How data can help reduce vascular access events

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The vascular access serves a number of important needs for the individual on dialysis. It is a critical connection for removing fluids, toxins, and filtering blood and, depending on access type, can have a significant influence on the morbidity and mortality of hemodialysis patients. Over time, an access often develops stenosis, a progressive narrowing that will cause the access to eventually thrombose. When the access thromboses, a relatively costly, invasive, and often painful surgery must be done on the patient to hopefully clear the blockage. Unfortunately, not all thrombectomy procedures are successful and a new access needs to be created. If stenosis is detected early enough, angioplasty, a minimally invasive procedure, can be performed to reopen that access.

In addition to the medical gravity of a blocked access, the financial ramifications are also disconcerting. It is estimated that vascular access procedures and maintenance totals between $8,000-$10,000 per dialysis patient per year. In 2005, we noticed a troubling trend among the 85 patients at our clinic of increased vascular access thrombosis events—this despite weekly dynamic venous pressure measurements to insure good access blood flow. The incidences of thrombosis were negatively impacting their adequacy and anemia benchmarks. The medical director asked the staff to investigate.

We developed a detailed spreadsheet of each patient with access complications, including all of the possible clinical variables. We found 110 thrombosis episodes from January – December 2005 and concluded that DVP measurements were not predictive of thrombosis incidences, nor could any other clinical indicator (or combination of factors) be found that provided better monitoring. While we did perform physical exams on a routine basis and listened to each access with a stethoscope as part of our active monitoring, this method alone was still leading to less desirable results. We also felt to fully comply with the 2006 Kidney Disease Outcomes Quality Initiative guidelines for monitoring and surveillance, we needed to add a surveillance component for additional testing.

A review of surveillance tools

We decided to look at a new method for vascular access surveillance while continuing our monitoring protocol. We reviewed a process developed by a team of physicians and engineers at Henry Ford Hospital. Rather than try and measure a decrease in blood flow, the team at Henry Ford Hospital developed a method to measure the increase in pressure caused by an occlusion. The research resulted in the development of the Venous Access Pressure Ratio Test (VAPRT). This method of predicting access dysfunction uses treatment data collected during the dialysis session to determine the pressure at the tip of the needle. The algorithm collects inputs from several factors including the pressure inside the venous drip chamber, negative arterial pressure, the pump speed, blood pressure and even the patient's hematocrit. It also corrects for the type of machine, needles, and tubing to derive the actual pressure in the access site. The result is then normalized, dividing it by the patient's mean arterial pressure, to develop the VAPR ratio. A separate algorithm tests the arterial side of the access. These results are used to identify patients who could be at risk for access complications.

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![Figure 1. Tracking access health](image)

How to interpret access surveillance reports

1Dynamic Venous Pressure (DVP) was deemed to be an unacceptable method of surveillance in K/DOQI 2006. 2Vaso-Alert LLC, West Lafayette, Ind.
Putting the technology to the test

After evaluating this technology, Sparrow Dialysis began using this surveillance device in January 2006 for all their arteriovenous access patients. To make use of the surveillance data, the medical director approved additions to the standing orders for patients alerting and deemed appropriate for referral. This empowered the nurses to initiate the referral of patients to interventional radiology.

The surveillance service indicates that a patient may be at risk from the results of the ‘test’ over several dialysis sessions. When a patient has three consecutive treatments with pressure readings above a predetermined threshold, it registers an ‘alert.’ These ‘alerts’ are highlighted on the resulting report by a red line on the graph. The historical results are indicated by a trend line that shows the severity of the occlusion (height of the lines) and the approximate growth rate of the stenosis (slope of the resulting trend line). See Figure 1.

If the patient has been issued an alert in the previous 30 days, they are placed on an “Alert List” and their weekly report is grouped with other “patients on alert” separate from those patients who are not “on-alert.” The staff can review only those patients who may have a problem with their access. After reviewing the reports, the recommended procedure is for the dialysis staff to look at other clinical indicators and conduct a physical examination of the access to confirm if the patient needs to be referred. This approach of building into the device the concept of ‘trending’ follows a recommendation in the 2006 Kidney Disease Outcome Quality Initiative guidelines:

“One should not respond to a single isolated abnormal value. With all techniques, prospective trend analysis of the test parameter has greater power to detect dysfunction than isolated values alone.” (4.4.1)

As the system became more familiar to staff, physicians and nurses began to review and discuss reports during patient care conferences. Reviewing all the reports and focusing on those patients who were ‘on alert’ (patients who had at least one alert in the prior 30 days) enabled the staff to flag patients at risk for thrombosis and schedule a preventive intervention.

Results

Within the first year of using the new surveillance system (January-December 2006), the team reported a decrease in thrombosis episodes—down to 75 from the previous year’s 110—a 30% decrease in one year. During this first year of surveillance, the team focused on the high alert patients. From January – December 2007, results proved even more successful, as the reduction not only maintained, but also dropped to 71. The staff then shifted their focus to include patients with longer-term access issues, rather than solely those on the “high alerts.” In time, the staff became more adept at utilizing the reports and in conjunction with increasing our fistula prevalence rate from 39% in 2005 to 70%, has been able to reduce our thrombosis rate even further, dropping to 18 patients for all of 2011 from 110 in 2005—an 84% decrease (see figure 2).

Figure 2. Decrease in clotting episodes: 2005-2012

<table>
<thead>
<tr>
<th></th>
<th>Clotting Episodes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>120</td>
</tr>
<tr>
<td>One year</td>
<td>75</td>
</tr>
<tr>
<td>Post-surveillance</td>
<td>60</td>
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<tr>
<td>Five years</td>
<td>30</td>
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</tbody>
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Summary

Thrombosis is the leading cause of access dysfunction and is expensive to treat. In 2011, only 10 AV access capable patients in our center were placed on a bridge catheter because of our ability to assess health and proactively use angioplasty to keep it open. Surveillance also helped us follow the progression of new fistula maturation and helped us decide on early intervention to prevent total access failure.

The Sparrow Center documented successful results with the selection of a new surveillance system that dramatically improved the quality of patient care and financial viability of the center. For dialysis center staffs looking for ways to operate more efficiently and at the same time reduce the incidence of vascular access complications caused by thrombosis, a data-driven surveillance device along with clinical monitoring protocols seems to provide a cost effective approach to addressing this critical area of patient care.

References


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