Between the Lines: The 50th Anniversary of Long-Term Central Venous Catheters

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Abstract

Background: *Tunneled central venous catheters (CVC) were developed five decades ago. Since then, several clinician-inventors have created a variety of catheters with different functions. Indeed, many catheters have been named after their inventor. Many have wondered who the inventors were of each catheter, and what specifically inspired their inventions. Many of these compelling stories have yet to be told.*

Data source: *A literature review of common catheters and personal communication with inventors. Only first person accounts from inventors or those close to the invention were used.*

Conclusions: *CVCs are now essential devices that have saved countless lives. Though the inventors have earned the honor of naming their catheters, it may be reasonable to consider more consistent terminology to describe these catheters to avoid confusion.*

Keywords: *Catheter, Tunneled, Central, Venous, Review*

Introduction

The tunneled central venous catheter (CVC) celebrates its 50th anniversary in 2017. It goes without saying that the tunneled CVC has been one of the most crucial important advances in medicine in our lifetime. After the first catheter was created and the concept of long-term central venous access was accepted, many modifications to the catheter have lead to additional uses which have benefited innumerable patients with life-saving therapy, including chemotherapy, bone marrow transplantation, and hemodialysis amongst countless other uses (Fig. 1). While these catheters are all considered commonplace now, their design and usage have evolved over several generations of practitioners. Added to this, many catheters have been named after the original inventor of the device. As a result, an entire generation has passed which may have little to no knowledge of the difference between these common but differently named catheters. This review aims to answer commonly asked questions and to clarify misconceptions about tunneled CVCs, from personal accounts of the inventors themselves (Table 1).

How did we get to this point and why would one need a central line?

Although fascination with human blood probably began with the first human, the story of vascular access must properly begin with bloodletting which is described in ancient Egyptian and Arabic texts; the Old Testament contains veiled references to blood transfusion,[1] but it remained for **William Harvey** and his students to begin scientific investigations of blood volume and blood pressure. These studies depended on crude metal tubes used as cannulae.[2,3] Several reports of blood transfusion appeared in the early 1600s with results ranging from "no ill effect" to "very effective." **Robert Boyle** and **Sir Christopher Wren** introduced more sophisticated cannulae crafted from the quill of a bird's feather[1,4,5] and by the late 1600s they had performed animal experiments involving the injection of intravenous narcotics, and the popular press was publishing reports (and cartoons) detailing animal-to-human blood transfusion. By 1697,

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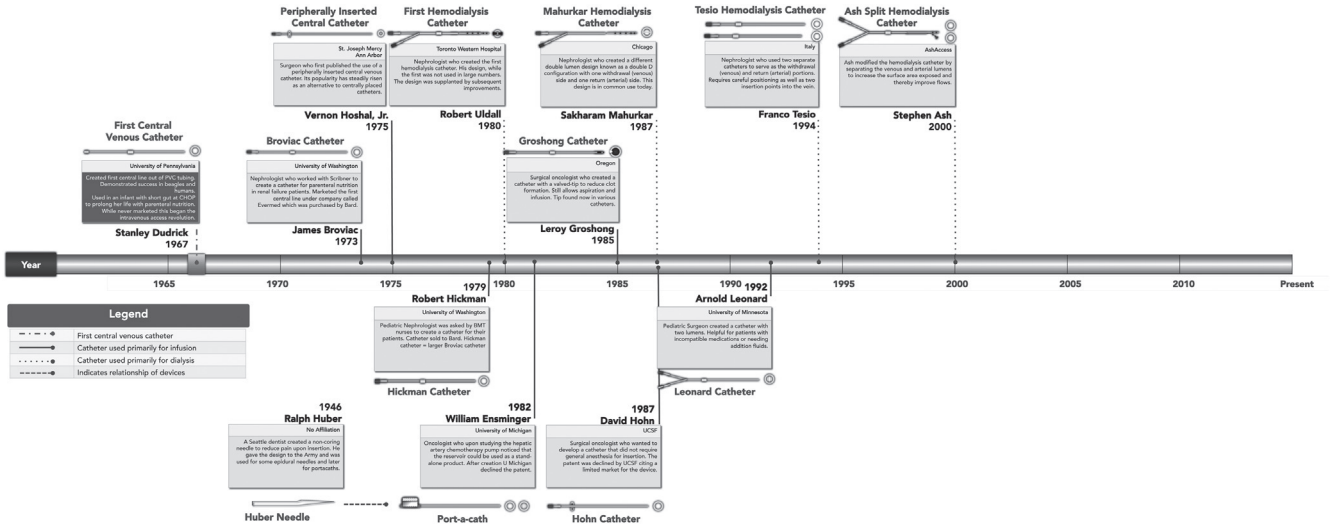

Fig. 1. **A timeline indicating when each tunneled central venous catheter was developed and the inventor.**

religious and secular opposition to the practice of "xenotransfusion" culminated in a ban on all transfusion for most of Europe. Bloodletting, however, continued to flourish. In 1733, **Stephen Hales**, an English clergyman, described experiments on animal physiology including measurements of the "force of blood" which essentially were the first descriptions of blood pressure.[3,6] It would be another 150 years before observations and studies on the massive fluid and electrolyte losses of cholera patients stimulated the investigation of intravenous fluid therapy. In 1831, **William O'Shaughnessy** coined the term "black blood"

Table 1. **Common commercial long term central venous catheters.**

Type of Catheter	Inventor(s)	Main use	Key distinguishing feature
Broviac	Beldig H Scribner, Robert C. Atkins, John W. Broviac	Fluid administration, hyperalimentation, chemotherapy, infusion therapy	Tunneled catheter held into the tract by a fabric cuff.
Hickman	Robert O. Hickman, James R. Sisley	Fluid administration, hyperalimentation, chemotherapy, infusion therapy	Similar to a Broviac but larger in size
Groshong	LeRoy E Groshong, Ronald J. Brawn	Fluid administration, hyperalimentation, chemotherapy, infusion therapy	Valved tip to reduce clot formation
Leonard	Arnold S. Leonard	Fluid administration, hyperalimentation, chemotherapy, infusion therapy	Double lumen catheter allowing administration of incompatible solutions simultaneously
Implantable venous access port	William D. Ensminger, Elton M. Tucker, John E. Niederhuber	Chemotherapy, infusion therapy	Subcutaneous port allows easier daily management for patients
Hemodialysis	Sakharam D. Mahurkar, Geoffrey Martin	Hemodialysis, Pheresis	Able to achieve high flows for withdrawal and reinfusion
Split Hemodialysis	Stephen R. Ash, Tim Schweikert	Hemodialysis, Pheresis	Separate tips have more side holes to increase flow rates
Hohn	David C. Hohn	Fluid administration, hyperalimentation, chemotherapy, infusion therapy	Does not require tunneling; inserted into central veins
Peripherally inserted central catheter	Verne L. Hoshal Jr.	Fluid administration, hyperalimentation, chemotherapy, infusion therapy	Does not require tunneling; inserted into peripheral veins