

# Troubleshooting a Patient with a Chest Drain. A Simulation Workshop

## Outline

This is a simulation session that aims to improve skills at assessing a patient with a chest drain. It is undertaken using a patient manikin plus the SuperAnnie chest drain simulator. The workshop runs with two scenarios, one where the patient is breathing spontaneously the other with IPPV. There are nine episodes altogether demonstrating different pathologies.

## Learning Objectives

- To understand the biomechanics and pathophysiology of the patient with a chest drain.
- To utilise a thorough approach to assessing a patient with a chest drain.
- To recognise the common problems with chest drains.
- To develop a comprehensive problem solving strategy for chest drains.

## Equipment Required

A manikin is used to allow the student to examine the patient and recognise relevant findings. The manikin will demonstrate chest movement, breath sounds and pulse oximetry. When breathing spontaneously the respiratory rate of the manikin is set to 12 to synchronise with the fixed rate of SuperAnnie. When IPPV is used, a Y piece connector is placed in the manikin ventilation circuit and connected to the endotracheal tube in SuperAnnie.

SuperAnnie, placed under the manikin bed, simulates the action of the patient's pneumothorax. It is a troubleshooting and insertion chest drain skills trainer available from [www.simcentral.com.au](http://www.simcentral.com.au).

A chest drain system is connected by an extension tube from SuperAnnie running through the manikin out through a dressing in the left axilla and down to an underwater sealed drain bottle.

Patient notes with the history and clinical progress [see below]

Additional results of investigations such as CXR and ABG may be provided

A draft systematic chest drain checklist is included below.

## Preparation of the Simulator

SuperAnnie is placed below the manikin and tubing used to connect its chest drain outlet with a chest tube running under the skin and coming out of the manikin. The drainage system is connected to controlled suction.

# SCENARIOS

Two versions of the scenarios can be run: with the patient breathing spontaneously or having positive pressure ventilation.

## **Introductory Briefing for Scenario A – patient on ventilator**

“Today you will assess a patient that has a chest drain. Our focus is on deciding if there is a problem with its function and developing a plan of management.

The patient has been admitted after an MVA yesterday. They had a chest drain placed in the Emergency Department and were intubated for hypoventilation. They were seen by the RMO this morning and the Progress Notes are here for you. The nurse has asked you to review the patient because they are not sure the chest drain is working properly.”

With this scenario you can run the episodes detailed below:

- Episode 1 Normal Drain - Small Air Leak
- Episode 2 Normal Drain - No Air Leak
- Episode 3 Blocked Chest Tube
- Episode 4 Blocked Drain System Connector
- Episode 5 Blocked Suction Tubing
- Episode 6 Leak in Drainage System
- Episode 7 Large Air Leak
- Episode 8 No Underwater Seal - IPPV

## **Introductory Briefing for Scenario B – patient breathing spontaneously**

“Today you will assess a patient that has a chest drain. Our focus is on deciding if there is a problem with its function and developing a plan of management.

The patient has been admitted after an MVA 4 days ago. They had a chest drain placed in the Emergency Department and were ventilated in ICU for 36 hours. They were transferred to HDU last night after extubation. They were seen by the RMO this morning and the Progress Notes are here for you. The nurse has asked you to review the patient because they are not sure the chest drain is working properly.”

With this scenario you can run the episodes detailed below:

- Episode 1 Normal Drain - Small Air Leak
- Episode 2 Normal Drain - No Air Leak
- Episode 3 Blocked Chest Tube
- Episode 4 Blocked Drain System Connector
- Episode 5 Blocked Suction Tubing
- Episode 6 Leak in Drainage System
- Episode 7 Large Air Leak
- Episode 9 No underwater seal – Spontaneous Breathing

# INTENSIVE CARE UNIT - PATIENT HISTORY SHEET

0830hrs ICU Daily Review Day 2 :-

## History :

46 year old male. Admitted via ED at 1900 yesterday. Front passenger in MVA. Left-side impact by another car at 30kph. Seatbelt in situ. No airbag. No entrapment. Both drivers unhurt. In ED complained of left-sided chest pain and shortness of breath. SpO2 89% on 15l/min O2. CXR showed small flail segment and haemopneumothorax. Chest drain inserted. Small amount of blood and air. SpO2 improved but remained tachypnoeic and complaining of severe pain. No other significant injuries on secondary survey. IV morphine relieved pain but resulted in hypoventilation so intubated.

Previous Medical History: Smoker 10cpd. No significant PMH.

Allergies: NKDA

## Progress :

Respiratory : Stable overnight with good gas exchange

SpO2 – 97% SIMV PS 10 with PEEP 5. FiO2 35%

Chest – Good AE throughout. Scattered coarse creps.

Chest drain - Secure. Insertion site OK. Swinging and some bubbling. Attached to suction at 20mmHg.

CXR at 0800 today showed residual small pneumothorax but good lung expansion.

CVS : Stable. Pulse – 80 BP - 136/66

Warm and well-perfused. Hb 105

Renal : UO 180ml/hr. Maintenance fluid @125ml/hr

Na 142, K 3.8, Ur 12, Creat 56

GI : Abdo – Soft. Bowel sounds normal.

Neuro : No LOC, GCS 15. No focal signs. C-spine films normal.

C-spine clinically OK but collar remains in situ due to distracting injuries. Morphine and midazolam infusion.

Micro : No antibiotics at present. Apyrexial. Sputum cultures sent

## Plan :

Paravertebral catheter for analgesia, wean from ventilator and extubate.

John Smith RMO2 [#678]

# HIGH DEPENDENCY UNIT - PATIENT HISTORY SHEET

2230hrs HDU Daily Review Day 3 :-

## History :

46 year old male. Admitted via ED at 1900 yesterday. Front passenger in MVA. Left-side impact by another car at 30kph. Seatbelt in situ. No airbag. No entrapment. Both drivers unhurt. In ED complained of left-sided chest pain and shortness of breath. T, SpO2 89% on 15l/min O2. CXR showed small flail segment and haemopneumothorax. Chest drain inserted. Small amount of blood and air. SpO2 improved but remained tachypnoeic and complaining of severe pain. No other significant injuries on secondary survey. Initially ventilated for 36 hours in ICU. Transferred to HDU for analgesia and physiotherapy.

Previous Medical History: Smoker 10cpd. No significant PMH.

Allergies: NKDA

## Progress :

Respiratory : Stable overnight with good gas exchange

SpO2 – 97% on a Hudson mask

Chest – Good AE throughout. Scattered coarse creps.

Chest drain - Secure. Insertion site OK. Swinging and some bubbling. Attached to suction at 20mmHg.

CXR at 0800 today shows residual small pneumothorax but good lung expansion.

CVS : Cardiovascularly stable. Pulse – 80 BP - 136/66

Warm and well-perfused. Hb 105

Renal : UO 180ml/hr. Maintenance fluid @125ml/hr

Na 142, K 3.8, Ur 12, Creat 56

GI : Abdo – Soft. Bowel sounds normal.

Neuro : No LOC, GCS 15. No focal signs. C-spine films normal.

C-spine clinically OK but collar remains in situ due to distracting injuries.

Micro : No antibiotics at present. Apyrexial. Sputum cultures sent

## Plan :

Maintain Fentanyl PCA.

Encourage deep breathing and coughing

Robert Brown RMO2 [#345]

# EPISODES

## **Episode 1: Normal Drain - Small Air Leak**

Manikin settings  
No pneumothorax  
Chest movement & breath sounds normal both sides  
Saturation 95%

SuperAnnie set to air in drain swinging with small air leak

Debriefing  
This normally functioning drain needs no intervention.

## **Episode 2: Normal Drain - No Air Leak**

Manikin settings  
No pneumothorax  
Chest movement & breath sounds normal both sides  
Saturation 95%

SuperAnnie set to air in drain swinging with no air leak

Debriefing  
This normally functioning drain needs no intervention.

## **Episode 3: Blocked Chest Tube**

Manikin settings  
Pneumothorax on  
Chest movement & breath sounds diminished on left side  
Saturation 85%

SuperAnnie set to air in drain not swinging not bubbling [clamped between SuperAnnie and manikin].

Debriefing  
This chest tube needs to be replaced as it is not working and the pneumothorax has reoccurred. CXR may reveal that the tube is kinked, subcutaneous or in a fissure between the lobes. It is important to exclude a blocked drain system [Episode 4] from this problem, as the management is different.

## **Episode 4: Blocked Drain System Connector**

Manikin settings  
Pneumothorax on  
Chest movement & breath sounds diminished on left side  
Saturation 85%

SuperAnnie set to air in drain swinging with small air leak. Blocked connector inserted between chest tube and drainage tubing

### **Debriefing**

The chest drain set needs to be replaced, as it is not working and the pneumothorax has reoccurred. It is important to differentiate a blocked chest tube [Episode 3] from this problem, as the management is different.

## **Episode 5: Blocked Suction Tubing**

Manikin settings  
No pneumothorax  
Chest movement & breath sounds normal both sides  
Saturation 95%

SuperAnnie set to air in drain swinging with large air leak

### **Debriefing**

If the suction system is blocked it will prevent the drainage system from functioning unless there is a pressure relief valve incorporated into the system. If there is no pressure relief valve then the system will behave like Episode 4 and a pneumothorax will reaccumulate.

It is also worth discussing the importance of low pressure suction at this point. If high suction is connected when there is no suction controller built into the bottle then high negative pressures will be transmitted to the pleural cavity with potential injury to the patient.

## **Episode 6: Leaking Drain System Connector**

Manikin settings  
Pneumothorax on  
Chest movement & breath sounds diminished on left side  
Saturation 85%

SuperAnnie set to air in drain swinging with small air leak. Connector with hole in it inserted between chest tube and drainage tubing

### **Debriefing**

The leak in the chest drain set needs to be identified and repaired, as it is not working and the pneumothorax has reoccurred. It is important to check connections that are taped together are in fact gas tight. An easy check is to clamp the chest tube for a few seconds while the system is on suction. If the bubbling continues then there must be a leak downstream.

## **Episode 7: Large Air Leak**

Manikin settings  
Pneumothorax on  
Chest movement & breath sounds diminished on left side  
Saturation 85%

SuperAnnie set to large air leak

Debriefing

A second chest drain needs to be placed as the current chest tube is functioning but is not adequately draining the leak. This is very unusual for a spontaneously breathing patient. It would be seen more commonly during IPPV.

## **Episode 8: No water in Drainage System [IPPV]**

Manikin settings  
No pneumothorax  
Chest movement & breath sounds normal both sides  
Saturation 95%

SuperAnnie set to air in drain swinging small air leak. No water in drain bottle.

Debriefing

Without the underwater seal the drain will not function. If the patient is breathing spontaneously the lung will collapse. If the patient is being positive pressure ventilated the lung will not collapse.

## **Episode 9: No water in Drainage System [Spontaneous Ventilation only]**

Manikin settings  
Pneumothorax on  
Chest movement & breath sounds diminished on left side  
Saturation 85%

SuperAnnie set to air in drain swinging small air leak. No water in drain bottle.

Debriefing

Without the underwater seal the drain will not function. If the patient is breathing spontaneously the lung will collapse. If the patient is being positive pressure ventilated the lung will not collapse.