15</td>
<td>10/25</td>
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<tr>
<td>Years on dialysis (mean)</td>
<td>0–11 (4.4)</td>
<td>0–11 (3.8)</td>
</tr>
<tr>
<td>Number prior access (mean)</td>
<td>0–12 (4.8)</td>
<td>1–15 (5)</td>
</tr>
</tbody>
</table>

Three functioned for 163–349 days (mean 232 days) prior to patient death
from causes unrelated to renal function or access. The remaining 27 Hemasites
have failed from 1–799 days (mean 370 days) after insertion. In 21 instances,
this failure was due to infection developing around the graft and in six instances
to thrombosis which could not be reversed by graft revision. Most graft infec-
tions were obvious, but three patients died of sepsis that developed insidiously.
without external signs of graft infection. Accumulation of pus about the graft, with corresponding micro-organisms isolated from other tissues, confirmed the Hemasite to be the source of sepsis in the only patient of the three to be examined by autopsy.

Over the same time period, 38 Hickman catheters were implanted in 35 haemodialysis patients (Table I). Thirty-three have received one catheter and three have received two. Twenty-four catheters continue to function 12–595 days (mean 242 days) after insertion. Eleven catheters functioned for 6–126 days (mean 36 days) until patient death from unrelated causes (six cases), recovery of renal function (two cases) or the maturation of more conventional arteriovenous access (three cases), prompted discontinuation of the Hickman dialysis. Only three catheters have failed to date. One failed at eight days because of poor surgical positioning through the left jugular vein. Two failed at 15 and 81 days when the stabilising cuff migrated along the subcutaneous tunnel toward the exit site, leading to poor flows due to catheter tip withdrawal from its vena caval position. No episode of catheter related sepsis was documented. Several exit site infections were easily controlled with oral antibiotics. The main difficulty encountered with these catheters was the daily replacement of heparin that was required to maintain patency [6]. Some patients were able to accomplish this at home without difficulty, but most required visiting nurse assistance to assure compliance. When thrombosis did occur, it was always partial, allowing infusion to continue but limiting withdrawal. Patency could be restored with low dose streptokinase infusion (1000 units per hour in 10cc D₅W for 12–48 hours).

Figure 2. Kaplan-Meier plot of Hickman dialysis catheter (upper curve) and Hemasite access port survivals
The Kaplan-Meier survival curves for the two devices are illustrated in Figure 2. There is a clear trend in favour of the Hickman catheter, but the difference is not yet significant (p=0.08). It should be noted that 13 patients were placed on venous dialysis after one to three Hemasites failed. Only one patient was implanted with a Hemasite because of patient preference after first receiving a Hickman.

**Discussion**

The Hemasite and Hickman are both attractive devices for trial in the patient who has unsuitable veins for conventional access. Both devices provide access that is immediately available by exploiting veins that are usually still untouched after multiple standard fistula procedures. Both devices can also be inserted under local anaesthesia and demonstrate reasonably long-term patency for a difficult group of patients. Access survival was 60 per cent at one year and 30 per cent at two years for the Hemasite, and even higher for the Hickman, in patients whose average of five prior access channels had each failed after less than one year of function.

Hickman catheters are technically simpler to insert, but require daily instillation of heparin and a single needle dialysis technique. For these reasons, we initially limited our use of the Hickman to a less favourable group of candidates. In fact, 13 Hickman patients received this type of access only after the failure of one or more Hemasites. It came as a pleasant surprise that their catheter survival rates have been even higher than those of the Hemasites. That these differences have not yet reached the levels of statistical significance is due to the small numbers in place beyond 18 months, which reflects our early reluctance to employ the Hickman except in desperately ill patients with abdominal sepsis who needed some quick means of haemodialysis that could be reused as long as needed.

Infection has presented a more serious problem than anticipated with the Hemasite device. One-half of these ports have failed because of infection. Most disturbing have been the three fatal cases of sepsis where the onset of symptoms was insidious and no clinically evident graft infection existed. Although intravenous antibiotics were useful in temporarily controlling these graft infections, often prolonging Hemasite survival for many weeks or even months, our experience with insidious sepsis has cautioned us not to persist in the antibiotic treatment of repeated Hemasite infections. This will undoubtedly increase further the survival difference being noted between the two devices.

**References**

3 Reed WP, Light PD, Sadler JH. *Kidney Int* 1984; 25: 838
5 Savage IR. *Ann Math Stat* 1956; 27: 590
6 Reed WP, Newman KA, de Jongh CA et al. *Cancer* 1983; 52: 185

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