UCSF MEDICAL CENTER
DEPARTMENT OF NURSING
NURSING PROCEDURES MANUAL

CHEST TUBES (NEONATAL/PEDIATRIC)

PURPOSE

Chest tubes in neonatal and pediatric patients use either gravity or suction to evacuate air and/or fluid from the chest cavity, and prevent return flow back into the chest. Chest tube (CT) treatment results in re-expansion of the lung, restoration of negative pressure to the pleural space, and improvement of ventilation and perfusion in the lung. Normally negative pressure in the intrapleural space keeps the lungs expanded. If air or fluid enters the intrapleural space, it may displace or collapse the lung, interfering with normal respiration. Air or fluid in the mediastinal space can exert pressure on tracheal tissue and lung tissue, impeding ventilation.

- To drain air from the pleural cavity, the CT tip is usually placed anteriorly near the lung's apex. As long as air remains in the intrathoracic space, there will be bubbling in the water seal chamber of the chest drainage system.
- To drain fluid, a **pleural** CT is placed laterally and near the base. In postoperative cardiac surgery patients, the **mediastinal** CT is usually used to drain blood and fluid from the mediastinum and /or pleural space.
- After a pneumonectomy, if a CT is in place, it is NEVER attached to suction; it may be connected to a gravity drainage/water seal collection system and/or it may be clamped for several days to allow the cavity to fill with fluid and form adhesions.

Chest tubes may be inserted at the bedside or treatment room, using local anesthetic and analgesia, or in the OR under anesthesia.

Registered nurses (RN) are responsible for monitoring and caring for CTs and drainage systems and assisting the provider with placement and removal of CTs.

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CRITICAL POINTS

A. Keep a rubber-tipped or plastic hemostat at the bedside at all times. In an emergency if the CT becomes disconnected from connecting tube of chest drainage system, the CT can be clamped off nearest to chest insertion site.

B. Provider order must be obtained to change the CT from suction to water seal for any reason (e.g., ambulation).

C. DO NOT clamp CTs (except: in an emergency; during removal; or to change the chest drainage collection system). If a provider orders the CT clamped, clarify rationale.

D. Never clamp or cap off the suction connection port or tubing.

E. If the patient is ≥ 18 years old or covered by an adult service, refer to Chest Tubes (Adult)

F. Report drainage to provider immediately when output is greater than 10% of circulating blood volume. (Total circulating blood volume in infants is equal to a volume of approximately 80 mL/kg and in children approximately 70 mL/kg).

G. Pain caused by the CT should be assessed and managed as appropriate with pharmacologic and/or non-pharmacologic interventions.

H. Monitor respiratory status. If patient demonstrates signs of respiratory distress (e.g., significant change in breath sounds, respiratory rate, work of breathing, or chest wall movement), or swelling indicative of subcutaneous emphysema, a clinical evaluation and chest x-ray should be obtained immediately as ordered by the provider.

EQUIPMENT / SUPPLIES

I. SETUP AND INSERTION SUPPLIES

A. Pediatric tray/Pediatric cut down tray (check for provider preference)

B. Additional supplies:

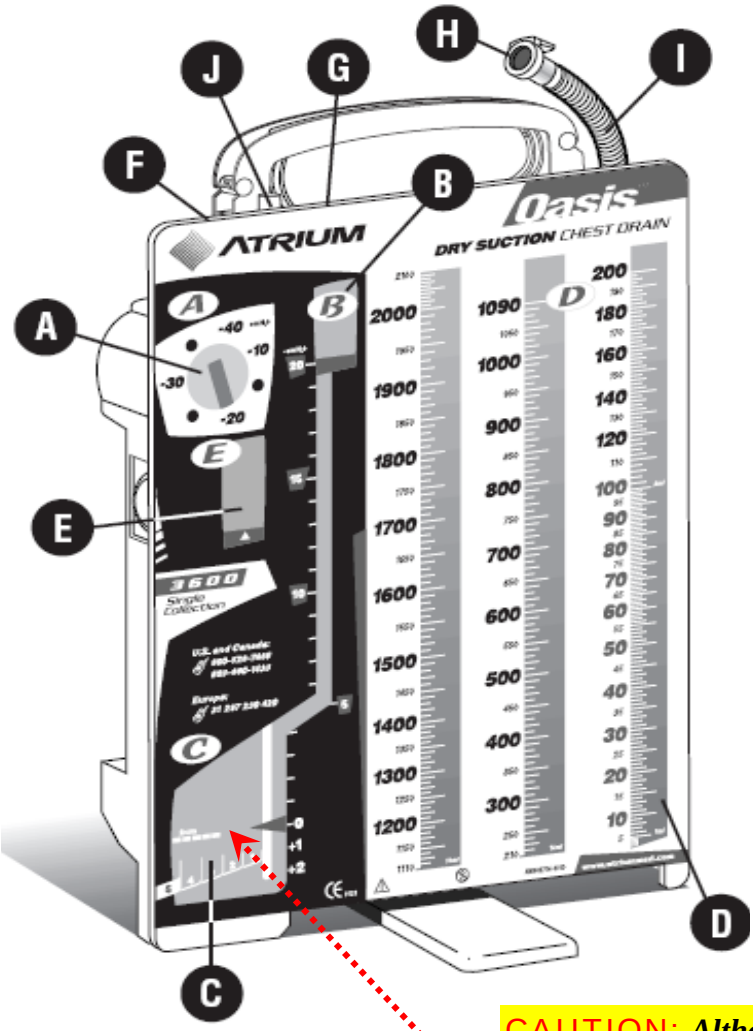
- Local anesthetic
- Antiseptic [e.g., Povidone-iodine or Chloraprep (2% chlorhexidine/70% isopropyl alcohol)]
- 2 × 2 IV sponge dressings
  Sterile gloves
- Dressing: dry gauze and occlusive dressing OR Bordered Gauze Dressing Skin Barrier
- Petroleum gauze (not required for CT Surgery Patients)
- Sterile towels, gown, hat, and mask
- Appropriate size chest tube
- Chest drainage collection system - Atrium Oasis 3600 (Figure 1)
- Sterile distilled water (included with drain system)
- 5-in-1 connector (included with drain system)
- Suction tubing
- Wall suction regulator
- Analgesia and sedation if necessary

II. SUPPLIES FOR REMOVAL

- Petroleum gauze
- Sterile gauze pads

CHEST TUBES (NEONATAL/PEDIATRIC) *(continued)*

- Occlusive dressing
- Sterile gloves
- Sterile scissors
- Protective wear (gloves, goggles, gown and/or mask) for standard precautions
- Red biohazard bag
- Analgesia and sedation as necessary



A Suction Control Regulator
B Water Seal Chamber
C Air Leak Monitor
D Collection Chamber
E Suction Monitor Bellows
F Positive Pressure Release Valve
G Manual High Negativity Vent
H In-Line Connector
I Patient Tube(s)
J Suction Port

Figure 1.
Atrium Oasis 3600

CAUTION: ***Although this chest drain system is labeled "Dry Suction Chest Drain" (see right upper corner of chest drain), this chamber MUST always have water at exactly the 2 cm mark.***

PROCEDURE FOR CT CONNECTED TO OASIS™ 3600 (ATRIUM) DRY SUCTION CHEST DRAINAGE SYSTEM

I. SETUP AND INSERTION

A. Gather required equipment listed in Equipment / Supplies section I.

B. Notify Child Life for procedural support as indicated.

C. Ensure patient and family understand the procedure.

D. Open packaged chest drainage system. Turn floor stand to open position. Then:

- **Fill water seal chamber with pre-packaged sterile water to the 2 cm mark through the suction port on top of drain.**
- Use 45 mL sterile saline or sterile water if pre-packaged sterile water is not included with the chest drainage system.

E. Premedicate patient with analgesics and/or sedatives as indicated and ordered. For neonates, restrain limbs as appropriate.

F. Remove any ECG electrodes from areas to be prepped and x-rayed (post-insertion).

G. Perform hand hygiene and don protective gear.

H. Place patient supine with affected side slightly up as directed by provider.

I. CT is inserted under sterile conditions by provider and is sutured in place.

J. Once CT is placed, remove cap from end of the connection tubing and sterilely attach it to end of CT.

- ***If suction is ordered***:
  1. Adjust dial on "dry suction control" to the prescribed amount of suction. For infants and pediatric patients, the typical setting is between -10 to -20 cmH_2O.
  2. Connect suction tubing from suction port to suction source.
  3. Turn suction source on and increase until **orange bellows** is expanded at least to the ▲ mark for settings of -20 cmH_2O and greater (requires minimum vacuum pressure of -80 mmHg at 20 L/min air flow). For suction levels less than -20cm H_2O, any expansion of bellows indicates adequate suction operation.
- ***If suction is not applied***: ensure the suction port is not capped or covered and tubing is not clamped.

K. Secure closed chest drainage system below chest level and secure drainage system and connection points in the tubing.

L. Using aseptic technique, provider or RN dresses insertion site:

- Apply petroleum gauze if pleural CT is placed. (Note – petroleum gauze not required for CT surgery patients.)
- Apply 2x2 IV sponge dressing and then apply occlusive dressing over 2×2 OR place bordered gauze dressing over petroleum gauze.

M. If additional securement is required, apply skin barrier onto thorax, posterior to CT insertion site. Tape CT to thorax, beyond dressing, and make a tension anchor with tape onto the skin barrier.

N. Obtain chest x-ray results and assess patient after procedure.

O. Observe initial drainage into the closed connection system.

P. Dispose equipment and perform hand hygiene.

II. MANAGEMENT OF OASIS™ (ATRIUM) DRY SUCTION CHEST DRAINAGE SYSTEM (3600)

A. Drainage Collection Chamber

1. Observe and document amount, color, and consistency of contents in CT drainage column immediately and routinely thereafter; frequency will depend on amount of drainage and acuity of patient.
   - Mark container to right of volume marker with time and date of each measurement.
2. If there is abrupt decrease in amount of drainage, assess CT and drain tubing for clots and observe patient for signs of respiratory distress or decreased cardiac output. Notify provider.
3. If drainage fills the entire drainage collection chamber, change drainage system as follows:
   a. Set up a new drainage system as described in Set-Up and Insertion.
      - Clamp latex tubing connected to CT.

      Or
      - With patients on positive pressure ventilation, do not clamp CT.
   b. Quickly disconnect tubing from chest drain at the in-line connector junction and reconnect to new chest drain *(discard **connector tubing** of new chest drain).*
   c. Maintain sterility at connection sites.
   d. Release clamp (if present) and reconnect chest drain to suction (if indicated).
4. Obtaining a drainage specimen:
   a. Scrub needleless luer portion of patient in-line connector with alcohol for 10-15 seconds and allow to dry.
   b. Attach a syringe (no needle), and aspirate desired volume.

B. Water Seal Chamber

1. Water seal:
   - Functions as a one-way valve
   - Measures negativity
   - Indicates degree of air leak
   - *Tidaling*, or fluctuation of the water level; observe (right side of water chamber):
     - *Non-mechanically ventilated* patient: water level rises on inspiration and falls in expiration. Fluctuation is accentuated when respiration generates large negative intrapleural pressures, as in coughing, atelectasis, or upper airway obstruction.
     - Patient on *positive pressure ventilation*: fluctuation is reversed. It falls on inspiration and rises on expiration. (Normal fluctuation is 2 to 6 cm.)
     - Tidaling may not be seen when suction is in use, the lung is expanded, or tubing is kinked or blocked.
2. Evaporation: In the presence of a large patient air leak, water may evaporate in the water seal requiring replacement to ensure desired amount of negative pressure is maintained.
   a. Assess fluid level: momentarily pinch suction tubing and observe if water level is at the 2 cm mark.
   b. Check water level daily. Refill as needed with sterile water:

- To refill: stop suction. Using a syringe and 20 g needle or smaller inject sterile water via grey grommet on backside of drain to the 2 cm mark. Restart suction.

3. Placement of CT to water seal:
   a. Disconnect suction tubing from suction port.
   b. Leave suction port open to air: **DO NOT cover** with gauze or cap. Air must be allowed to escape freely from patient.

4. ***Patient*** air leak: assessment for and interventions
   a. Bubbling in the air leak monitor section (of water chamber) indicates an air leak. Monitor bubbling by observing chambers 1 (low) to 5 (high) of the water seal fluid.
   b. If bubbling stops when CT is clamped momentarily near patient's chest, the leak is either in the patient or around the chest tube.
      - Remove clamp and apply pressure to the skin at CT site.
        - If bubbling stops when pressure is applied, the leak is around the CT. Apply a sterile occlusive dressing with petroleum gauze around CT insertion site.
        - If bubbling continues and increases in intensity, leak is **from patient's chest**. Notify provider if this is a new finding.
   c. Note: Patients returning from OR with delayed sternal closure (open chest) will have an air leak.
      - If patient has a known persistent air leak and water seal bubbling suddenly stops, examine system for obstructions. Note: Bubbling may also cease if lung is fully expanded. (Expansion can be assessed by auscultation and confirmed by chest x-ray.)
      - If patient has an air leak and becomes disconnected from drainage system, DO NOT CLAMP THE TUBES. Reconnect patient immediately to chest drainage collection and notify provider as soon as possible. If it is not possible to reconnect to the drainage system, place end of CT in a container of sterile water to create a water seal.
      - If you suspect an air leak, do not disconnect suction.

5. ***Drainage system*** air leak: assessment and interventions
   a. If bubbling in the water seal chamber continues while the tubing is clamped momentarily near patient's chest, the source of the leak is the connection directly above the clamp. Find section where leak is located. Start at chest wall and clamp tubing above succeeding connections until bubbling stops; source of the leak is the connection directly above the clamp.
   b. Check and ensure all connections are secure and taped.
   c. If air leak is due to a hole in the tubing of the drainage system: set up and switch to a new system; notify provider; complete an incident report; and send defective system or tubing to Materiel Services.
   d. If defect is in the CT: notify provider, complete an incident report, and send faulty tube to Material Services after removal from patient.

6. High negativity release valve and negativity in patient's pleural space
   a. As negativity increases, the water level rises in the water seal chamber. At 20 cm, the ball valve rises in the chamber.
   b. Water level may rise past the ball but the chamber is designed to automatically vent excess negative pressure.

c. Factors that may increase negativity include: respiratory distress, coughing, crying, stripping/milking CT, or autotransfusion via continuous infusion from collection chamber.

d. Calculate patient's pleural space negativity: add the imposed suction (the dialed setting, e.g. -20 cm H_20) to the reading indicated by the water level in the water seal chamber. For example: dialed setting is -20 cmH_20, water level is -5 cmH_20, thus the total patient negativity is -25 cmH_20.

e. If needed, the high negativity release valve (white button on top inside edge of drain above water seal column) allows manual venting of excess negative pressure. (**Do not use unless ordered by attending physician or fellow).**

- To lower the height of the water seal column or to lower patient pressure when connected to suction, depress high negativity release valve until ball valve (in water column) releases and water column returns to desired level.
- **Do not use manual high negativity release valve to lower water seal column when suction is not operating or when patient is on gravity drainage**.

7. Positive pressure protection

a. Positive pressure valve (located directly above suction control dial on top left inside corner) automatically vents that chamber if positive pressure is created by blocked or occluded tubing.

b. Do not obstruct the positive pressure valve.

C. **Suction Control Chamber**

1. The amount of suction is determined by the setting of the suction control dial (typically -10 to -20 cm H_2O in infants and pediatric patients).
2. Ensure orange bellow expands to at least the ▲ mark to ensure adequate suction. **For suction levels less than -20cm H_2O, any expansion of bellows indicates adequate suction operation**. Increase wall suction until orange float reaches ▲ or beyond. Visualizing the float as described indicates the negative pressure exerted is the degree of suction set by the regulator dial.
3. To increase suction level (more negative pressure) ***(****requires provider order****):***
   a. Adjust suction regulator dial (on front of drain) to a higher negative number.
   b. Adjust suction *source*. When orange bellow in the window expands to ▲ or beyond, the suction imposed is the same as the selected setting.
4. To decrease suction level follow these two-steps *(requires provider order)**:***
   a. Dial suction regulator on drain to a lower setting (lower negative number). Orange bellow may contract to less than the ▲.
   b. Depress high negativity release valve until water level goes down to zero.

III. MANAGEMENT OF CHEST TUBES & TROUBLESHOOTING

A. Clot formation

1. Gently pinch tubing around clot and gingerly milk fluid to move it into the collection chamber; repeat as necessary. Unless absolutely necessary, do not strip tubing because this creates high negative pressure and can damage lung tissue.

- Note: Mediastinal tubes in postoperative cardiac surgery patients may be stripped by RNs trained in the procedure as indicated for acute cessation of fluid drainage and/or signs of cardiac tamponade.

2. If clot or obstruction persists following milking, and previous drainage was more than 3-5 mL/kg/hr, notify provider immediately and continue to attempt to re-open tube using milking.
3. Turn patient and if awake and not intubated, encourage coughing and deep breathing to promote drainage and prevent pooling.
4. Observe for signs of mediastinal shift due to intrapleural fluid accumulation or cardiac tamponade including: weak pulse, tachycardia, signs of shock, tracheal deviation, or decreased breath sounds on same side as CT insertion. If evident, notify provider immediately. Access CT for patency and, if necessary, milk tubes to re-establish drainage.

B. Cessation of gravity flow

1. Always keep chest drain and drainage system lower than patient's chest and free of dependent loops or kinks. If hung on bed, it is recommended to display a sign warning others to refrain from lowering bed onto the chest drain.
2. During transport maintain chest drain lower than patient's chest.

C. Foaming into suction connecting tubing and suction source regulator

1. A large pleural air leak combined with 1-2 full collection chambers will create a foaming effect.
2. Nothing can decrease the foaming effect except to siphon foam off and keep suction source regulator clean:
   a. Connect suction connector tubing to "patient" port of a collection canister.
   b. Connect suction connector tubing from "vacuum" port of collection canister to suction source regulator.

D. Dislodged CTs

1. DO NOT PUSH CT BACK INTO PATIENT.
2. If patient does NOT have an air leak, to prevent air from being sucked into the pleural cavity, immediately: apply petroleum gauze dressing and notify provider.
3. If patient DOES have an air leak, apply a dressing with your hand, releasing it periodically or at any sign of respiratory distress, so pleural air can escape. Notify provider immediately.
4. If CT is not completely dislodged, but slips out slightly to expose an air hole in the tube, apply petroleum gauze over the hole and notify provider. Do not disconnect CT from suction.

E. Autotransfusion: refer to nursing procedure Chest Tubes (Adult)

IV. CHEST TUBE IRRIGATION

A. **Pediatrics – irrigation only done by physicians.**

B. Refer to Chest Tubes (Adult) Section VI Irrigation.

V. PATIENT ASSESSMENT & CARE

C. Assess for pain as indicated and treat accordingly. As the rib cage is significantly innervated, patients may have significant pain from pleural CTs.

D. Document number and placement of CTs immediately following initial insertion.

E. Ensure clamps are present at bedside.

F. Verify all connections and joints are secure at beginning of each shift..

G. Ensure drainage tubing has a straight flow to drainage collection device and does not have any dependent loops or kinks.

H. Monitor and document type and amount of drainage (e.g., bloody, serous, serosanguinous, milky). Notify provider of change in color or character from expected type of drainage.

I. Observe drainage for purulence and notify provider if present.

J. Every shift assess and document patient's cardio-respiratory status and pattern, and chest auscultation findings.

K. Observe for fine crackling under the skin (subcutaneous emphysema) by palpating either the right side of the neck (often indicative of spontaneous pneumothorax) or the area surrounding the CT insertion site. Report finding, if present.

J. Perform dressing/site care.

1. Assess and record condition of dressing immediately following insertion and every shift thereafter.
2. Change dressing per unit-based frequency:
   - Pediatric critical care units: every 48 hours.
   - Acute care units: routinely twice per week.
   - ICN: prn when dressing becomes wet, dirty, loose, or saturated with discharge.
3. Follow these site care and dressing application steps:
   a. Gather supplies: sterile gloves; sterile saline; petroleum gauze (for pleural CT); 2×2 IV sponge dressing (pre-slit) and occlusive dressing OR bordered gauze dressing. (Note: petroleum gauze not required for CT Surgery patients.)
   b. Perform hand hygiene. Don unsterile gloves. Remove old dressing. Assess and record condition of skin around insertion site. If site is red, tender, or exudate present, notify provider. Assess for any subcutaneous air around insertion site. If present, notify provider.
   c. Perform hand hygiene. Don sterile gloves. Cleanse site with sterile saline, using sterile technique.
   d. Apply new dressing (in same manner as old one) using sterile technique as directed in Section I.L.

K. Monitor for signs/symptoms of infection (e.g., elevated temperature, elevated WBC, cellulitis, increased heart rate).

L. Provide daily range of motion exercises as tolerated. Include joint rotation to arm and shoulder of affected side.

M. Obtain provider order (required) to ambulate on water seal.

VI REMOVAL OF CHEST TUBE

A. Gather equipment listed in CT Removal Supplies.

B. Administer analgesics. If oral pain medication given, wait 30 minutes; if intravenous, wait 5 minutes before CT is removed.

CHEST TUBES (NEONATAL/PEDIATRIC) *(continued)*

C. Remove suction before any CT is discontinued. After provider unties sutures from around the CT–
   - Non-intubated infants and pediatric patients with pleural chest tubes: expect CT to be pulled out at end of expiration.
   - Intubated infants and children with pleural chest tubes: place on CPAP bag and hold inspiratory phase while CT is removed. (This is not required for mediastinal CTs).

D. Assist provider, as needed, with removing CT (following standard precautions):
   1. Pinch skin around CT as it is being pulled.
   2. Pinch insertion site shut just as tube tip exits skin.
   3. Hold insertion site shut (until provider has tied the skin suture, if present).

E. Dress insertion site with a sterile, occlusive dressing. The standard is a petroleum gauze covered with a sterile 2×2 gauze dressing and Tegaderm or boardered gauze dressing, taped securely and snuggly.

F. Provider may order a chest x-ray.

G. Assess chest after tube removal. Document and notify provider of any changes from prior assessment (with chest tube in place).

H. Dispose of chest drainage system and chest tube:
   1. Clamp any tubing from which leakage might occur.
   2. Place in red biohazard bag and tie securely.
   3. Place in Biohazard Waste bin.

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CHEST TUBES (NEONATAL/PEDIATRIC) *(continued)*

◆◆◆◆◆◆◆PROCEDURE HISTORY◆◆◆◆◆◆◆

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APPENDIX A: OASIS SET UP - QUICK VIEW INSTRUCTIONS

Step 1. Fill Water Seal to 2cm Line - Add 45ml of sterile water or sterile saline via the suction port located on top of the drain. For models available with sterile fluid, twist top off bottle and insert tip into suction port. Squeeze contents into water seal until fluid reaches 2cm fill line.

Step 2. Connect Patient Tube to Patient - Connect chest drain to patient prior to initiating suction.

Step 3. Connect Suction to Chest Drain - Attach suction line to suction port on top of chest drain.

Step 4. Turn Suction Source On - Increase suction source vacuum to 80mmHg or higher. Suction regulator is preset to -20cmH_2O. Adjust as required.

APPENDIX B: GUIDE FOR WHAT TO CHECK DURING SYSTEM OPERATION

■ Verifying Suction Operation Via The Suction Monitor Bellows

The bellows located in the suction monitor will expand only when suction is operating. The monitor bellows will not expand when suction is not operating or disconnected. The calibrated ~ mark allows quick and easy confirmation of vacuum operation over a wide range of continuously adjustable suction control settings.

■ Changing Suction Pressures

Suction regulator is preset to -20cmH_2O and can be adjusted from -1 0cmH_2O to -40cmH_2O. To change suction setting, adjust rotary suction regulator dial located on the side of the drain. Dial down to lower suction pressure and dial up to increase suction pressure.

To lower regulator setting from a higher level (-40cmH_2O) to a lower level (-20cmH_2O), adjust regulator down to lower setting and then temporarily depress the manual high negativity vent located on top of the drain to reduce excess vacuum.

Bellows must be expanded to ~ mark or beyond for a –20cmH_2O or higher regulator setting.

■ Placement Of Unit

Always place chest drain below the patient's chest in an upright position. To avoid accidental knockover hang the system bedside with the hangers provided.

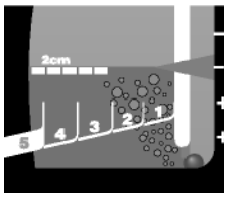
■ Verifying Water Seal Operation

The water seal must be filled and maintained at the 2cm level to ensure proper operation and should be checked regularly when used for extended periods. As required, additional water may be added by a 20 gauge or smaller needle and syringe via the grommet located on the back. Fill to the 2cm line.

■ Recording Drainage Volume

The collection chamber incorporates a writing surface with easy-to-read fluid level graduations. Please refer to individual product inserts for specific model calibrations.

■ Observing Water Seal For Patient Air Leaks



Atrium offers superior air leak detection with rapid air leak assessment and improved visibility due to the tinted water. When air bubbles are observed going from *right to left* in the air leak monitor, this will confirm a patient air leak. Continuous bubbling in the bottom of the water seal air leak monitor will confirm a persistent air leak. Intermittent bubbling in the air leak monitor with float ball oscillation will confirm the presence of an intermit-tent air leak.

No bubbling with minimal float ball oscillation at bottom of the water seal will indicate no air leak is present.

■ Graduated Air Leak Monitor

For those models with a graduated air leak monitor, air leak bubbling can range from 1 (low) to 5 (high). Air bubbles create an easy to follow air leak pattern for monitoring patient air leak trends.

■ Manual High Negativity Vent

To manually vent the system of high negative pressure, depress the filtered manual vent located on top of the drain until bubbling occurs in the air leak monitor.

Do not use manual vent when suction is not operating or when the patient is on gravity drainage.

■ Observing Calibrated Water Seal Column For Changes In Patient Pressure

Patient pressure can be deter-mined by observing the level of the blue water and small float ball in the calibrated water seal column. With suction operating, patient pressure will equal the suction control setting plus the calibrated water seal column level. For gravity drainage (no suction) patient pressure will equal the calibrated water seal column level only.

CHEST TUBES (NEONATAL/PEDIATRIC) *(continued)*

- High Negativity Float Valve

Atrium's high negativity float valve, with its controlled release action, enables any thoracic patient to draw as much intrathoracic pressure as is required during each respiratory cycle. During prolonged episodes of extreme negative pressure, Atrium's controlled release system will automatically relieve excess vacuum to a lower, more desirable pressure level.

- Positive Pressure Protection

Atrium's positive pressure valve, located on top of drain, opens instantly to release accumulated positive pressure. *Do not obstruct the positive pressure valve.*

- Sampling Patient Drainage

Taking samples of patient drainage must be in accordance with approved hospital infection control standards. Fluid samples can be taken directly from the patient tube by forming a temporary dependent loop and inserting a 20 gauge or smaller needle at an oblique angle. *Do not puncture patient tube with an 18 gauge or larger needle.*

- System Disconnection

For models equipped with an in-line connector, ***close the patient tube slide clamp prior to disconnecting*** the chest drain patient tube from patient. Clamp off all indwelling thoracic catheters prior to disconnecting chest drain from patient.

APPENDIX C: TROUBLESHOOTING & FREQUENTLY ASKED QUESTIONS

Q What if the patient pulls out his pleural or mediastinal chest tube?

A Actions depend on whether there is a known air leak or not.

- If there is ***no air leak***: apply an occlusive dressing (petroleum gauze) and notify the doctor, who will decide if the tube should be replaced.
- If there ***is an air leak***: apply a dressing with your hand, but release it periodically or at any sign of respiratory distress, so pleural air can escape. Notify the doctor immediately so tube can be replaced.

Q What if the chest tube gets accidentally disconnected from the Atrium?

A Immediately reconnect to the drainage system. If this is not possible **or** the connection is contaminated, the next action depends if there is a pleural leak.

- ***If no leak:*** clamp the chest tube close to the insertion site as soon as possible to prevent a pneumothorax from occurring. Expedite changing the drainage system or reattaching the tube to the Atrium. Minimizing the time the tube is clamped (ideally no more than a minute or two) helps prevent a tension pneumothorax.
- ***If there is an air leak:*** place the end of the chest tube in a container of sterile water to create a water seal until ready to reattach to drainage system. Avoid clamping due to the greater risk of tension pneumothorax (air is unable to escape).

Q What if there is no drainage?

A If the patient's *condition is deteriorating*, follow the emergency procedures of milking/stripping to dislodge clots. Milking and Stripping CTs

If the patient's *condition is stable*, analyze the drainage system set-up and patient progress:

- Chest drainage system is low enough so gravity can assist drainage (raise bed or lower collection chamber)
- Turn patient on affected side and observe.
- Check tubing: any kinks or bends?
- Check taped connections: is the tape so tight it's partially occluding the tubing's lumen?
- Consider patient's condition and disease process: has drainage been tapering off the past few shifts? The lack of drainage may be expected.

Q What if the collection chamber is full?

A Replace the chest drainage system with a new one. Follow the directions included in the package or that are outlined in the Chest Tubes nursing procedure. Maintain sterility at the chest tube/drainage tube connection. Appendix A Oasis Set Up

Q What if the chest drainage system has been knocked over, can I use it and what should I do?

A After a chest drainage system has been knocked over, set it upright and immediately check the fluid level of the water seal for proper volume. The Oasis has knock-over nozzles that allow the water seal volume to be fully recovered in addition to reducing the incidence of interchamber spills. There is a convenient self-sealing diaphragm for access by a 20 gauge or smaller needle and syringe to adjust the water level in the water seal chamber, if required. The water level needs to be at the 2 cm line. Steps:

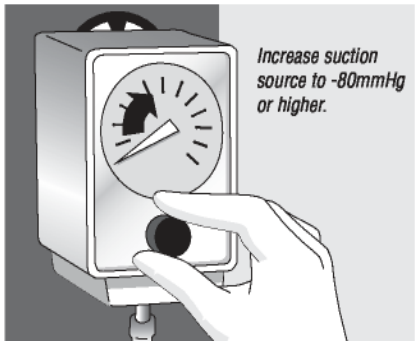
- Alcohol swab the needle access area and *aspirate any overfill* that may have occurred.
- If the water seal has an inadequate fluid level, simply *replace the lost volume* with sterile water.
- If a significant amount of *blood* has entered the water seal, it may be advisable to *change the system* for a new one.
- Mark the collection chamber with the new drainage level PRN, or change the system for accuracy of measurements.

Q What should I do when the suction monitor bellows is not expanded to the ▲mark when the regulator is set at -20cmH2O or higher?

A The position of the bellows across the suction monitor window will alert the operator that the suction source has fallen below the minimum operating range for the prescribed suction control setting. Simply increase the vacuum source to -80mmHg or higher. The suction monitor bellows must expand to the ▲mark or beyond for a -20cmH2O or higher suction regulator setting.

Not enough vacuum for -20cmH_2O or higher suction control setting.

Normal suction operation for -20cmH_2O or higher.



Q What should I do when the bellows does not fully expand to the ▲mark *after* I increase the suction source vacuum?

A Dry suction chest drains require higher levels of vacuum pressure and air flow from the suction source to operate efficiently at each suction control setting as compared to traditional water controlled operating systems.

- The suction source should provide a minimum vacuum pressure of -80mmHg at 20 liters of air flow per minute for chest drain operating efficiency at a suction control setting of -20cmH2O.
- The suction source should be greater than -80mmHg when multiple chest drains are connected to a single suction source.
- If the bellows does not fully expand to the ▲mark, it may simply be that the suction source is not functioning to its full potential to provide the minimum vacuum pressure or air flow required to "drive" the suction control regulator.
- Additionally, conditions may exist that can reduce, or "restrict" air flow from the suction source. A restrictive clamp, connector, or kink in the suction line tubing can potentially "starve" the chest drain of air flow. A leak in a connection or wall canister, along with extensive lengths of suction tubing can also reduce air flow to the unit.

To troubleshoot this situation:

- First check to be sure that all connections are air-tight.
- Inspect the suction tubing and connections for possible cracks, leaks, kinks, or occlusions.
- You may need to simply bypass a "leaky" wall canister. Try connecting the chest drain to a different suction source or wall regulator.
- When multiple chest drains are "Y" connected to a single suction source, if possible, reconnect the drains to separate suction sources.
- Finally, replace the chest drain if you suspect the unit is cracked or damaged.

Q Does the bellows need to expand beyond the ▲mark for a -10cmH2O regulator setting?

A No. For a regulator setting less than -20cmH2O suction (-10cmH2O), **any** observed bellows expansion across the monitor window will confirm suction operation. The bellows need not be expanded to the ▲ mark for suction pressures less than -20cmH2O, just visibly expanded to confirm suction operation.

Q How do I confirm my patient has an air leak when there is:

■ No bubbling in the water seal?

A *If there are no air bubbles observed going from right to left in the air leak monitor,* there is *no patient air leak.* In order to confirm that your patient's pleural chest catheter(s) are patent, temporarily turn suction off and check for oscillation of the patient pressure float ball in the water seal column coinciding with patient respiration. For mediastinal chest tubes there should be no movement of the water level and no bubbling.

■ **Bubbling present in the water seal?**

A Whenever *constant or intermittent bubbling* is present in the water seal *air leak monitor,* this will *confirm an air leak is present.* Oscillation of the patient pressure float ball at the bottom of the water seal *without bubbling will indicate no apparent air leak.* To determine the source of the air leak (patient or catheter connection):

- Momentarily clamp the patient tube close to the chest drain and observe the water seal. If bubbling stops, the air leak may be from the catheter connections or the patient's chest.
- Rule out the "usual suspects": loose connections between chest tube and drainage tubing, and between drainage tubing and the chest drainage system. Tighten connections and retape PRN.
- Then if connections are tight and bubbling still exists: test the system for air leaks by starting at the patient and working towards the collection chamber. Use a padded clamp. Check the water seal chamber for cessation of bubbling each time you clamp. *When you place the clamp between the source of the air leak and the water seal chamber, the bubbling will stop.*
  Steps:
  1. Begin at the dressing and momentarily clamp the chest tubing close to the dressing. If bubbling ***does not stop*** go to **2**. If bubbling stops the air leak is either in the patient or around the chest tube. Unclamp. Then:
     - Remove the dressing. Inspect the insertion site. Look and listen for obvious leaks. Make sure the drainage ports at the distal end of the chest tube have not pulled out beyond the chest wall.
     - Apply pressure around the skin at the chest tube entry point. If bubbling stops the leak is around the tube. Reapply a sterile occlusive dressing with Vaseline gauze. Notify the MD of the finding and action taken.
     - If bubbling continues and you cannot see or hear any obvious leaks at the site, suspect the leak is from the lung. Replace the dressing. Notify the MD.

  2. Keep moving the clamp down the drainage connecting tubing toward the collection chamber, placing it at 8-12 inch (20-30 cm) intervals. Each time you clamp, check the water seal chamber for cessation of bubbling. If the location of the leak is found along the length of the connecting tubing, replace the connecting tubing or the entire drainage system.

Q **How do I lower the water seal level?**

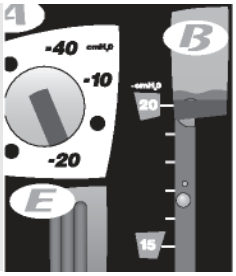
A Changes in your patient's intrathoracic pressure will be reflected by the height of the water in the water seal column. These changes are usually due to mechanical means such as milking or stripping patient drainage tubes, or simply by deep inspiration by your patient after all air leaks have subsided.

- If desired, the height of the water column and patient pressure can be reduced by temporarily depressing the filtered manual vent located on top of the drain, until the float valve releases and the water column lowers to the desired level.

CHEST TUBES (NEONATAL/PEDIATRIC) *(continued)*

- ***Do not lower water seal column when suction is not operating, or when patient is on gravity drainage.***

Q What happens when the water rises to the top of the water seal float valve?



A The water seal column is a diagnostic manometer for monitoring your patient's intrathoracic pressure. When intrathoracic pressures increase, causing the water to rise to the top of the water seal float valve, the ball floats up and "seats" up against a valve seat. This valve seat has been carefully engineered to allow a certain amount of water to pass through it during a precise amount of time.

- When vacuum pressures greater than -20cmH2O on gravity or -40cmH2O on suction occur for an *extended period of time,* water will pass through the valve seat and float valve to allow the water seal to release *automatically.*
- The benefit of Oasis's *controlled release* design is that during normal or deep inspiration, the float valve will float up and down with each respiratory cycle, not allowing the water seal to release.

Q Is it normal for the patient pressure float ball to fluctuate up and down (tidal) near the bottom of the water seal column?

A Yes. Once your patient's air leak is resolved, you will generally observe moderate tidaling in the water seal column. Increases in intrathoracic pressure will cause the water level to rise (the ball rises) during patient inspiration and will lower or decrease (the ball drops) during expiration. This diagnostic tool will help to confirm patency of your patient's catheter(s).

Q How do I determine patient pressure with a dry suction chest drain?

A Whether a traditional wet or dry suction operating system, one cannot overemphasize the importance of the calibrated water seal column when it comes to diagnosing the patient's condition or monitoring normal system operation.

CHEST TUBES (NEONATAL/PEDIATRIC) *(continued)*

- Patient pressure can be determined by observing the level of the blue water and small float ball in the calibrated water seal column.

- With suction operating and the bellows expanded across the suction monitor window, patient pressure will equal the suction control setting (read directly from the regulator dial) *plus* the calibrated water seal column level.

- For example, when the suction monitor bellows is expanded to the ▲ mark or beyond to confirm a –20 cmH2O suction setting, and the calibrated water seal column reads -15cmH2O, patient pressure is -35 cmH2O (-20cmH2O + -1 5cmH2O = -35cmH2O).

- For gravity drainage (no suction) patient pressure will equal the calibrated water seal column only.