

## The Massa or Rochester Plastic Needle

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In 1950, a short article in the *Proceedings of the Staff Meetings of the Mayo Clinic* provided the first description of the modern intravenous catheter.<sup>1</sup> Written by Mayo Clinic anesthesiology resident David J. Massa (1923-1990) (Figure 1, left) and associates, this article represents a milestone in infusion therapy.

### MASSA'S INNOVATION

Massa's new catheter was designed to allow plastic tubing attached to a shortened 16-gauge steel needle to be threaded over a 19-gauge needle that acted as a stylet (Figure 2). Once this stylet needle had been inserted into a vein, the plastic catheter was threaded over it and the stylet was withdrawn (Figure 3).

Previously, 3 methods had been used to administer intravenous fluids, none of which was ideal.<sup>2</sup> The first was to perform a cutdown on a vein. Plastic tubing for use in such cutdowns became available in the mid-1940s.<sup>3</sup> Cutdowns required surgical skill and supplies, were time-consuming, could be uncomfortable for the patient, and usually meant both sacrificing the vessel and leaving a scar. They also had a high incidence of infectious complications. The alternative to cutdowns was the use of hollow metal needles to gain venous access. These needles were commonly reusable, and, depending on their sharpness, could cause discomfort on insertion. Because of their rigidity, such needles often became dislodged from the vein and required repeated insertion. To try to prevent this problem, patients' arms were usually immobilized with an arm board, and veins near joints were avoided as possible cannula insertion sites. In 1945, Zimmermann<sup>3</sup> and Meyers<sup>4</sup> independently reported a third technique, namely, threading plastic tubing into veins through previously inserted hollow metal needles and then withdrawing the needle over the catheter. This practice was more comfortable for patients, permitted catheters to be inserted in veins near joints, and allowed the catheter to be left in situ for prolonged periods while giving the patient more mobility. The 2 disadvantages of this technique were (1) leakage of fluid through the skin puncture and venous access sites caused by the catheter being of smaller diameter than the introducer needle and (2) inadvertent move-

ment of the needle occasionally shearing off the catheter tip and causing it to embolize into the circulation.<sup>5</sup>

Massa apparently came up with the concept of his disposable cannula while working in the cardiac catheterization laboratory at Mayo Clinic. (Information concerning the cannula prototypes, their original production, and early use is provided in Massa et al<sup>1</sup> and supplemented by the recollections of Drs R. A. Devloo and J. S. Hattox, resident colleagues of Dr Massa, provided in interviews conducted in 2007-2008.) The Becton, Dickinson and Company needles and polyethylene tubing (BD Medical, Franklin Lakes, NJ) used to construct the original prototypes were obtained from a surgical supply shop in Rochester, MN. Massa produced these prototypes in the basement of his home, sometimes enlisting the help of his fellow residents.

The plastic tubing was soaked in acetone to increase its diameter and make it pliable so that it could be threaded over the stylet needle and onto the hub of the cannula. A rotating cloth buffer was then used to buff away the square shoulder of the plastic catheter tip. The cannulas were initially sterilized by being heated in Massa's kitchen oven. Originally, only 16-gauge cannulas were made, and these devices were used for patients in the hospital wards rather than in the operating suite. Massa and his colleagues perceived that using this cannula offered all the advantages of the Zimmermann-Meyers technique, was technically easier, and was not associated with fluid leakage around the venous access site.

### COMMERCIAL PRODUCT

Massa's concern about producing the cannula in quantities was overcome when he was introduced to Emil Gauthier (1910-2005) (Figure 1, right). Mr Gauthier was the manager and part owner of the Rochester Products Company, established in 1946 to manufacture medical products. Initially, Becton, Dickinson and Company continued to be the supplier of the needles needed to assemble the cannula. Two major improvements incorporated into the design and manufacture of the commercial cannula were based on clinical experience with the prototype. (Information concerning the commercial manufacture of the cannula is provided in Massa et al<sup>1</sup> and supplemented by the recollections of Mr Thomas Gauthier and Ms Diane Osland, the son and granddaughter of Mr Emil Gauthier, provided in interviews in 2007-2008.)

The first modification was to grind notches in the short metal needle onto which the plastic tubing was threaded to

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FIGURE 1. Left, Dr David J. Massa. Right, Mr Emil Gauthier. Photograph courtesy of Ms Diane Osland.

prevent the catheter from becoming dislodged and embolizing into the circulation. This problem had occurred with the prototype, and on occasion minor surgery was attempted to retrieve an embolized catheter.<sup>2</sup> When the prototypes were used, nurses were instructed to have a tourniquet ready to place around the limb in case the catheter was dislodged.

The second improvement to the commercial cannula was sharpening the catheter tip so that its leading edge coincided with the bevel of the stylet needle. This modification was designed to prevent the plastic tip from being caught on the skin and vessel wall as it was being inserted, a common problem with the prototype needle. To achieve this, the stylet end of the catheter was redipped in acetone to remove plasticizer and thereby harden the distal quarter inch of the plastic catheter. This allowed the catheter tip to be ground down more finely with the rotating cloth buffer to obtain the desired shape.

When first marketed, the cannulas were packaged 12 to a box without sterilization. Subsequently, the cannulas were individually packaged, sterilized by autoclaving, and marketed as the Rochester Plastic Needle (Figure 4). Soon,

the manufacture of the intravenous catheter became a major component of the Rochester Products Company's business. In 1957, the company reportedly sold 7500 needles per month, and by the time it sold the rights to manufacture the needle in the mid-1960s, it had produced more than 3 million needles. This success occurred despite occasional reports of catheter embolism and, particularly on prolonged insertion, phlebitis.<sup>2,5</sup> Interestingly, Gauthier and Massa did not obtain a patent on the needle until 1963, long after its usefulness had been established.<sup>6</sup> Their acquisition of the patent did, however, precede Rochester Products Company's sale of the manufacturing rights to Johnson & Johnson (Langhorne, PA) in 1965.

**SUBSEQUENT CAREERS OF MASSA AND GAUTHIER**

After completing his training at Mayo, Massa returned to his hometown of Mansfield, OH, where he became a leading and respected physician. During his lifetime, some of his contemporaries attached his name to descriptions of the intravenous cannula.<sup>2</sup>

Following the sale of the rights to manufacture the intravenous cannula, Emil Gauthier's company (at that

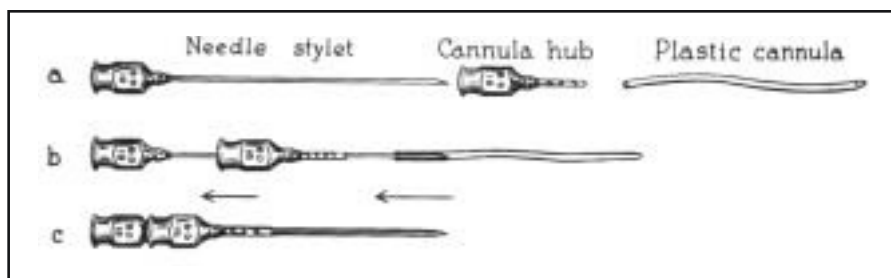


FIGURE 2. Cannula components and assembly. From *Proc Staff Meet Mayo Clin.*<sup>1</sup>

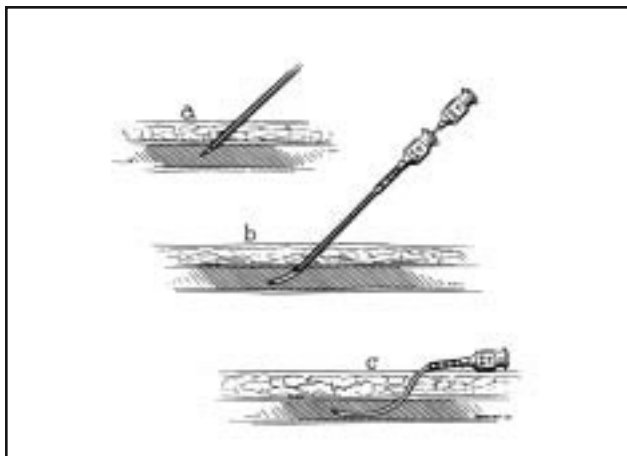


FIGURE 3. Method of cannula insertion. From *Proc Staff Meet Mayo Clin.*<sup>1</sup>

time called the Rochester Medical Equipment Company) and its successors continued to prosper. His company was the first to manufacture a home dialysis machine. In his later life, Mr Gauthier and his family became major benefactors to the Rochester community.

#### CONCLUSION

With their invention and manufacture of the modern disposable intravenous cannula, Dr Massa and Mr Gauthier made a major contribution to medicine. The device was inexpensive, easy to use, and could be inserted into a wide variety of vessels. It also caused little patient discomfort or trauma and allowed the patient freedom of movement, particularly important advantages in some patients, such as children. As Lundy and Adams<sup>7</sup> pointed out in their 1951 editorial, improvements in venipuncture helped end the scenario in which a “patient is exposed to a series of painful and sanguinous attempts at venipuncture, and as a result has hematomas and extremities that are swollen and painful for several days.” The new cannula also reduced the need to

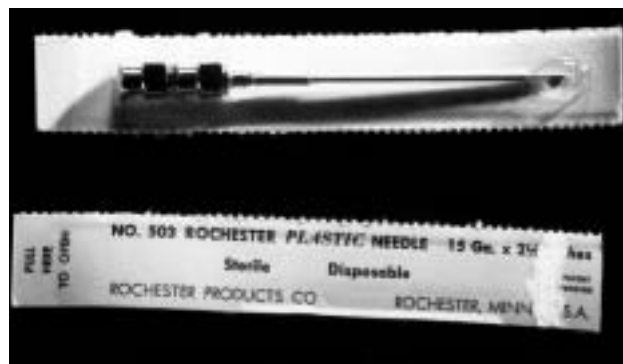


FIGURE 4. The Rochester Plastic Needle in its package.

perform venous cutdowns in patients requiring prolonged or repeated intravenous therapy. This was a valuable asset in patients with limited venous access, such as patients with burns or cancer and children.

*We would like to thank the many people who helped us reconstruct this description of the invention of the modern intravenous cannula. We are particularly indebted to Drs Robert A. Devloo and John S. Hattox, who were fellow anesthesiology residents and friends of David Massa; Ms Diane Osland and Mr Tom Gauthier, the granddaughter and son of Emil Gauthier; Mr Brad Noe of BD Medical; and Mr Frank King and Ms Mae Savos of the Archive Unit, BD Medical.*

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