

# Minimally Invasive Procedure for Ventriculoatrial Shunt—Combining a Percutaneous Approach with Real-time Transesophageal Echocardiogram Monitoring: Report of Six Cases

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To make the ventriculo atrial (VA) shunt procedure less invasive and avoid atrial catheter malpositioning, we combined a percutaneous approach with transesophageal echocardiogram (TEE) to monitor the atrial catheter tip. From July 1995 to October 1996, we performed 6 VA shunt procedures by combining these 2 techniques. Except for one patient who had a concomitant Port-A catheter, which obscured the detection of TEE in the procedure, all other atrial catheters achieved ideal positioning and good function. The mean operation time was shorter, and the complications were fewer than those using the conventional procedure in our hospital. In addition to this particular aspect, by combining these 2 techniques, the VA shunt procedure can be performed much less invasively, but more accurately, quickly, and safely. (*Chang Gung Med J* 2002;25:62-6)

**Key words:** hydrocephalus, percutaneous approach, transesophageal echocardiogram, ventriculoatrial shunt.

Ventriculo atrial (VA) shunt, although less common than the ventriculo-peritoneal shunt, is still used to manage hydrocephalus in special conditions.<sup>(1)</sup> However 2 technical difficulties exist in this procedure: first, it requires a long neck incision and a lot of time may be spent finding an appropriate vein; and second, there is no good way to monitor the position of the shunt in the atrium intraoperatively. To solve the first problem, we used a simple set of atrial introducers to puncture the internal jugular vein and insert the catheter through the lumen to reach the right atrium. To solve the second problem, we propose the application of a transesophageal echocardiogram (TEE) to monitor the position of the atrial catheter in real time throughout the entire procedure. Herein, we report our experience in 6 patients using this technique.

## CASE REPORT

We combined and applied these 2 techniques in 6 hydrocephalic patients who fulfilled the indications for VA shunt (Table 1). The indications for VA shunt included: 3 previous laparotomies (1 gastric cancer, 1 colon cancer, and 1 peritonitis secondary to VP shunt), 1 peritoneal adhesion due to previous multiple VP shunt revision, 1 ascites due to hepatic insufficiency, and 1 pregnancy-induced peritoneal malabsorption. Their prognoses were followed up by regular OPD visitation or by questioning their family by telephone. In the meantime, we searched for VA shunts done by the traditional method in our hospital through our medical record computer system. Operation times, surgical results, and complications were collected and analyzed.

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**Table 1.** Summary of Clinical Data

Case	Gender	Age (y/o)	Indication for VA shunt	Symptom/sign	Follow-up period	Prognosis
1	Woman	3	previous laparotomy	headache, drowsiness	1 m	died of gastric cancer
2	Woman	84	previous laparotomy	headache	1 yr	died of colon cancer
3	Woman	30	pregnancy	headache, drowsiness	5 yr	alive and well
4	Man	39	peritoneal adhesion	headache	1yr	died of stroke
5	Man	58	previous laparotomy	headache	4 yr	alive and well
6	Man	43	ascites	apathy	5 yr	died of hepatic failure

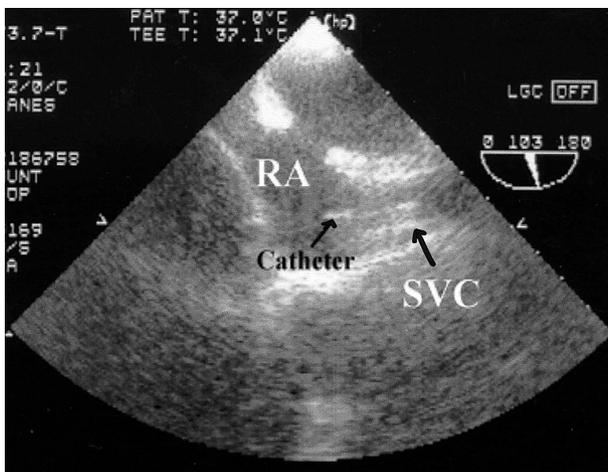
Under general anesthesia, the TEE transducer (5.0 mHz, SONOS 1000, Hewlett Packard, California, USA), was inserted into the esophagus and directed to the junction where the superior vena cava and the right atrium meet. After the surgical fields were prepared and sterilized, we punctured the internal jugular vein in the neck with an 18-ga. puncture needle. The "J" shaped spring guide wire was passed into the vein through the puncture needle; the sheath-dilator assembly followed and was passed into the vessel following the guide wire. The guide wire and dilator were removed, while the outer sheath was left in place. The heparinized shunt catheter was put into the vessel through the sheath to reach the junction of the superior vena cava and the right atrium under the monitoring of TEE (Fig. 1). Then the end of the catheter was pulled up to the vertex through a subgaleal tunnel. A ventricular punc-

ture was performed as usual, and it was connected to an appropriate reservoir and shunt catheter. The wounds were closed in layers. The atrial catheter was continuously monitored by TEE throughout the entire procedure.

The symptoms of all patients were relieved, and each one's consciousness remained clear after the VA shunt procedure. The mean operation time was 2 h 24 min (range from 1 h to 3 h 45 min). There were no complications at the puncture site or in the introduction of the ultrasound transducer, and there was no shunt malfunctioning or meningitis recorded in the follow-up period (Table 2).

Only 1 atrial catheter could not be traced clearly by TEE during the operation in a 31-year-old female (case 1) who had gastric cancer with lymph node metastasis and who had received a gastrectomy and lymph node dissection. She had a Port-A catheter via the right subclavian vein to the right atrium for chemotherapeutic drug delivery. During the procedure, we inserted the atrial catheter via the left internal jugular vein, but its tip was obscured by that of the Port-A. Therefore we had to change to fluoroscopy to direct the tip on the level at T7.

The mean follow-up time was 32.1 months (range from 1 to 60 months). The first patient died within one month due to gastric cancer, and the second patient died at one year because of colon cancer. The sixth patient with ascites died 5 years later due



**Fig. 1** Intraoperative TEE. The atrial catheter was introduced into the junction of the SVC-RA under real-time monitoring. (RA: right atrium, SVC: superior vena cava)

**Table 2.** Comparison between the New and Traditional Methods

	New method (6 cases)	Traditional method (12 cases)
Mean operation time	2 h 24 min	3 h 44 min
Malfunction	0	7
Meningitis	0	2

to hepatic failure. The fourth patient with severe peritoneal adhesion had SAH resulting from aneurysmal rupture. He died suddenly at one year after the shunting procedure due to another stroke. The third patient had obstructive hydrocephalus due to a pineal cyst for which she had received a VP shunt previously. Her shunt had malfunctioned when she became pregnant. We changed it into a VA shunt with TEE monitoring during the operation. She recovered and has remained well to the present. The fifth patient had normal-pressure hydrocephalus. He received a VP shunt but it was complicated with peritonitis, but he has been doing well to the present after changing to a VA shunt.

From our hospital medical records, we collected 12 VA shunt patients whose procedure were performed by the traditional method. Two of them had complications of meningitis, and 7 of them had shunt malfunction and needed revision. The mean operation time was 3 h 44 min (range from 2 h 15 min to 6 h).

## DISCUSSION

VA shunt is well known for its high morbidity rate. There were 71 complications in 99 VA shunt procedures in a large study by Illingworth et al.<sup>(18)</sup> In addition there was a 15.7% infection rate with the VA shunt in Shurtleff's<sup>(19)</sup> 12-year study. Villegas-Camargo<sup>(20)</sup> also reported an unusual complication with VA shunt. Traditionally, the VA shunt procedure requires a long neck incision and a lot of time can be spent locating an appropriate venous access.<sup>(2)</sup> In this new method, we puncture the internal jugular vein using a simple set of atrial introducers and insert the shunt through the lumen to reach the right atrium. There are other techniques for percutaneous insertion<sup>(3-12)</sup> to make the procedure easier and simpler. Because of minimal wound exposure and a shorter operation time, this approach decreases the incidence of shunt infection and obstruction.<sup>(5)</sup> In our series, only one catheter could not be visualized by a TEE during the procedure because of a pre-existing Port-A catheter. Besides this case, there was no shunt-related infection or dysfunction in the follow-up. Moreover, in comparing the new and traditional VA shunt procedures, the new method reduced the operation time by more than one hour.

As compared with fluoroscopy and portable chest roentgenography, TEE provides a very useful and reliable tool throughout the procedure. It is also very stable, without interfering with the surgical field, unlike a transthoracic echocardiogram.<sup>(13-17)</sup> In addition TEE provides further benefits:

- (1) there is no risk of radiation exposure to medical staff or patients;
- (2) there are no contrast medium related allergic reactions;
- (3) it provides real-time monitoring throughout the entire procedure; and
- (4) the atrial catheter is easily directed to the caval-atrial junction.

Although our patient number was small, we believe the procedure for VA shunt insertion can be performed with minimal invasiveness, greater accuracy, and higher safety by combining these 2 techniques.

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