

An Improved Puncture-Insertion Kit for a Swan-Ganz Catheter

Toshiyasu Suzuki*, Yoshio Kinefuchi*, Masahiro Kanazawa*
Haruo Fukuyama*, Tetsuo Takaya*
Mamoru Takiguchi, Michio Yamamoto*

ABSTRACT

To facilitate easy and safe insertion of a Swan-Ganz catheter, we developed a new pilot/introducer needle and dilator-sheath-introducer kit. We made a Y-shaped side port for a guide wire insertion in the hub of a 22-gauge metal needle. We then inserted a 7cm long dilator-sheath-introducer over the guide wire and inserted a Swan-Ganz catheter through the introducer in the usual way. This dilator-sheath-introducer has a fine tip and the shape of its assembly tapers down gently from the introducer to the guide wire. A Swan-Ganz catheter was inserted through the introducer in the usual way. When this kit was used in 50 cases, we had a success rate of 92% with no serious complications. The success rate and the time taken to insert the introducer did not differ between a staff anesthesiologist and first-year trainees. This kit was also useful to help preserve venous access in patients suffering from severe hemorrhage shock.

The internal jugular vein is a reliable site for Swan-Ganz catheter insertion. Various techniques for internal jugular vein puncture have been reported with high success rates and rare complication^{1~4}). But for unskilled physicians, insertion of a Swan-Ganz catheter or a central venous catheter is not an easy technique. Insertion of a Swan-

Ganz catheter is an especially invasive procedure for the patient. The most common complications are hematoma, arterial puncture, and pneumothorax which tend to occur when using a larger needle. Our newly designed pilot/introducer needle and dilator-sheath-introducer kit facilitate easy and safe insertion of a Swan-Ganz catheter.

Description of the device

The set consists of a 22-gauge, all-metal exploring needle, a 2.5 ml syringe, a 60 cm long, and 0.46 mm thick guide wire with a pigtail tip, a 7 cm long dilator-sheath-introducer, and the usual skin preparation kit. A self-sealing Y shaped side port is attached to the hub of the exploring needle at an angle of approximately 30 degrees for passage of the guide wire (Figure 1). The length of the needle is 3.2 cm. The shape of the fine-tipped dilator-sheath-introducer tapers down gently to the guide wire (Figure 2).

Patients and technique

We used this kit in 50 patients scheduled for open-heart surgery. A clinical trial using this kit was approved by the Ethics Committee of Tokai University and informed consent was obtained from all patients. The operating table was tilted down 15 degrees for a right internal jugular vein puncture, the patient's head was turned to the left, and the site of insertion was prepared and draped

*Department of Anesthesiology, Tokai University School of Medicine

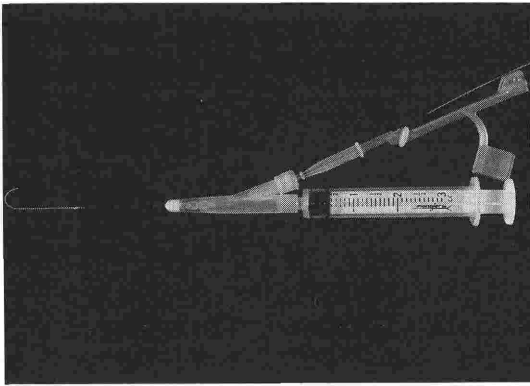


Fig. 1 A pilot/introducer needle set side port for a guide wire (spring type, 0.46mm in diameter, 60cm long, J shaped guide wire) on the hub of a 22 gauge metal needle)

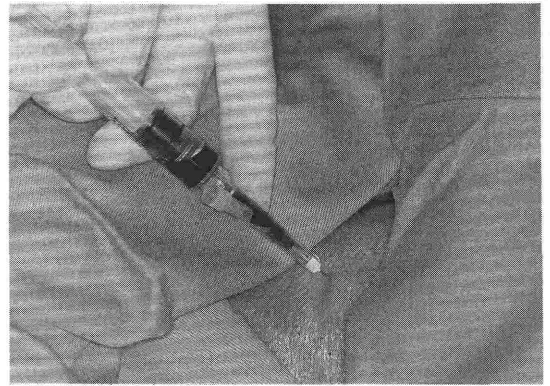


Fig. 3 The 22 gauge exploring needle hit the internal jugular vein (central approach)

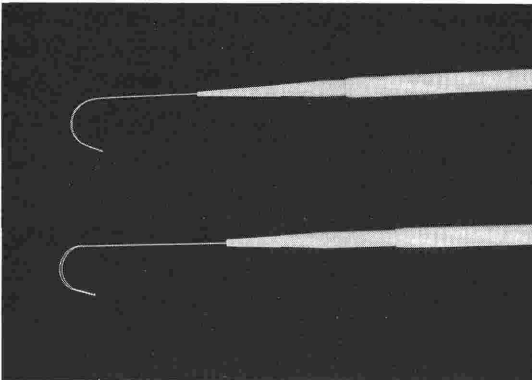


Fig. 2 Our new dilator-sheath-introducer (upper)
The shape of the fine-tipped dilator-sheath-introducer tapers down gently to the guide wire

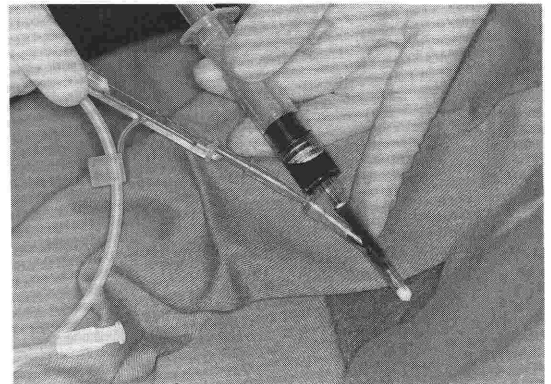


Fig. 4 Guide wire insertion without removal of the needle. 20cm of the guide wire left in venous lumen

in the usual way. Internal jugular venipuncture was performed using central approach technique (Figure 3)¹⁾. The patient's vein was punctured under local anesthesia. when blood return was observed, the syringe was held fast in the left hand while the guide wire was threaded a length of 20 cm through the diaphragm in the side port (Figure 4). After the needle and syringe assembly were withdrawn, a small stab incision was made at the insertion site to the depth of a subcutaneous tissues to accept the dilator. A dilator-sheath-introducer was inserted over the guide wire (Figure 5). The guide wire and dilator were removed, leaving the sheath

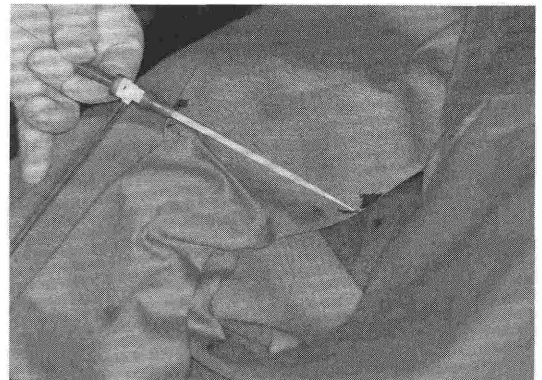


Fig. 5 A small stab incision is made at the insertion site to the depth of a subcutaneous tissue, to accept the dilator. A dilator-sheath-introducer was inserted over the guide wire

in the venous lumen. The Swan-Ganz catheter was then inserted through the sheath (Figure 6).

Results

Using this kit, fifty introducer cannulations have been performed. In 30 cases, the procedure was performed by staff anesthesiologist experienced more than five years and in 20 cases, by first-year trainees. The overall success rate was 92 % in the first trial. The success rate of the procedure was 100 % when performed by staff anesthesiologists but 90 % when performed by first-year trainees. From skin preparation to introducer insertion, staff anesthesiologists utilized 85.5 ± 22.4 seconds, and first year-trainees used 93.7 ± 29.0 seconds. Statistically, however no significant differences were found between the two groups. The time taken from skin preparation to Swan-Ganz catheterization was 480.9 ± 27.9 seconds by staff anesthesiologists, and 829.7 ± 14.8 seconds by first year-trainees. There were significant differences between the two

groups ($P < 0.05$) (table 1). Two complications occurred, arterial puncture and failure to insert the dilator-sheath-introducer because of guide wire kinking at the insertion site. In the latter case, by adding a small stab incision, the insertion was performed successfully.

Discussion

When a large-bore needle is used during ultrasonography-guided internal jugular vein catheterization, the needle tip puts pressure on the vein and displaces the anterior venous wall. Both anterior and the posterior walls may be punctured at a time and the needle may dwell in the vein, or causing complications such as arterial puncture or pneumothorax. To avoid these complications, we devised a safe and reliable Seldinger's method kit using a sharp, fine needle which does not deform the artery⁵. We also developed a Safe Guide Catheterization Kit for easy central venous catheterization by modifying the pilot puncture needle to allow guide wire insertion with a single puncture, and reported its usefulness⁶⁻⁸. Using same principle, we developed a dilator-sheath-introducer for Swan-Ganz catheter insertion. The conventional method has drawbacks: (1) The needle is too large and may cause complications such as arterial puncture^{9,10} or pneumothorax¹¹. (2) Two times venous punctures are necessary. (3) Gap in time between insertion of the dilator and the sheath-introducer often results in pain during insertion. Our new method uses a 22-gauge needle with a side port for guide wire insertion without withdrawing the needle. As a result, the time taken for catheter insertion is shortened and the risk of air embolism is reduced¹². Even in cases of accidental arterial puncture, complications may be less due to use of a fine-bore needle. Although the diameter of the guide wire is 0.018 inch, it has sufficient strength to guide the introducer. Compared to the conventional dilator-sheath-introducer, the new one has a sharp bevel and gently tapered end, thus reducing the differences between guide wire and dilator. As a result, only 5 % of the patients complained of pain or

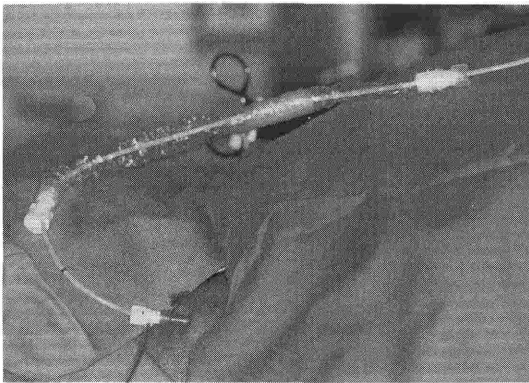


Fig. 6 A Swan-Ganz catheter is inserted through the introducer

Table 1 Difference in success rate between staff-anesthesiologists and first-year trainees

	Successes/Patients		Time taken to the procedure (mean \pm S.D.)
	Number	Success rate	
Staff anesthesiologists	30	100%	85.5 ± 22.4 sec
First year-Trainees	20	90%	93.7 ± 29.0 sec

unpleasant sensation during introducer insertion. In one patient, the guide wire kinked during introducer insertion. By slightly pulling the kinked part of guide wire into the dilator and making an adequate incision at the catheterization site, the dilator-sheath-introducer was successfully inserted. A 100% success rate was obtained with second trial. Using this method, the time taken from skin preparation to completion of introducer insertion by experienced anesthesiologists and trainees did not differ more than 2 minutes. This method can be used not only in pulmonary artery catheterization, but also in cases of hemorrhagic shock, and open heart surgery, even when using heparin and in patients with coagulopathy, the introducer may be used as a transfusion route with least danger of making hematoma.

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