OESOPHAGEAL ATRESIA AND TRACHEO-OESOPHAGEAL FISTULA PRE AND POST-OP CARE IN THE NEONATE - GCNC - CHW

PRACTICE GUIDELINE ©

DOCUMENT SUMMARY/KEY POINTS

- Infants should be nursed with the head of the bed elevated to 30-40 degrees.
- All pre-operative infants with oesophageal atresia should have a replogle tube inserted and connected to continuous suction of -5 kPa at all times.
- The replogle tube can be transferred from continuous suction at the bedspace and commenced on transport portable suction set to 80mmHg during transfer of infants to the operating theatre and other hospital departments.
- Flush small lumen (blue end) of replogle tube every 15 minutes with 0.5ml normal saline +/- air.
- Use maximum 0.5 ml sterile normal saline with each flush.
- Between saline flushes, if the infant develops desaturation or has copious oral secretions, flush small lumen with 1-2 ml air and observe if secretions are moving through the replogle tube prior to using saline.
- Thick secretions or frequent oxygen desaturations may require more frequent flushing, discuss this with the Neonatal team.
- Pre-operatively, the use of High Flow Nasal Prongs, mask or nasal prong CPAP, bag and mask ventilation and mechanical ventilation should be avoided where possible.
- Once extubated post-operatively, infants should not be placed on high-flow nasal prong oxygen or mask or nasal prong CPAP unless discussed with the Neonatologist and Surgical Consultant.
- Endo-tracheal suctioning is limited to above the site of the fistula following surgery.

This document reflects what is currently regarded as safe practice. However, as in any clinical situation, there may be factors which cannot be covered by a single set of guidelines. This document does not replace the need for the application of clinical judgement to each individual presentation.

Approved by:	SCHN Policy, Procedure and Guideline Committee	
Date Effective:	1st June 2022	**Review Period**: 3 years
Team Leader:	Clinical Nurse Consultant	**Area/Dept**: GCNC - CHW

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- The position and taping of the trans-anastomotic tube should be checked regularly, to ensure that the tube does not become dislodged.
- The trans-anastomotic tube is not to be removed until permission is given by the surgeon.
- Only Surgeons are to insert new trans-anastomotic tubes.
- If the infant has had a Foker procedure, the dressing will usually be attended daily by the Surgeon to adjust the tension. Nursing staff are not to change, adjust or remove the dressing unless the Surgeon is present, as this will affect the amount of traction being provided.
- All infants with OA and or TOF should be referred to the CHW infant lung clinic for long term follow-up. A member of the infant lung clinic should be contacted to see the patient prior to discharge.
- All infants are to have a referral to the Grace Developmental Clinic for developmental follow-up
- Key Performance Indicators
  - Replogle tube is positioned correctly in oesophageal pouch observable on chest x-ray.
  - Trans-anastomotic tube is taped securely and labelled.
  - Contrast study is attended on the 5th post-operative day or first working day thereafter.

CHANGE SUMMARY

- Picture instructions on how to secure an oral replogle tube have been added
- Picture instructions on documentation in eMR has been included
- Appendix B includes pictures and instructions on how to set up a replogle tube to an underwater seal drain.
- **1/3/23**: Minor review – updated title to include GCNC.

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Background

Definition

Oesophageal atresia (OA) is a congenital anomaly in which the oesophagus ends in a blind pouch[1]. Tracheo-oesophageal fistula (TOF) refers to a fistula (connection) between the trachea and the oesophagus[2].

Etiology

The development of OA and TOF occurs during early foetal development at approximately 22-36 days post conception[3]. It is a result of abnormalities which occur during the process of separation of the primitive foregut tube into the respiratory and gastrointestinal components[4].

The pathological anatomy of the condition is variable. The most common presentation is Type C OA with a TOF from the trachea to the distal part of the oesophagus accounting for 85% of all OA. The next commonest is OA with no TOF these often have a normal trachea. H-type defect is where a TOF occurs in the presence of an otherwise normal trachea and oesophagus. Rarer presentations are OA with a proximal TOF from the upper oesophageal pouch to the trachea, and OA with both a proximal and distal TOF[4]. See figure 1.

Other structural anomalies occur in 50-70% of infants with OA and TOF these are often referred to as VATER or VACTERL association[2]. The abnormalities included in VACTERL association are **V**ertebral anomalies, **A**norectal, **C**ardiac defects (usually patent ductus arteriosus, atrial septal defect and ventricular septal defect), **T**racheo-o**E**sophageal, **R**enal and **L**imb anomalies[5].

TOF/OA occurs in around 1 in every 2500-4500 live births. There is no known cause with the majority of cases occurring sporadically, however it is noted to be 2-3 times more likely to present in twins[3].

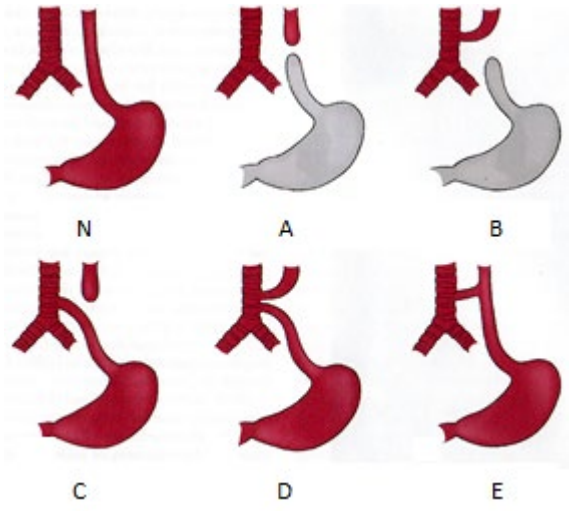


Figure 1: N) Normal anatomy A) Type A: Pure OA (8%), B) Type B: OA with proximal TOF (1%), C) Type C: OA with distal TOF (85%), D) Type D: OA with proximal and distal TOF (1%), E) Type E: H-type TOF (4%)[2].

Diagnosis

The presence of the following symptoms could indicate OA and/or TOF:

- A history of polyhydramnios is often present in an OA without a fistula (Type A) as there is no pathway for the absorption of amniotic fluid. Polyhydramnios is uncommon in the commonest form of OA with a distal TOF[1,2].
- Large volumes of frothy oral secretions are produced and may lead to coughing, choking and aspiration into the lungs[1].
- Feeding intolerance with gagging and vomiting of undigested milk through the mouth and nose[6].
- Inability to pass a size 6fg or 8fg nasogastric tube further than 7-10cm[1].
- Abdominal distension if a distal TOF is present[1,2].
- A chest x-ray may show the nasogastric tube resting against the wall of the air filled oesophageal pouch or may show it coiled within the pouch. Large amounts of air in the stomach and intestines could indicate a distal TOF[1,2,3].

Surgical procedures

Primary repair

Primary repair of oesophageal atresia and tracheo-oesophageal fistula involves a surgical incision (usually a thoracotomy), ligation and division of the tracheo-oesophageal fistula and an end-to-end anastomosis of the upper and lower ends of oesophagus[6].

At the commencement of the surgical procedure, a laryngo-bronchoscopy (LBO) will often be performed to assess the presence, size and location of the fistula, which is usually around 5–7mm above the carina. The procedure may also check for the presence of bronchial abnormality or tracheomalacia, which may influence when to extubate the infant after surgery.

Staged repair

A staged repair may be attended when the pulmonary status of the infant is too unstable such as when the infant is born prematurely or when there is a long gap between the proximal and distal oesophagus, usually types A;B and occasionally C . Long gap oesophageal atresia is defined as a distance >2cm between the proximal and distal oesophagus, or approximately 2 vertebrae on chest x-ray[5]. These cases typically involve the ligation and division of the fistula (when present) and a gastrostomy to allow for gastric decompression and feeding. Continuous drainage of the oesophageal pouch continues with the use of a replogle tube[2,3] A delayed primary repair will often be attended approximately 8-12 weeks later[5].

An alternative to a delayed stage repair may be the Foker procedure. This may be offered in cases where there is a very large gap between the upper and lower oesophageal segments. Many variation of the Foker procedure have evolved over time. The Foker procedure involves the induction and stimulation of growth of the short oesophageal segments through the use of sutures kept under tension[6,7]. This is achieved through the use of surgically placed sutures into the ends of each oesophageal segment. These sutures can either be left insitu and tied together under tension, or can be brought out through the skin and secured under tension. In

this method, stimulation of growth is encouraged through increasing the tension daily. Once there has been sufficient growth of the oesophageal segments, the infant will then be offered a delayed primary oesophageal repair; this will usually take between 5-14 days.

Should primary repair not be feasible, there are a number of different techniques available to restore continuity by the method of oesophageal replacement. Established methods include using a 'gastric pull up' or a colonic interposition[7].

Pre-Operative Care

Positioning

- Infants should be nursed with the head of the bed elevated by 30-40 degrees to facilitate collection of secretions by the replogle tube and to reduce the risk of spill over saliva rom the blind-ending upper oesophageal pouch. This can reduce the risk of aspiration pneumonia. To promote consistency of nursing care, appropriate signage should be applied to the patient's bed detailing positioning requirements and documented in the patient's electronic medical record.

Replogle tube

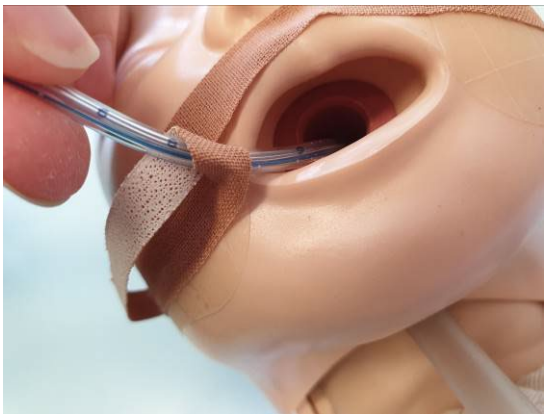
For an infant with an oesophageal atresia the replogle tube allows for continuous aspiration of the blind oesophageal pouch, thereby reducing the risk of aspiration pneumonia. The second lumen allows the lumen to be flushed thus reducing the risk of blockage and the accumulation of thick, viscous secretions.

Specific Instructions:

- All pre-operative infants with OA should have a replogle tube inserted and connected to continuous suction at all times.
- There are two ways to apply suction to a replogle tube. See **Appendix A** for connecting to low wall suction (preferred first line treatment) or see **Appendix B** for connecting to a chest drain chamber (second line option for long gap OA with thick secretions).
- The first insertion of a replogle tube should be attended by a NUM, CNS, NP or member of the surgical team.
- Nasal insertion is preferential provided the patient does not also have choanal atresia or is a small baby <2000grams. Nasal insertion promotes opportunities for non-nutritive sucking and decreases the risk of accidental tube dislodgement particularly when facilitating wrapping with hands to face depending upon the infants individualised developmental care plan.
- When inserting or replacing the replogle tube, gently insert the tube and advance into the pouch until resistance is met, usually around 8-11cm from the nose for a term baby. Care must be taken that the tube does not perforate the posterior pharyngeal wall and that the tube is not taped so as to cause undue pressure on the pouch.
- For a **nasal** replogle tube, secure similarly to a nasogastric tube:

- Apply a strip of *Comfeel* to the cheek on the same side that the replogle is inserted, ensuring that it is close to the nare
- Cut a piece of *Leucoplast* tape long enough to cover from nare to tragus of the ear and cut two small slits at either end, horizontally.
- Ensure the replogle tube does not press against or blanch the nare before securing with *Leucoplast*.

- To secure an **oral** replogle tube:

<table>
<tr>
<td> 
Apply a strip of Comfeel to either side of the mouth and cut two trouser leg pieces of brown tape.
Place one trouser leg on the side of the replogle with the top tape going across the philtrum.</td>
<td> 
Wrap the bottom tape up and around the tube on a diagonal.</td>
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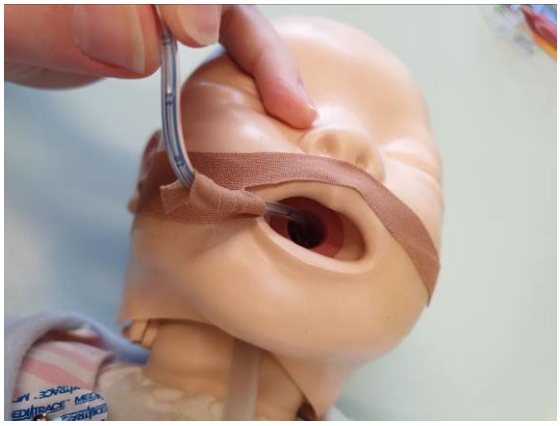
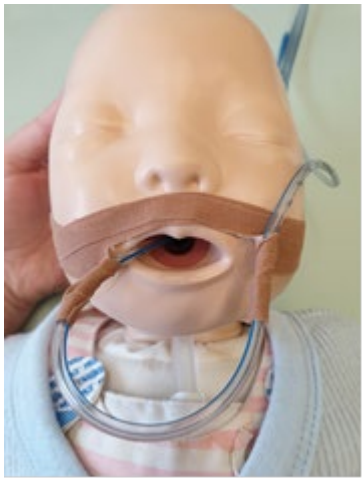
<tr>
<td> 
Pinch the end of the tape to leave a tab</td>
<td> 
Loop the replogle tube to allow enough room for a dummy</td>
</tr>
</table>

 Repeat the process for the second tape	

- Document insertion and measurement in the patient's electronic medical record as an 'Airway Management' titled progress note.
- Excessive oral secretions may indicate that the tube has become blocked, the connections are not secure or the tube is not correctly placed in the oesophageal pouch. If the secretions are not being aspirated check the tube position and if necessary, replace tube.
- **A spare replogle tube must be kept at the bedside at all times.**

Transport

- When transferring a patient with a replogle tube insitu, the patient is to remain on continuous suction.
- The use of portable suction has been approved in consultation with the surgical team as part of safe airway management for the patient.
- Ensure that a portable suction machine is charged and suctioning appropriately.
- Disconnect the patient from their bedside suction, and connect to the portable suction set to 80mmHg.
- Ensure that oro-pharyngeal suction catheters are also available in the event of an emergency.

Nursing Care

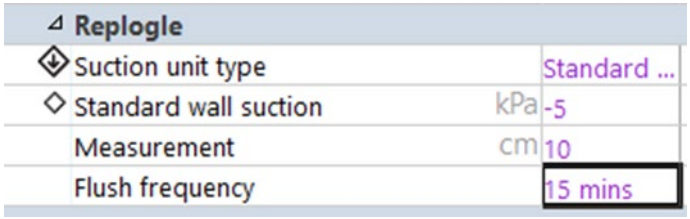
- Frequently check that the replogle tube is correctly positioned and functioning properly by observing that secretions are being aspirated.
- Change the replogle tube every three days as per the manufacturer recommendation as tube functionality decreases with frequent sump of excessive or thick secretions[8].
- If securing nasally, alternate insertion sides with each change to prevent pressure injury to the patient.
- Ensure that the tape is dry to prevent the tube slipping from the correct position.

- Change suction tubing and bottle every second day or as required.
- Flush small lumen (blue end) with 0.5 ml sterile normal saline every 15 minutes to ensure the tube and suction is functioning. 10 ml ampoules of normal saline may be used. The saline flush may be followed by a flush with 1-2 ml air. The saline should be visible immediately moving back through the tube. Secretions should be moved through the length of the tube into the suction trap to ensure patency. Ensure flushing syringe is not left attached after flushing as this can block the sump drainage system.
- Between saline flushes, if the infant desaturates or has copious oral secretions, flush small lumen with 1-2 ml air and observe if secretions are moving up through the replogle tube prior to using saline.
- Thick secretions or frequent desaturations may require more frequent flushing, discuss this with the Neonatal team.
- A recurring timer should be set on the patient's bedside monitor at the interval of replogle flushing

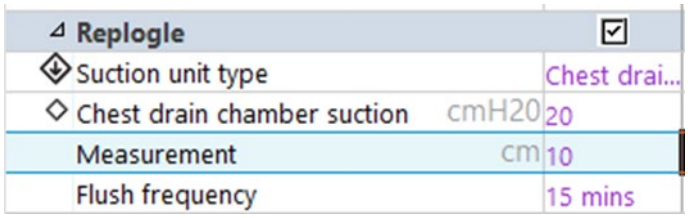
Documentation

- Document all flushes in the patient's electronic medical record. See below examples which are available in *Interactive View I&O*

Example of hourly observations for standard wall suction



Example of hourly observations for chest drain suction



Oral care

- Patient's with a replogle tube are able to and should have PO sucrose administered prior to and during painful procedures
- EHM for Immune Supportive Oral Care (ISOC) is encouraged for patients with a replogle tube.

Emergency Situations

- If unable to flush the replogle tube, remove the replogle tube and suction the oro-pharynx gently with an oral suction catheter no further than the measured depth of the oesophageal pouch.

- Immediately insert a new replogle tube.
- Ensure that a properly functioning flow-inflating bag and emergency suction equipment is available at all times.

Monitoring

- The infant should have continuous heart rate, respiratory and saturation monitoring with hourly observations, documented in the patient's electronic medical record.
- Ventilated infants should also have end tidal carbon dioxide monitoring.

Maintenance of fluid balance

- The infant will be nil by mouth and receiving intravenous therapy unless a gastrostomy has been sited due to long gap OA.
- All nappies should be weighed and an accurate input and output fluid balance maintained.

Ventilation

- The use of High Flow Nasal Prongs, mask or nasal prong CPAP, bag and mask ventilation and mechanical ventilation should be avoided where possible. If required, minimal pressures should be used to avoid over-distension of the abdomen from air passing from the trachea into the stomach via the fistula. If there is a need for increased preoperative respiratory support the surgical team should be informed immediately
- Where mechanical ventilation is required regularly assess the abdomen for the degree of abdominal distension.

Investigations

- All infants with a TOF or OA should have a VACTERL screening as TOF and/or OA are commonly associated with other conditions, however not all patient's will have additional comorbidities identified through this process[9].
- Physical examination to establish the presence of a patent anus and to look for radial limb anomalies (e.g. absent thumb).
- A chest x-ray and abdominal x-ray following admission to assess the presence of a distal fistula and examine the vertebrae. If a distal fistula is present, the stomach will contain air while if no distal fistula is present, the stomach will have no air[3].
- A cardiac assessment including echocardiography should be sought to identify if any cardiac abnormalities are present and to visualise the position of the aorta as this may affect the side from which the operation is performed.
- A renal ultrasound should also be performed to identify the presence of a renal anomaly.

Post-Operative Care

Ventilation

- Infants will usually return to the ward from the operating theatre intubated and ventilated.
- In the event where the oesophageal gap is large and a large amount of tension is placed on the anastomotic site, the infant maybe muscle relaxed and should be nursed with the head in a flexed position as ordered and documented by the Surgeon.
- Care of the ventilated and muscle relaxed infant is undertaken according to the Respiratory Support in the NICU Practice Guideline[10].
- Once extubated, infants should not be placed on high-flow nasal prong oxygen or mask or nasal prong CPAP unless discussed with the Neonatologist and Surgical Consultant.

Suctioning

- When suctioning the oropharynx care needs to be taken to ensure the passage of the catheter does not damage the anastomosis. The catheter is passed no more than a few centimetres into the mouth.
- Endo-tracheal suctioning is limited to shallow suctioning (do not extend beyond the length of the ETT) above the site of the repair of the fistula as suctioning at or past the site may cause trauma to the site and can lead to breakdown or a leak from the site.
- The length of the passage of the suction catheter is documented in the patient's electronic medical record.

Investigations

- On return to the ward from the operating theatre, a chest x-ray is necessary to check for the presence of air in the pleural or extra-pleural space as well as the placement of the endo-tracheal tube, chest drain and any other lines that are present.
- Blood is collected for a blood gas and electrolytes, urea and creatinine and a full blood count are taken and sent to pathology.
- A contrast study is to be attended on the 5th day post-surgery or the first normal working day thereafter to check for evidence of stricture or leakage at the anastomotic site.
- Any investigations for VATER and VACTERL association that were not attended pre-operatively can be completed in the post-operative period.
- A chromosome microarray

Antibiotics

- The insertion of a chest drain post operatively indicates the need for prophylactic intravenous antibiotics in the form of Cefazolin until drain removal. Additional intravenous antibiotics are at the discretion of the individual surgeon. Refer to the ANMF consensus document for medication guidance. https://www.anmfonline.org/wp-content/uploads/2021/06/cefazolin-16122020-2.0.pdf

Proton Pump Inhibitor (PPI)

- PPI is commenced to manage gastric acidity and usually continues at discharge. Refer to the ANMF consensus document for medication guidance on:

Omeprazole https://www.anmfonline.org/wp-content/uploads/2021/06/omeprazole-19072018-1.1.pdf

Ranitidine https://www.anmfonline.org/wp-content/uploads/2021/06/ranitidine-20022017-1.1.pdf

Chest Drain

- A chest drain connected to an underwater sealed drainage system is sited during the operation. The position of the chest drain may be intra-pleural or extra-pleural and its position should be documented in the patient's electronic medical record.
- On return to the ward from theatres, the chest drain should only be attached to suction at -20cm H_2O on the Atrium Oasis Drainage System if ordered by the Surgeon.
- Hourly observations of the chest drain include:
    - Monitoring the tube and drain for the presence of swinging and bubbling. The presence of bubbling represents a leak of air into the thoracic cavity. This may be due to a leak from the anastomosis or from the trachea. If bubbling present, the Surgeon should be contacted to review the infant.
    - Any losses should be measured and assessed for appearance.
    - If intragastric feeds have been commenced prior to chest drain removal, the fluid should be checked for the presence of milk.
    - The insertion site should also be checked to ensure the drain remains secure and nil signs of infection are present.
    - Where ordered, the suction should be checked to ensure it is still attached and working. This should be a separate suction canister to the patient's bedside emergency equipment.
- Abnormalities, especially in the amount or appearance of drainage, of bubbling must be notified to the Medical Officer and Nurse-in-Charge immediately.
- The chest drain is removed at the specific direction of the surgeon, usually following a satisfactory contrast study by an accredited RN or medical officer.

Pain Management

- In the immediate post-operative period, pain should be assessed 2-4 hourly and analgesia given as per the Pain Management in Newborn Infants Practice Guideline[10].

Trans-anastomotic tube

- A trans-anastomotic tube will usually be inserted by the Surgeon during the operation.
- The trans-anastomotic tube must be clearly labelled as such and with the date of insertion.
- The position of the trans-anastomotic tube at the nares should be recorded in the patient's electronic medical record upon return from the operating theatre.

- The position and taping of the trans-anastomotic tube should be checked regularly, to ensure that the tube does not become dislodged.
- The trans-anastomotic tube is placed on free drainage with the management of this dictated by the surgical team.
- Feeds are only to be commenced via the trans-anastomotic tube when indicated by the Surgeon.
- The tube is not to be removed until permission is given by the surgeon. This will usually be given once the infant is tolerating full oral feeds.
- In the event that the tube is accidentally removed, the Surgeon and Nurse-in-Charge are to be notified immediately. An IIMS report should also be completed.
- Only Surgeons are to insert new trans-anastomotic tubes. The surgical team may request Interventional Radiology to replace the tube under fluoroscopic control.

Wound Care

- On return to the ward from the operating theatre the wound is observed and the appearance of the wound documented in the patient's electronic medical record.
- The wound is then assessed each shift for signs of bleeding or infection and any abnormalities found should be reported to the Neonatal Medical Officer and Surgeon.
- The dressing is to be removed seven days post-surgery as directed by the surgeon.
- If the infant has had a Foker procedure, the dressing will usually be attended daily by the Surgeon to adjust the tension. Nursing staff are not to change, adjust or remove the dressing unless the Surgeon is present, as this will affect the amount of traction being provided.

Feeds

- The infant will usually be kept nil by mouth until the contrast study has been performed on day five and nil evidence of leakage found.
- Feeds via the trans-anastomotic tube may be commenced prior to this at the discretion of the Surgeon.
- In the event where feeds are introduced prior to the contrast study, they should be commenced at a small amount and graded up slowly to prevent reflux into the oesophagus up to the anastomotic site.
- Once the contrast study has been performed and permission to give feeds has been given by the Surgeon, oral and trans-anastomotic tube feeds may be commenced and graded up as tolerated by the infant.
- The surgical team should be consulted in regards to the patient being prescribed a proton pump inhibitor such as omeprazole or ranitidine.

Discharge Planning

- Planning for discharge should begin on admission as per the Discharge Of Infants Home From Grace Centre For Newborn Care Practice Guideline[11].

- All infants with OA and or TOF should be referred to the CHW infant lung clinic for long term follow-up. A member of the infant lung clinic (Dr Karpelowsky or A/Prof Fitzgerald) should be contacted to see the patient prior to discharge.
- Prior to discharge, outpatient appointments should be made with the Surgeon, the CHW infant lung clinic and the Grace Newborn Follow-up Clinic.
- All infants will be followed up in the Grace Developmental Clinic

Complications

Anastomotic Leak

The presence of an anastomotic leak may be indicated clinically by persistent or increased drainage from a chest drain or by the presence of bubbles or saliva in the drain or drainage under the wound dressing. It may be indicated radiologically by a pneumothorax on chest xray or leakage of contrast into the chest during a contrast study. The treatment for an anastomotic leak usually involves drainage of the fluid via a chest drain, the infant remains nil by mouth on intravenous fluids and antibiotics may be used[3,8]. If a leak is suspected the surgical team should be informed as surgical revision may be required.

Gastro-oesophageal Reflux

Gastro-oesophageal reflux is a common complication due to decreased oesophageal peristalsis and the upward pull on the lower oesophageal pouch and stomach[2,10]. The presence of reflux may result in oesophagitis and the formation of strictures as well as nutritional and respiratory problems[7]. The prophylactic use of proton pump inhibitors, in order to reduce gastric acid production, should be used in this situation[7], and continued on discharge. This is also an important clinical consideration for the patient with a gastrostomy sited in the case of long gap OA as leaking of gastric contents can occur and may irritate the surrounding skin resulting in skin breakdown.

Chylothorax

A rare complication is a chylothorax where chyle from the thoracic duct leaks into the pleural space which may result as a complication of surgery to the thorax or neck[12]. Chyle may appear as a cloudy liquid in the drainage from the chest drain. Treatment for a chylothorax includes drainage through a chest drain and the use of Monogen or Lipistart once feeds are commenced.

Anastomotic Oesophageal Stricture

An oesophageal stricture is when there is a narrowing at the location of the anastomotic site. This can result in pooling of secretions, difficulty swallowing and desaturations if the pooling of secretions is not well managed. An anastomotic stricture is one of the most common complications for patients in the first year following an oesophageal atresia repair[15]. Management of a stricture includes dilatation of the narrowing under general anaesthetic to widen the narrowing to improve the passage of secretions down the oesophagus.

Parent Education

- Parents are not responsible for replogle tube management including routine flushes. This is an important aspect of the patient's airway management and is the responsibility of the bedside nurse.
- Parents should be included in the development of a care plan for their infant from admission.
- Where possible, parents should be encouraged to participate in caring for their infant through attending to cares and having cuddles.
- Parent education as a part of discharge planning should also begin from admission[13].
- A factsheet on Oesophageal Atresia and/or tracheo-oesophageal fistula[14] is available on the Children's Hospital at Westmead website that contains information on the abnormality as well as long term complications which can be given to parents.

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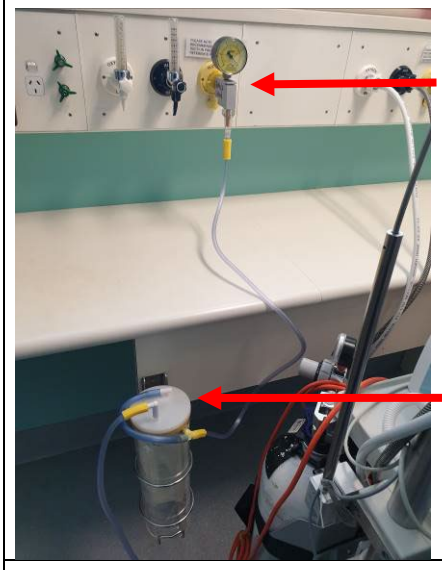
Appendix A – Replogle tube connected to low wall suction



Low wall suction identified by the silver block beneath the pressure display meter

Connected to a suction chamber which is secondary to the emergency suction. Patient requires both.

Snip off the yellow rubber end from the suction tubing and push the replogle tube into the suction tubing.

Appendix B – Replogle tube connected to chest drain chamber

Connect a wall suction (note: this is not a low wall suction).

Push the replogle tube into the chest drain suction tubing.

Take the 49ml WFI via from the back of the chamber and squeeze the water into the blue tip. The blue ball in the water chamber (B) will turn white as the water turns blue.

Now connect the yellow suction tubing connects to the blue tip of the chamber.

Turn the dial (A) to the prescribed suction level.

Note: -10 to -35cmH20 (Continuous low pressure suction of -15 to -35 cmH20 on the Atrium drain is equal to a suction pressure of -11 to -25 mmHg)

Turn the suction on at the wall until the orange bevel (E) pops out to the arrow.

You should hear and see bubbling in chamber (B).