

LETTER TO EDITOR

Central Venous Pressure Monitoring; Introduction of a New Device

Mahmood Ghafoori Yazdi¹, Arya Shoghli^{1*}, Sina Faghihi¹, Alireza Baratloo²

1. Faculty of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

2. Emergency Department, Shohadaye Tajrish Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

*Corresponding author: Arya Shoghli; Faculty of Medicine, Shahid Beheshti University of Medical Sciences, Evin, Tehran, Iran.
Post code: 198396-3113, Email: arya_sh89@yahoo.com

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To the editor:

Central Venous Pressure Monitoring

Hemodynamic monitoring is needed in up to 58% of patients presented to the emergency department (1). Although central venous pressure (CVP) monitoring is generally useful to assess general volume status, its reliability as a guide to resuscitation in critically ill patients is a subject of debate (2, 3). Generally, there are several methods of CVP measurement, which can be categorized as invasive and non-invasive. Currently two methods are available for direct and invasive measurement of CVP. In the first method, after fixing a CV line catheter, CVP is measured using a CVP manometer connected to patient's CV line. In the other method, an electronic transducer, connected to the CV catheter from one side and to the digital monitor from the other, is used to demonstrate measured CVP. There are also non-invasive methods such as direct observation and ultrasonography, which are used for indirect measurement of CVP. Observation of internal jugular venous pulsation remains an acceptable method to estimate right atrial pressure (4). In addition, ultrasonography can be used to determine elevated jugular venous pressure (5). If the jugular vein appears larger than the adjacent common carotid artery when the patient is in a semi upright position, CVP is probably >10 cmH₂O. Another method of measurement is plethysmography. Change in forearm volume in response to externally applied pressure to upper arm veins is an indicator of CVP measure (6). Forearm volume may be measured by mercury-in-silastic strain gauge plethysmography. The correlation between CVP measured by this technique and invasive CVP is about 0.97 (7).

All the mentioned methods have some negative points. Using a manometer, is time consuming and may be affected by operator errors. Using a transducer is expensive (about 25 dollars for each patients in Iran) and requires the patient to be in a stable, calm environment in

order to provide a more accurate measurement. In addition, non-invasive methods may be inaccurate since they measure the CVP indirectly and can render variable results depending on the operator. Considering the above-mentioned, here we introduce a new device that can facilitate CVP measurement and provide physicians with further accurate data that can be helpful in decision making and patient management.

Electronic Continuous CVP Monitoring Device

This new device (figure 1) uses a sensor to measure CVP, by calculating the pressure difference between CV line catheter and the atmosphere. The device is equipped with a liquid crystal display (LCD), which shows time and date, CVP at the moment, mean CVP, and variance. The pressure sensor is fixed at the bottom of the device and has two openings, one is connected to the CV line using an appropriate plastic tube, and the other remains free to measure the atmosphere pressure for comparison. The device has a secure digital (SD) memory card slot, which keeps records of all the measured data for the patient. The device needs to be connected to a power source to receive the 12 volts needed for its functioning.

With the patient lying flat in supine position, the device is held at the level of right atrium. The designed sensor is connected to the CV line using an appropriate plastic tube.

CVP is measured twice per second, and the measured CVP at each moment appears on the LCD. The device is equipped with an alarm system, which sets off if the measured CVP is lower or higher than the defined range. Mean CVP value is calculated automatically and shown on the LCD, and gives the physician an estimation of the patient's status since the time of connection to the device. Variance is also calculated and shown on the LCD, and if it is wider than a pre-defined range, it may be a sign of clogging of the line and the alarm sets off.

Compared to other available methods a number of ad-



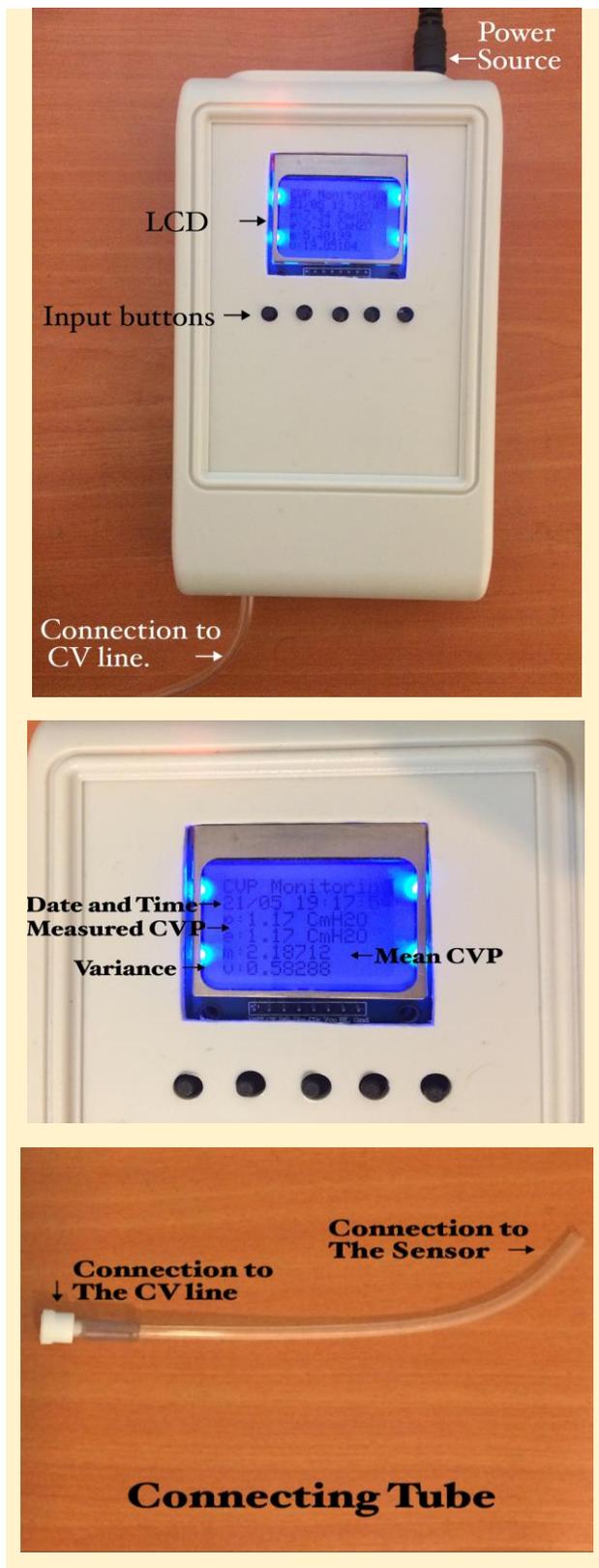


Figure 1: Electronic continuous central venous pressure (CVP) Monitoring Device.

Advantages can be pointed out for this device. The electronic continuous CVP Monitoring device is relatively small, which makes it very portable and easy to use on different patients. It can measure CVP within seconds, which leaves more valuable time to provide care for critical patients. This method will also cost much less for the patients, since it only uses a simple plastic tube for connecting to the CV line. Furthermore, all the data will be saved on an SD card, which will be given to the patient and can be used in the future as a part of the patient's medical profile.

Once the device is connected, it will measure the CVP twice per second continuously, while calculating the mean CVP and variance, a feature lacking in previous methods which is crucial for evaluating patient's progress during treatment and plays an important role in decision making. The alarm system is another notable advantage which can make a huge difference in a crowded ER, helping physicians to avoid missing a patient in critical condition.

Clinical Testing

The device was tested on 11 patients in emergency departments of 3 different hospitals in Tehran, Iran, for whom CV line catheter had been fixed. CVP was measured by conventional manometer method, and immediately afterwards by the electronic device. The difference between values measured by two methods was not clinically significant.

Future Outlook

The device needs to be tested on more patients and results need to be taken into account after using larger sample sizes in the future, in order to calibrate the device for maximum accuracy. The results should also be compared to those measured by the monitor connecting transducer, as it may be a more reliable method than CVP manometer.

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