Dear Friend,

In celebration of our 30th anniversary, it is appropriate to use the TipS to thank all of you, for your interest in and support of our products over the years. Looking back, we can recall that it was in 1981 when we sent our first port, the model GPV to a number of prominent researchers - Drs. Landi, Nolan, & Coatney and Dan Garner for their evaluation. While our product range has grown tremendously since those early days, we could not have done it without the assistance of you, the laboratory animal research community. We are thankful to all who have worked with us developing products for tomorrows’ research. Unfortunately, there is not enough space to thank everyone who has been part of our history and contributed to our success, but please know how grateful we are.

In the coming years we will continue with our efforts, working with you in your exciting intellectual endeavors to bring new and innovative ideas and products to the life sciences. **Collaboration creates new possibilities and opportunities which wouldn’t otherwise exist.**

Please remember, the TipS is a forum for sharing and we welcome your comments. **Pam**

**Past**

**PRESENT**


**FUTURE**

The history of infusion has amusing as well as interesting facets, as its roots were planted in the Middle Ages. What follows are just a few of the highlights that lead to the remarkable achievements in long-term access we take for granted today. If you are interested to learn more, please call 847-674-7131 and I will be delighted to send you the complete manuscript.

1628  Discovery of circulatory system by William Harvey

1657  Sir Christopher Wren, first instrument for IV infusion - a pig bladder and a feather quill

1663  Robert Boyle extended IV infusion from animals to humans

1831  Dr. Thomas Latte, pioneered the use of intravenous saline infusion in the treatment of cholera

1929  Werner Forssmanns’ self experimentation opened a new chapter in the history of medicine: diagnostics in cardiology with the aid of a cardiac catheter

1950’s  Attention was focused on the nutritional needs of the surgical patient

1968  Arrival of long term venous catheters

1973  Design of the long term catheter improved by Drs. Scribner & Broviac

1979  Further improvements on this catheter by Drs. Hickman & Broviac

1981  Vascular Access Port, the Access Technologies GPV, offered to animal researchers

1986  First published study (Dr. Hans Brinker, Cancer) on benefits of the VAP/the Injection Capsule in human oncology patients

While the use of implantable ports has grown tremendously and many technological changes have come about in the biomedical/life-science industry, the Vascular Access Port concept still is the most efficacious device for maintaining long-term venous access. New devices have not replaced it, but rather device manufacturers have kept up with the needs of researchers and modified the original design to reduce complications and improve needle stability. We are especially proud of the changes we have introduced. Examples of design changes include the Rounded Port Chamber of the ClearPort and Rat-O-Port, the Penny MousePort; a species specific port, the Phantom, a location specific port and most recently the GridLock which offers extreme needle stability. In the coming year we plan to introduce additional light-weight polysulfone designs as well as a new family of titanium ports.

If you would like to join our email product update list please send your email address to: pwolf@norfolkmedical.com.
The major classifications of catheter occlusion according to etiology are (a) mechanical, (b) non-thrombotic, and (c) thrombotic.

**Mechanical Etiologies** - the cause is external to the catheter such as catheter kinking, a suture holding the catheter in place may be constricting the lumen, the needle placed into an implanted port may have become dislodged or occluded by the septum. An under appreciated criterion of mechanical occlusion is Catheter Tip Position.

**THE “IDEAL CATHETER TIP LANDING ZONE”**
A catheter tip, in order to be centrally located for optimal use, needs to be in the lower 1/3 of the SVC at or near the junction of the right atrium & SVC. Dr. Peter Verhey1 in 2008 described 3 principles of catheter tip placement that are met with true cavoatrial placement:

1. tip is in an area of high flow
2. tip lies parallel to the vessel
3. pulsatility & turbulence created by atrial contraction

These 3 principles provide an optimal environment for catheter tip placement and continued function.

1. high flow provides rapid dilution of the infusate
2. parallel tip position allows for free floating of the tip within the vessel to minimize irritation of vessel walls
3. turbulence created by contraction of the atria aides in preventing stagnation of blood on the catheter tip.

**Why Does It Matter Where The Catheter Tip Is Located?**
...because one of the frustrations often encountered is the apparent ‘failure’ of the catheter & the question....

**Why can I infuse but not withdraw?**
Two of the most common reasons are;

**Incorrect positioning of the catheter** - the catheter may be in a position that results in the tip abutting against the vessel wall, thereby resulting in a partial occlusion due to malposition. The catheter functions for infusion, but when aspiration is attempted negative pressure “pulls” the tip of the catheter up against the vessel wall preventing inflow. Optimal catheter tip location in a large vessel or at the right atrial - vena cava junction generally reduces this complication.

**Thrombus formation at the catheter tip** - the catheter tip is probably rubbing the endothelial lining of the vessel creating irritation and platelet aggregation. No secret why blood return is difficult to establish, since constant tip irritation leads to fibrin formation and consequently a PWO.

**Thrombotic Etiologies** - include intraluminal thrombus, extraluminal fibrin sleeve, mural thrombus, or major vessel occlusion and present as either complete or partial occlusion.

The **Fibrin Sleeve**, a fibrous collagen substance, typically propagates from the site of catheter insertion in the vessel and may extend beyond the distal end of the catheter tip. When the sleeve encases the tip, function is affected and a withdrawal occlusion results. The physiologic mechanism for the presentation of a partial withdrawal occlusion has been compared to a one-way valve: during infusion the sleeve is pushed away from the tip of the catheter allowing fluids to infuse, during aspiration, as negative pressure is applied, the sleeve is pulled over the catheter tip, occluding it and preventing aspiration.

**THE FIBRIN SHEATH EFFECT**
Flushing the catheter displaces the sheath/thrombus from the catheter tip and allows saline to exit the lumen.

**The Mural Thrombus** forms where the Catheter touches or “rubs” the vein wall. Common sites are the entry site and catheter tip.

**The Intraluminal Thrombus** occurs when blood refluxes inside the catheter lumen. The most common causes include inadequate flushing & improper syringe use.

The common practice of “fast flushing” by applying continuous pressure to the syringe plunger may not result in complete cleaning. In laminar flow, the center of the stream moves rapidly and the fluid at the perimeter moves slowly or not at all leaving the residue in the periphery untouched. Developing “turbulent flow” using a push-pull technique may be more appropriate. The vigorous swirling motion created by the turbulence is better able to remove build-up on the catheter wall.

Biofilm formation is a natural microbiological protection process by the body but, it is also a clinically relevant process and has been identified as the causative agent of catheter related infections. Once the colony is formed it is extremely difficult to eradicate making prevention of biofilm formation a priority.

The Ideal lock solution must therefore;

• Provide antimicrobial protection
• Not lead to resistance
• Confer antithrombogenic protection

Taurolidine Citrate Solution (TCS) meets these requirements - it makes the internal flow passages resistant to clot formation and hostile to bacterial and fungal growth.

To understand how flushing procedures affect the risk of bloodstream infections we must first explore the major cause of infections (Ryder - see the New in the Literature section for the reference) - Biofilm and its development on catheter surfaces. and ask the question…….

“Which Comes First - Biofilm or Thrombus?”

Biofilm development on intravenous catheters is a series of complex but discrete and well-regulated steps as is shown in Figure 1 below - the Biofilm Life Cycle:

1. **Microbial attachment to the catheter surface.** The mere “touch” of the cell wall of the organism with the catheter starts the production of a sticky adhesion that attaches the cell to the surface. The first opportunity for such contact is during catheter insertion as it passes through the layers of the normally colonized skin. While most skin microorganisms can be removed through meticulous aseptic technique, the catheter enters the blood stream with some burden of bacteria attached to it.

2. **Adhesion, growth, and aggregation of cells into microcolonies.** Upon arrival of the catheter into the venous system, a conditioning process begins with proteins, platelets and white blood cells attaching to the catheter surface and enveloping the catheter as a fibrinous sheath. As the cells continue to divide cell clusters form and the production of exopolymer saccharides or “slime” embeds the aggregating cells. Microcolonies comprising of “trapped bacteria and red blood cells” are the result.

3. **Maturation and dissemination of progeny cells for new colony formation.** Detachment & dissemination of cells is accomplished by shedding or shearing into the systemic circulation. This may result in infection, depending on the host immune system and bioburden of cells released.

At the most basic level - Biofilm can be described as bacteria embedded in a thick slimy barrier that protects them against external threats such as antibiotics; the Biofilm comes first!

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**New In The Literature....**


Another first - a Vascular Access Port offering exceptional needle stability using our PosiGrip Huber needle - no special needle, no special maintenance and over 1000 punctures with a 22 gauge Huber point needle.

The GridLock™ provides the best of both worlds - extreme needle stability at the perimeter for continuous infusion and easy access in the center ‘SweetSpot’ for flushing and withdrawal - making it truly the first Dual Purpose Port for the researcher.

Why a Special Port for Needle Stability: with the increasing length of continuous infusion studies, the need for assured needle security has become more important and something more than simply taping the needle in place in a conventional port was needed.

How it works: the design of the dual grid molded septum binds a standard Huber point needle between the upper and lower metal embedded grids creating high resistance against inadvertent needle dislodgement. The greater the angle of insertion, the more stable the needle preventing accidental dislodgement.

We have a limited number of sterile samples so if you are interested in trying the GridLock, please let me know.

Dacron® Mesh SkinButton - can be used as an alternative to a harness or jacket for rodents with externalized catheters. These disposable buttons are perfect for longer term studies as the subcutaneous tissue will grow into the mesh ensuring stability. The catheter is protected as it passes through the stalk/skin and can be attached to a tether.

The Locking Loop Catheter - this 6.5 French PolyUrethane locking loop drainage catheter is percutaneously placed over a guidewire to facilitate drainage. Once the device is in place the locking mechanism is activated. The locking loop pigtail configuration minimizes catheter tip migration avoiding accidental dislodgement after the retention loop is locked. This catheter is used in veterinary patients to divert urine from the renal pelvis to the bladder in patients with urethral obstruction.

Our Solution for Mouse Infusion eliminates an external catheter eliminates repeated tail vein venipuncture is perfect for intraperitoneal access

<table>
<thead>
<tr>
<th>Application</th>
<th>Mice - intravenous</th>
<th>Mice - intraperitoneal</th>
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<tbody>
<tr>
<td>Body Material</td>
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<tr>
<td>Needle Guard</td>
<td>Stainless Steel</td>
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<tr>
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PennyPort™

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tel. 847.674.7131
email: pwolf@norfolkmedical.com