

Determination of Central Venous Pressure from Intraocular Pressure

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Abstract

Background: In many clinical situations, knowledge of central venous pressure (CVP) is important. Measurement of CVP is not always possible.

Objective: To determine if intraocular pressure (IOP) can be used as an estimate for CVP.

Methods: IOP and CVP were measured concurrently in 30 candidates of coronary artery bypass graft surgery. Those with carotid artery or jugular venous diseases as well as those with glaucoma or cardiac ejection fraction of less than 50% were excluded from the study.

Results: A linear correlation was found between CVP and IOP ($r = 0.66$, $p < 0.001$). CVP can be easily derived by halving the IOP.

Conclusion: The use of this very simple method, particularly in those health care centers where due to the lack of necessary equipment for accessing central veins, CVP measurement is not possible, may provide useful information to physicians.

Iran J Med Sci 2003; 28(2):

Keywords • Fluid therapy • intraocular pressure • central venous pressure • intensive care unit

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Introduction

In several disease conditions, knowledge of patient's volume status is imperative. Central venous pressure (CVP) is a good index of volume status.¹⁻³ However, its measurement requires an invasive procedure, i.e. central venous cannulation. This procedure, although simple and safe if performed in an equipped center by an experienced hand, is not always possible to perform. For example, physicians practicing in rural health care centers might not be well-equipped to perform such procedures; thus, they could not use the very useful information a CVP line provides. It has been reported that intraocular pressure (IOP) is directly related to the episcleral and jugular venous pressure in patients without underlying ophthalmic diseases.^{4,5}

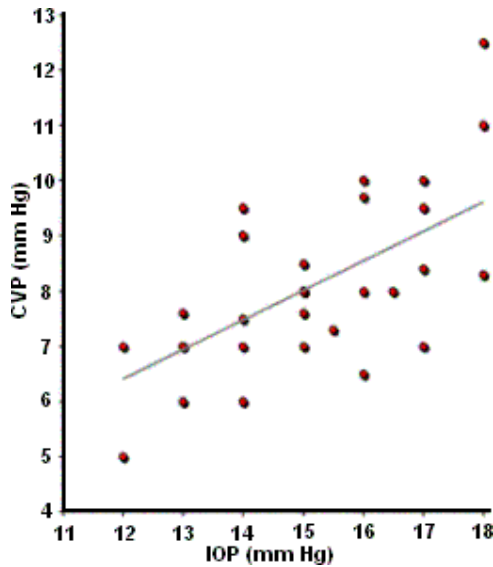


Figure 1: Scattered plot of CVP vs. IOP

Measuring IOP is simple and non-invasive. Therefore, it appears logically justified to assume that IOP might provide a good estimate for CVP. This study was conducted to determine if one could derive a clinically acceptable estimate of CVP from IOP readings.

Patients and Methods

Thirty candidates of coronary artery bypass graft (CABG) surgery with a minimum cardiac ejection fraction of 50% were enrolled into the study. These patients were examined by an ophthalmologist to exclude any concurrent ophthalmic diseases. Patients with previous carotid surgery, documented carotid disease also superior vena cava obstruction, were excluded from the study. A written informed consent was taken from each patient. A central venous catheter was inserted in the right internal jugular vein by the method described by Daily, et al⁶ using Seldinger technique⁷. The IOP was recorded using a Perkins tonometer (Mooler-Wedel, 5111-5601). CVP was recorded concurrently.

Using linear regression analysis (no intercept model) and Pearson's correlation coefficient, the data were analyzed.

Results

A linear correlation (Fig. 1) was found between CVP and IOP ($r = 0.66$, $p < 0.001$). An estimation of CVP can be derived from the IOP using the following equation:

$$\text{CVP} = 0.53 \times \text{IOP}$$

The mean percentage of the relative deviation of the predicted value is 11.5%.

Discussion

Measuring the CVP is necessary for monitoring the volume status in critically ill patients. Should one be not capable to insert a CVP catheter, the fluid status of the patient cannot be determined and as a consequence, the physician may experience some difficulties.

We found that IOP changed linearly with CVP in the studied range.

The pressure in the right atrium which is equivalent to the CVP, is transmitted to the intraocular space through the orbital, episcleral and choroidal vessels.⁸

To measure CVP, there are numerous routes by which a catheter can be placed in the central circulation. The internal jugular vein is the most common access route.¹ Right internal jugular vein is frequently chosen because it offers the most direct route to the right atrium. Using this technique, we found that CVP can be estimated by halving the IOP, which is similar to the study by Roberts et al, whose measurements were performed during laparoscopic surgery.⁸

The proposed equation is very easy to use at bedside and has an acceptable clinical accuracy. This equation, although helpful in many instances, has its own limitations. If the patient suffers from glaucoma, carotid artery disease, obstruction of or pressure over the jugular veins or any condition that disturbs the normally existing homeostasis in the choroidal, episcleral, orbital and internal jugular venous pressures, the relationship might not be valid and the physician should treat the condition cautiously.⁹⁻¹²

In our study, we used candidates of CABG surgery. These patients with their atherosclerotic coronary arteries might also have other undiagnosed concomitant arterial diseases which would affect the results. However, for ethical issues, we could not expand our study to the patients who did not need any CVP monitoring.

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