

# HAEMODIALYSIS: PREVENTION AND TREATMENT OF AIR EMBOLISM ASSOCIATED WITH CENTRAL VENOUS HAEMODIALYSIS CATHETERS OR HAEMODIALYSIS TREATMENT

University Hospitals of Leicester   
NHS Trust

**RRCV CMG**  
**Renal and Transplant Service**

## 1. Introduction

Air embolism is a potentially catastrophic yet preventable complication associated with haemodialysis that can lead to death unless quickly detected and treated. Air embolism relates to the entry of air into the venous system and may occur in relation to haemodialysis in two situations:-

- via a central venous catheter (Vascath or Permcath) where the catheter lumen is open to air either during insertion or when the dialysis lines are disconnected (accidentally or during starting/stopping dialysis)
- due to pressurised infusion of air into the venous system by the blood pump – this can only happen using modern dialysis blood monitors if the blood line is not connected to the air detector or this is bypassed/over-ridden.

Sub-clinical air embolism has been reported to occur in up to 2% of cases of central venous catheter insertion. It is a particular risk during percutaneous insertion of central venous haemodialysis catheters where a large bore sheath is inserted into the jugular vein. The volume and rate of air entering the circulation determines the severity of venous air embolism. It has been estimated that 300-500ml of air entering at 100ml/sec is potentially fatal – this volume and rate can be easily achieved through a haemodialysis catheter which is open to air with a pressure gradient of 5cm water.

## 2. Scope

This guideline is relevant to all clinical staff involved in the delivery of haemodialysis or the insertion/management of central venous haemodialysis catheters. These guidelines are applicable to patients directly under the care of University Hospitals of Leicester NHS Trust. Local guidance (for example for the inpatient care of kidney patients not in a Leicester hospital) may also exist and take precedence.

Clinical guidelines are 'guidelines' only. The interpretation and application of clinical guidelines will remain the responsibility of the individual practitioner. If in doubt consult a senior colleague or expert.

## 3. Recommendations, Standards and Procedural Statements

### 3.1 Symptoms

These depend to an extent on the position of the patient.

- In seated patients, infused air will tend to migrate into the cerebral venous system without entering the heart, causing obstruction to the cerebral venous return with loss of consciousness, convulsions and even death.
- In recumbent patients, the air tends to enter the heart, generate foam in the right ventricle, and pass on into the lungs causing dyspnoea, cough and chest tightness.

### 3.2 Signs

- Foam may be seen in the venous blood lines or the dialyser
- Respiratory or cardiovascular signs may occur i.e. increased respiratory rate, tachycardia, cyanosis
- Disorientation, agitation or more serious neurological signs may occur
- If air has entered the heart, a peculiar churning sound ('mill wheel murmur') may be heard by auscultation.

### 3.3 Prevention

- At catheter insertion. Patients should be routinely placed in head down position (Trendelenberg) for the insertion procedure. However, this does not rule out the possibility of air embolism. Care should be taken throughout to ensure catheter or sheath is not open to air.
- If possible, the patient should be asked to hold a breath in expiration or perform a Valsalva manoeuvre during insertion of PermCath into split sheath when risk of air entrainment is greatest.
- During insertion of a tunneled catheter through a split sheath, the sheath should be covered or pinched as the catheter is inserted into the sheath.
- During haemodialysis Care should be taken to ensure blood lines are securely connected to central venous haemodialysis catheters and that blood lines are correctly placed in air detector device. The air detector device should NEVER be bypassed or over-ridden.

### 3.4 Treatment

- If air embolism is suspected to have occurred during haemodialysis (e.g. if a line has become disconnected from a central venous dialysis catheter during haemodialysis) the dialysis should be discontinued immediately, without wash back.
- Clamp both arterial & venous bloodlines and stop the blood pump. Disconnect the patient from the extra-corporeal circuit as per procedure.
- Position the patient on left-hand side (recumbent position) with chest & head tilted downward (i.e. tilt bed/chair).
- Record blood pressure, pulse and respiration rate
- Administer 100% oxygen

- Alert medical staff (or appropriate team for satellite unit) to assess patient
- Commence oxygen saturation monitoring and obtain arterial blood gas sample as appropriate
- Further treatment includes cardio-respiratory support as required.
- Full cardio-respiratory resuscitation should be commenced as appropriate
- If air embolism is suspected through a haemodialysis central venous catheter, aspiration of distal port of catheter should be attempted.
- Aspiration of air may be both diagnostic and therapeutic. The medical practitioner may need to advance catheter to achieve this.
- If patient's vital signs are stable, arrange urgent assessment by medical staff and admit to hospital for observation.
- Document in patient records
- Complete an incident form

#### 4. **Education and Training**

No new skills are required for this iteration of the guideline – continued awareness of the risk of air embolism is needed amongst staff caring for people treated with haemodialysis.

#### 5. **Monitoring and Audit Criteria**

Key Performance Indicator	Method of Assessment	Frequency	Lead
The number of clinical incident forms relating to air embolism associated with central venous catheter for haemodialysis or haemodialysis treatment.	Review of clinical incident forms.	Yearly	Richard Baines

#### 6. **Legal Liability Guideline Statement**

See section 6.4 of the UHL Policy for Policies for details of the Trust Legal Liability statement for Guidance documents

## 7. Supporting Documents and Key References

Handbook of Dialysis - 2nd Edition. Daugirdas J, Ing T (1994)

<http://www.emedicine.com/emerg/topic787.htm> Conrad SA. Venous air embolism. Accessed 22 Nov 2003

<http://www.utdol.com/application/topic.asp?file=vascular/7351&type=&selected Title=1~16>. Air embolism. O'Dowd LC, Kelley MA. Accessed 6 Jan 2004

## 8. Key Words

Haemodialysis; Air Embolism; Central venous catheters

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<b>Author / Lead Officer:</b>	Martin Gerrish Graham Warwick Richard Baines		<b>Title:</b> Senior Nurse Consultant Nephrologist Consultant Nephrologist
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