ADAM STRAIN

SUPPLEMENTAL REPORT

PREPARED BY SALLY G. RAMSAY

INTRODUCTION

I have been asked to respond to the questions outlined in the Supplemental Brief, dated 13th September, 2011.

1. **Describe the process of transferring a paediatric patient from the operating theatre to the paediatric intensive care unit (PICU) in 1995 and now, particularly addressing the following issues:**

(a) The personnel who would generally be involved in the transfer of a paediatric patient from theatre to paediatric intensive care (PICU)

The process involved preparing the patient in order to minimise any risks associated with the transfer. This included ensuring sufficient personnel to manage ventilation, monitoring and the safety of any infusions. It also included ensuring appropriate equipment was available for the transfer i.e. battery operated infusions pumps and monitors. The staff needed appropriate skills for handling an emergency such as a cardiac arrest or a dislodged breathing tube.

The location of the PICU in relation to the operating theatre and recovery room may have influenced the number of staff needed

In 1995, it is unlikely, in my opinion, that transfer practices were documented in a written protocol. The Paediatric Intensive Care Society published standards in 2001. These stated that there should be written guidelines for admission to PICU, but did not include intra-hospital transfer. I have been unable to find their earlier standards, published in the 1980's but believe these described general, rather than specific care issues.

In 2010, the Paediatric Intensive Care Society published Standards for the Care of Critically Ill Children (4th Edition). These state:

> "*Protocols should be used covering transfer of seriously ill children within the hospital, for example, to or from imaging or theatre. The protocol should specify the escort arrangements.*" (P23)

(b) The personnel, including surgical/medical staff, nursing staff and/or medical technical officers (MTOs), whom you would have expected to have been involved in the transfer of Adam from theatre following his transplant surgery to PICU

In view of Adam's condition, I consider his transfer required a consultant anaesthetist, another doctor, a registered nurse from either theatre/recovery unit or PICU and a porter to move the bed.

In 2011, the Royal College of Nursing published the document Transferring Children to and from Theatre: Position statement for good practice. This includes an Infant, Child and Young Person's Transfer Risk Assessment Tool in which the personnel needed to safely transfer and mechanically ventilated child are as follows:

- Registered nurse (child)
- Doctor – Specialist Registrar of above
- Anaesthetist – Specialist Registrar or above
- Porter

(c) How the care and treatment of a paediatric patient would be handed over from the theatre staff to PICU staff, including the briefing that would normally be received, when this would be done and who would be involved in the handover.

It is not within my area of expertise to comment on the handover between medical staff i.e. from the accompanying anaesthetist to the intensivist. From a nursing perspective I would have expected the recovery nurse to advise the PICU nurse of the following:

- The operation, its duration and outcome
- Breathing and ventilation
- The intravenous infusions – their location, fluids in progress including the type, volume, additives
- Recent vital sign recordings and any relevant observations of colour.
- Presence of arterial and venous monitoring (CVP)
- Presence of a urinary catheter and information concerning urinary output
- When any blood specimens were taken and any relevant results e.g blood gases
- Any medicines given in the post-operative period e.g. pain relief, antibiotics
- The information given to the parents

It was usual for most of this information to be given verbally to the PICU nurse either in the recovery room, if the PICU nurse was assisting the transfer, or on arrival in the PICU.

(d) Specifically in Adam's case, what you would have expected to have been communicated in the handover and to whom this would have been communicated, regarding:

It is my opinion that a theatre/recovery unit nurse should have communicated the following information to the PICU nurse.

(i) Adam

A brief background giving his age, cause of renal failure and that he had undergone a renal transplant after several years of peritoneal dialysis.

(ii) his renal transplant surgery

That he had undergone a transplant, had a drainage tube from the kidney and the dialysis catheter was still in place.

(iii) the reasons for his failure to breathe spontaneously and his fixed dilated pupils post operatively

I would not have expected the nurse to give a reason, but to give a factual account of the situation. This should have included how long Adam had been unresponsive.

(iv) Adam's serum sodium concentration

To advise the PICU nurses of the serum sodium level if this was regarded as a problem for which intervention had been prescribed i.e. that his fluids were restricted because his sodium level had fallen and he was thought he may have inappropriate ADH secretion.

(v) Adam's fluids regime during the transplant procedure

The intra-operative fluid regime was not information that I regard as important for his post-operative nursing care. Consequently, I would not have expected any transfer of information between nurses concerning this.

(vi) his central venous pressure readings

As a CVP line was in place, the theatre nurses should have passed on information concerning earlier readings in order that judgements could be made as to the accuracy of or difference in subsequent readings.

(e) Identify any guidance or protocols that existed in November 1995 relating to the transfer from theatre to PICU of paediatric patients and the handover to PICU staff.

It is my opinion that protocols and guidelines have developed considerably since the introduction of clinical governance in the late 1990's and the formalisation of paediatric intensive care. The latter followed from the report of the working party on Paediatric Intensive Care in 1997. I have been unable to find any examples of protocols for transfers between the operating theatre/recovery unit and a PICU in 1995. Consequently, it is my opinion that protocols or guidelines for this situation were rare or non-existant.

(f) Identify any guidance or protocols that exist now relating to the transfer from theatre to PICU of paediatric patients and the handover to PICU staff.

Standards for the Care of Critically Ill Children (PICS, June 2010.) state:

"*Protocols should be in use covering transfer of seriously ill children within the hospital, for example to or from imaging or theatre. The protocol should specify the escort arrangements.*"

Transferring children to and from theatre (RCN, 2011) states that observations should be documented on a chart during transfer.

I have been unable to find any current guidance or protocols concerning handover between theatre and PICU staff.

(g) The notes that you would have expected to be made as part of the transfer of a patient to PICU, including the adequacy of the notes made in Adam's case

It is my opinion that this was a serious and stressful situation. There was urgency in getting Adam to the PICU in order to asses and manage his condition. I have not seen any documents showing observations made during the transfer. In my opinion, this was not unusual at the time, particularly if electronic monitoring was in progress and the transfer time was short.

A nursing assessment was recorded on the Patient Assessment form (058-038-159) at 14.00. Although Adam was admitted to PICU at 12.15 (058-038-182), it is likely that clinical interventions prevented the assessment from being recorded promptly. I think this was no unusual. These document are of an acceptable standard for the time.

2. **Please describe the process of managing a CVP line when admitting a child to PICU from theatre, including**:

(a) How a central venous pressure line would have been transferred over to a PICU monitor

A nurse or doctor with the necessary skills would have attached the CVP line to either a manometer (094-131-346) or a transducer.

(b) What would be done to ensure that readings were accurate and reliable?

The transducer or manometer must be level with the patient's right atrium. This is achieved by using a spirit level and adjusting the position of the transducer or manometer. The monitor is then zeroed. This process was described by Cole (2008) in the attached paper.

(c) Whether the management in Adam's case of the CVP line going up into the neck was appropriate for the time. If not, what would you have expected in relation to management of this CVP line?

In my experience, CVP lines were usually placed in the neck. In 2004 Radford M. wrote "*the CVP is a manometer line inserted into a central neck vein, usually the subclavian or jugular vein.*" As a doctor performs the insertion of a CVP line, I am unable to comment on whether the position was appropriate for Adam.

(d) What you would have expected to have been communicated in Adam's case in the handover to PICU, and to whom this would have been communicated, regarding:

(i) the position of the CVP line during the transplant procedure

This information was not essential for Adam's post-operative nursing care

(ii) the position of the CVP line on completion of the transplant procedure

The nurse needed to know the position of the CVP line i.e. in the neck, and to note that it was fixed securely.

(iii) the CVP readings during the transplant procedure

This was not information needed by the PICU nurses.

(iv) the explanation for those CVP readings

This information was not needed

(v) any concerns relating to the CVP line

The nurses needed to know if there were any concerns regarding the accuracy of the readings or the patency of the line.

(vi) whether the CVP line was functioning effectively and reliably

As in (v) above

(e) Identify any guidance or protocols that existed in November 1995 on the management by nursing staff of CVP lines.

I have been unable to identify any guidance or protocols existing in 1995. CVP monitoring is not covered in detail in general children's nursing texts. A commonly used book, at the time, was Nursing Care of the Critically Ill Child (Hazinski, 1992). It is likely that it includes information on managing CVP lines.

(f) Identify any guidance or protocols that exist now on the management by nursing staff of CVP lines.

I have been unable to identify any published guidance or protocols specific to managing CVP lines in children. In 2010, Scales published a continuing education article on CVP monitoring. Although this was not specific to children, it contains useful information.

3. The book 'Clinical Management of Renal Transplantation' which was edited by Mary G. McGeown and published 1992, was, as far as the Inquiry team is aware, the only text regarding renal transplantation. Please address the following:

(a) Your comments on the section regarding 'Transplantation in children' (pages 176-178, provided at Ref: 070-023i-257 to 259), and how Adam's care and treatment was or was not in line with the guidance provided in this section

This medical textbook describes the medical, surgical and anaesthetic issues associated with transplantation in children. Although the information is of value to nurses, it is not within my area of expertise to comment on whether Adam's care and treatment was in line with the guidance, other than that as recommended, he was cared for in a PICU.

(b) Whether there are any other sections of the book which you would like to see to comment further on (see contents page at Ref: 070-023i-245 to 251)

Having reviewed the contents list I do not think there are any other sections I wish to see.

References

Campbell S. Glasper E.A.(eds) (1995) Whaley & Wong's Children's Nursing. Mosby:England
Cole E. (2008) Measuring central venous pressure
Hazinski M. F. (1992) Nursing Care of the Critically Ill Child
Paediatric Intensive Care Society (2001) Standards
Paediatric Intensive Care Society (2010) Standards for the Care of Critically Ill Children, 4th Edition
Radford M et al (2009) Advancing Peri-operative Practice, Nelson Thornes
Royal College of Nursing (2011) Transferring children to and from theatre: A position statement for good practice. www.rcn.org.uk
Scales K. (2010) Central Venous Pressure Monitoring in Clinical Practice. Nursing Times 24, 29 49-55

6.0 STATEMENT OF COMPLIANCE

I understand my duty to the Court, and have complied with that duty.

7.0 STATEMENT OF TRUTH

I confirm that I have made clear which facts and matters referred to in this report are within my own knowledge and which are not. Those that are within my own knowledge I confirm to be true. The opinions I have expressed represent my true and complete professional opinions on the matters to which they refer.

Signed  Date 17th Sept 2011

Measuring central venous pressure

Elaine Cole
Senior lecturer ED/Trauma, City University Barts and the London NHS Trust

Learning outcomes

That the clinician can:

Describe the sites of central venous catheterisation

Understand why central venous pressure monitoring is performed

Demonstrate how to perform central venous pressure monitoring using a manometer and a transducer

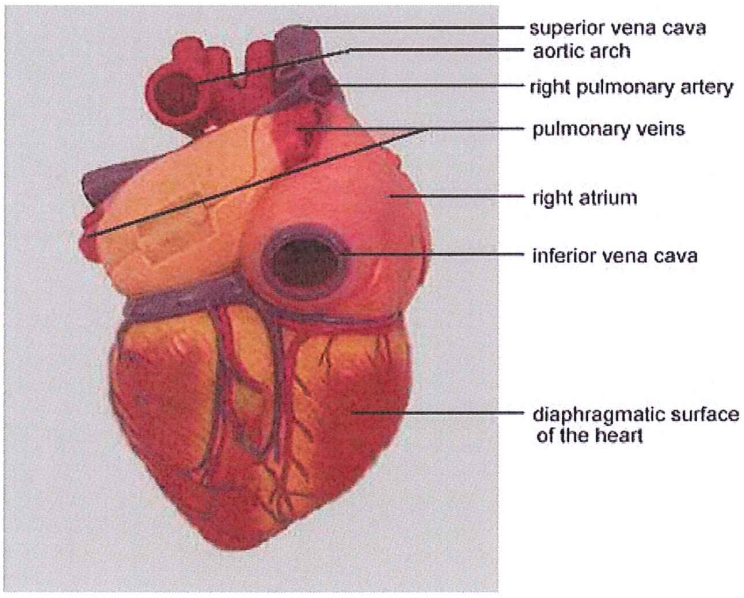
State normal parameters for CVP

Introduction

Central venous pressure measurement is often associated with intensive and critical care settings. However, with increasing numbers of critically ill patients being cared for on medical and surgical wards, it is essential that clinicians are able to record central venous pressure measurement accurately and recognise normal and abnormal parameters.

Reasons for measuring CVP

Circulating blood flows into the right atrium via the inferior and superior vena cava. The pressure in the right atrium is known as central venous pressure (CVP).



The condition of the patient and the treatment being administered determine how often CVP measurement should take place, for example, critically ill unstable patients may need hourly measurements.

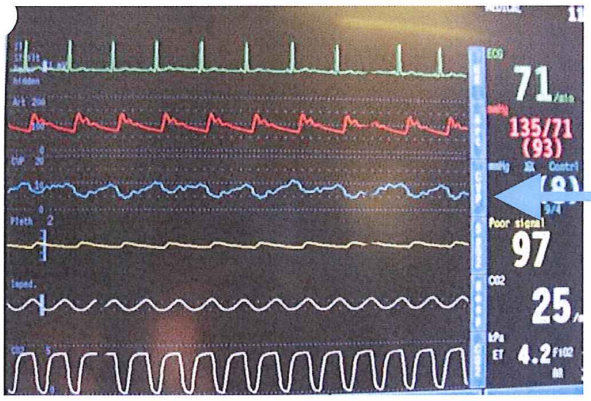
Measuring central venous pressure

Equipment: manometers

CVP is measured using an indwelling central venous catheter (CVC) and a pressure manometer or transducer. Both methods are reliable when used correctly.
Wards generally use **manometers**.

Equipment: transducers

Accident and Emergency departments, High Dependency areas and Intensive Care units use **transducers** for measuring CVPs.

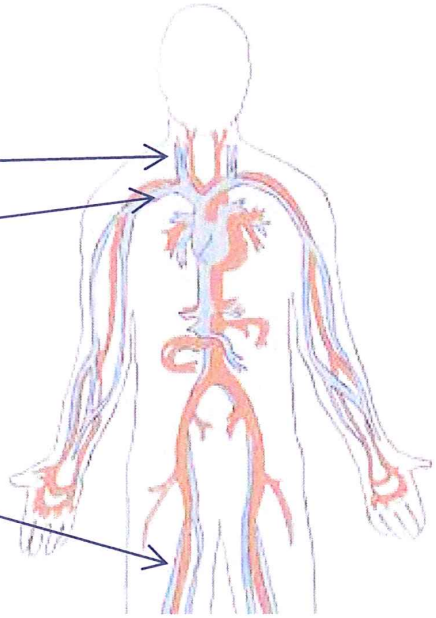


Transduced CVP waveform

Insertion sites

CVC insertion sites include:

- Internal jugular vein
- Subclavian vein
- Femoral vein



Measuring central venous pressure

Insertion sites

Internal jugular veins

This site is chosen frequently as there is a high rate of successful insertion and a low incidence of complications such as pneumothorax. Internal jugular veins are short, straight and relatively large allowing easy access, however, catheter occlusion may occur as a result of head movement and may cause irritation in conscious patients.

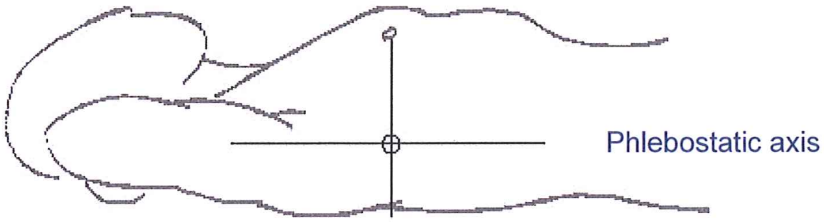
Subclavian veins

This site is often chosen as there are more recognisable anatomical landmarks, making insertion of the device easier. Because this site is positioned beneath the clavicle there is a risk of pneumothorax during insertion. A subclavian CVC is generally recommended as it is more comfortable for the patient.

Femoral veins

This site provides rapid central access during an emergency such as a cardiac arrest. As the CVC is placed in a vein near the groin there is an increased risk of associated infection. In addition, femoral CVCs are reported to be uncomfortable and may discourage the conscious patient from moving.

CVP Recording



Nursing and medical staff must be familiar with the equipment being used to ensure accurate readings and provide patients with appropriate care.

CVP is usually recorded at the mid-axillary line where the manometer arm or transducer is level with the phlebostatic axis. This is where the fourth intercostal space and mid-axillary line cross each other allowing the measurement to be as close to the right atrium as possible.

Using a manometer

1. Explain the procedure to the patient to gain informed consent.

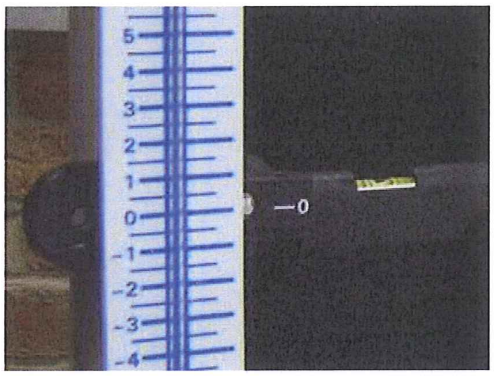
2. If IV fluid is not running, ensure that the CVC is patent by flushing the catheter.

3. Place the patient flat in a supine position if possible. Alternatively, measurements can be taken with the patient in a semi-recumbent position. The position should remain the same for each measurement taken to ensure an accurate comparable result.

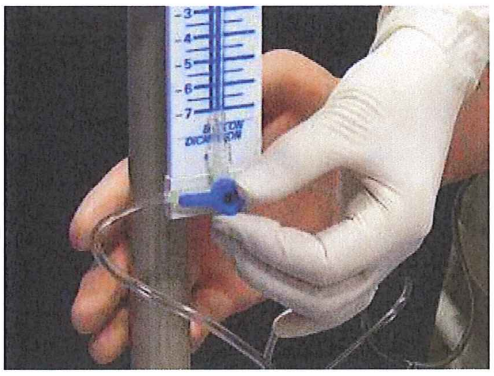
Measuring central venous pressure

Using a manometer

Line up the manometer arm with the phlebostatic axis ensuring that the bubble is between the two lines of the spirit level.



Move the manometer scale up and down to allow the bubble to be aligned with zero on the scale. This is referred to as 'zeroing the manometer'.



Turn the three-way tap off to the patient and open to the manometer.

Open the IV fluid bag and slowly fill the manometer to a level higher than the expected CVP

Measuring central venous pressure

Using a manometer

Turn off the flow from the fluid bag and open the three-way tap from the manometer to the patient

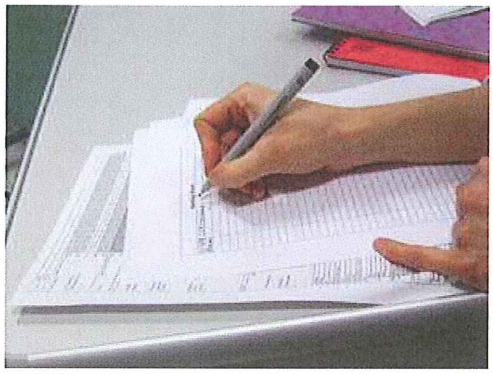
The fluid level inside the manometer should fall until gravity equals the pressure in the central veins

When the fluid stops falling the CVP measurement can be read. If the fluid moves with the patient's breathing, read the measurement from the lower number

Turn the tap off to the manometer

Measuring central venous pressure

Using a manometer



Document the measurement and report any changes or abnormalities

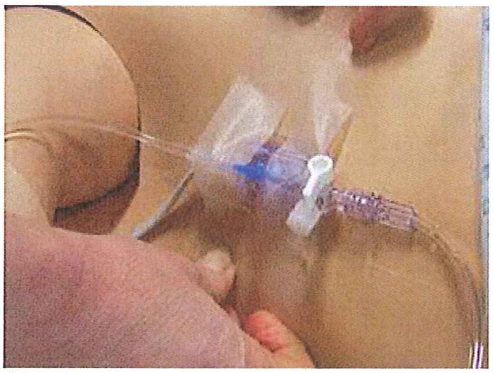
Using a transducer

Explain the procedure to the patient to gain informed consent.

The CVC will be attached to intravenous fluid within a pressure bag. Ensure that the pressure bag is inflated up to 300mmHg.

Place the patient flat in a supine position if possible. Alternatively, measurements can be taken with the patient in a semi-recumbent position. The position should remain the same for each measurement taken to ensure an accurate comparable result.

Catheters differ between manufacturers, however, the white or proximal lumen is suitable for measuring CVP.

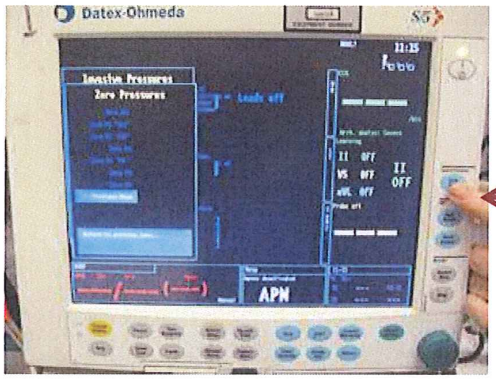


Tape the transducer to the phlebostatic axis or as near to the right atrium as possible.

Measuring central venous pressure

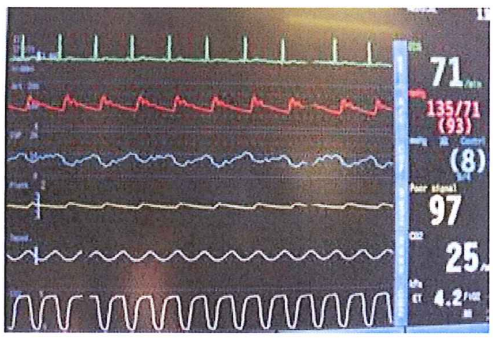
Using a transducer

Turn the tap off to the patient and open to the air by removing the cap from the three-way port opening the system to the atmosphere.



Press the zero button on the monitor and wait while calibration occurs.

When 'zeroed' is displayed on the monitor, replace the cap on the three-way tap and turn the tap on to the patient.



Observe the CVP trace on the monitor. The waveform undulates as the right atrium contracts and relaxes, emptying and filling with blood. (light blue in this image)

Document the measurement and report any changes or abnormalities

Measuring central venous pressure

Interpreting measurements

The normal range for CVP is 5-10cm H2O (2-6mmHg) when taken from the mid-axillary line at the fourth intercostal space.

Many factors can affect CVP, including vessel tone, medications, heart disease and medical treatments. A CVP measurement should be viewed in conjunction with other observations such as pulse, blood pressure and respiratory rate and the patients response to treatment.

Potential complications

Haemorrhage from the catheter site - if it becomes disconnected from the infusion. Patients who have coagulation problems such as those on warfarin or those will clotting disorders are at risk.

Catheter occlusion, by a blood clot or kinked tube - regular flushing of the CVC line and a well secured dressing should help to avoid this.

Infection - redness, pain, swelling around the catheter insertion site may all indicate infection. Careful asepsis is needed when touching a CVC site. Swabs for MC&S should be taken if infection is suspected.

Air embolus - if the infusion or monitoring lines become disconnected there is a risk that air can enter the venous system. All lines and connections should be checked at the start of every shift to minimise the risk of this occurring.

Catheter displacement - if the CVC moves into the chambers of the heart then cardiac arrhythmias may be noted, and should be reported. If the CVC is no longer in the correct position, CVP readings and medication administration will be affected.

References

Cole E (2007) Measuring central venous pressure. *Nursing Standard.* 22 (7) 40-42
Hamilton H (2006a) Complications associated with venous access devices: part one. *Nursing Standard.* 20, 26, 43-50.
Hamilton H (2006b) Complications associated with venous access devices: part two. *Nursing Standard.* 20, 27, 59-65.
Jevon P, Ewens B (Eds) (2007) *Monitoring the Critically Ill Patient.* Second edition. Blackwell Science, Oxford.
Morton PG, Fontaine DK, Hudak CM, Gallo BM (2005) *Critical Care Nursing: a Holistic Approach.* Eighth edition. Lippincott Williams and Wilkins, Philadelphia PA.
National Institute for Clinical Excellence (2002) *Central Venous Catheters: Ultrasound Locating Devices.* Technology appraisal No. 49. NICE, London.
Wiklund CU, Romand JA, Suter PM, Bendjelid K (2005) Misplacement of central vein catheters in patients with hemothorax: a new approach to resolve the problem. *Journal of Trauma.* 59, 4, 1029-1031.
Woodrow P (2002) Central venous catheters and central venous pressure. *Nursing Standard.* 16, 26, 45-51.