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PAEDIATRIC NASOPHARYNGEAL AIRWAYS (PNA)

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A paediatric nasopharyngeal airway (PNA) is an airway adjunct consisting of a hollow plastic tube designed to stent the nose and nasopharynx. Depending on the level of the obstruction the PNA will terminate in the nasopharynx, oropharynx or hypopharynx. It is better tolerated than an oropharyngeal (Guedel) airway and has the advantage that it can be used in patients with an intact gag reflex, trismus and oral trauma.

Although PNAs have mainly been used in emergency and anaesthetic medicine, they are being increasingly used in paediatric otolaryngology. PNAs can be used to alleviate obstruction at any level from the anterior nasal cavity to the oropharynx *(Table 1)*. They are often used to maintain airway patency in patients with a high risk of developing postoperative respiratory complications after adenotonsillectomy.

Level of obstruction	Aetiology
Nose	Pyriform aperture stenosis Choanal atresia
Nasopharynx	Adenoid hypertrophy Underdeveloped midface (Crouzon's, Apert's, Pfeifer's syndromes)
Oropharynx	Tonsil hypertrophy Tumours Macroglossia
Hypopharynx	Micrognathia (Pierre Robin Syndrome) Lingual tonsil hypertrophy Glossoptosis

Table 1: PNAs can be used to alleviate obstruction at any level from the anterior nasal cavity to the hypopharynx

Relative and absolute contraindications to a NPA include severe stenosis or atresia of the nasal cavities, facial fractures, recent surgery of the skull base, active sinonasal infection, active epistaxis, and uncorrected coagulopathies or anticoagulant use.

Commercially available PNAs come in different sizes and materials *(Figure 1)*. The size is determined by the patient's age. *(Table 2)*. They can also be fashioned from endotracheal tubes (ETT) in resource constrained settings.

Figure 1: Commercially available PNAs come in different sizes

Age	PNA size	Suction catheter size
Preterm - 1mo	3	6
1-6mo	3.5	8
6-18mo	4	8
18mo - 3yrs	4.5	8
3-6yrs	5	10
6-9yrs	5,5	10
9-12yrs	6	12
12-14yrs	7	14

Table 2: PNA size according to patient's age

This chapter describes how to manufacture an PNA using an ETT, how to insert and fix it to a patient *(Figure 2)*, and its aftercare.

Making PNA from Endotracheal Tube (ETT)

- *Figure 2* illustrates materials needed to create an PNA from an ETT

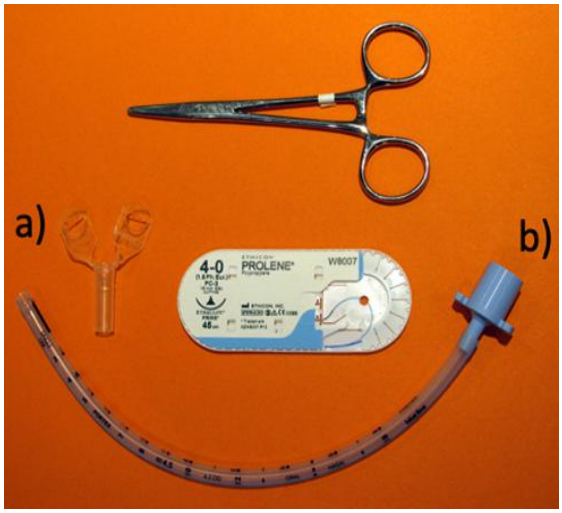


Figure 2: Materials needed to create an PNA from an ETT: a) Portex® tube holder (half-size smaller than the ETT); b) Portex® Blue Line® ETT (ID 0.5 - 1mm smaller than age-appropriate size, or similar to diameter of the patient's little finger)

- A soft, uncuffed ETT (Portex® Blue Line®)) is preferred, ideally without Murphy eye *(Figure 3)*
- The inner diameter (ID) should be 0.5 to 1mm smaller than the age-appropriate ETT size
- Determine the starting length of the PNA by measuring the distance from the nasal tip to the tragus, adding a few centimetres to allow for adjustments should it be required *(Figure 4)*
- For custom-made PNAs the length is dictated by the level of obstruction that needs to be bypassed
- Cut the ETT to the desired length at its proximal (unbevelled) end
- The bevel of the PNA should face medially, away from the lateral pharyngeal wall to avoid soft tissue of the pharynx blocking the end of the tube. The bevel faces medially by default when the right nasal passage is used

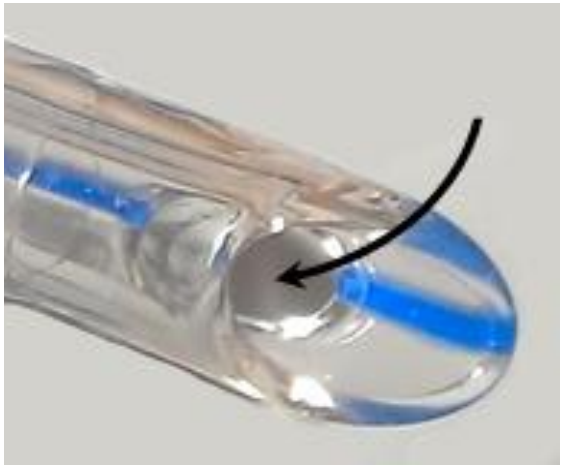
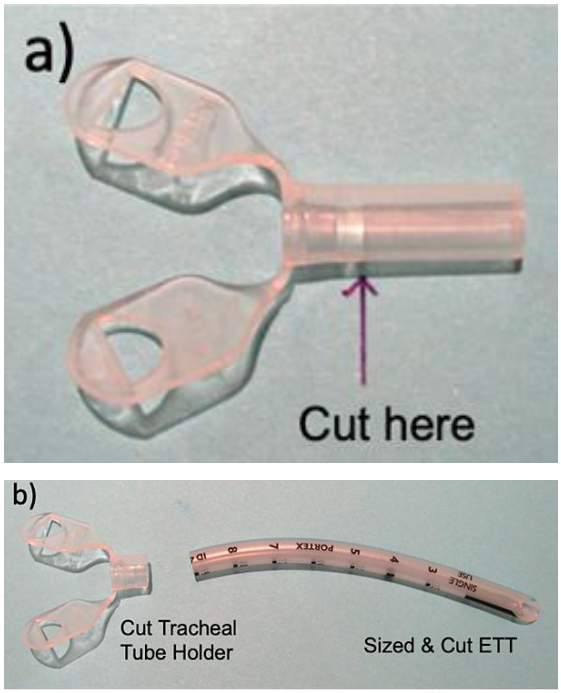


Figure 3: Murphy eye /additional air vent (arrow)

Figure 4: Determine the starting length of the PNA by measuring the distance from the nasal tip to the tragus

- If the PNA needs to be passed on the left side, a new bevel must first be created by cutting the distal end of the tube obliquely, taking care not to leave any sharp edges
- Once the correct length has been determined, mark the proximal end flush with the nasal rim, and cut the ETT at this point

- A half-size smaller Portex® tube holder is cut distal to its flanges *(Figures 5a,b)*
- Suture the tube holder to the ETT using a Prolene® or nylon 4-0 suture *(Figures 6, 7)*



Figures 5a, b: Cutting tube holder and ETT

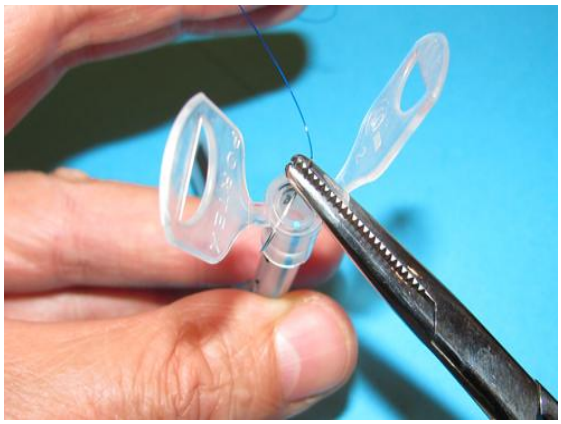


Figure 6: Suturing the tube holder to the ETT; Prolene® 4-0 suture is being used, and the knot is tucked inside the lumen

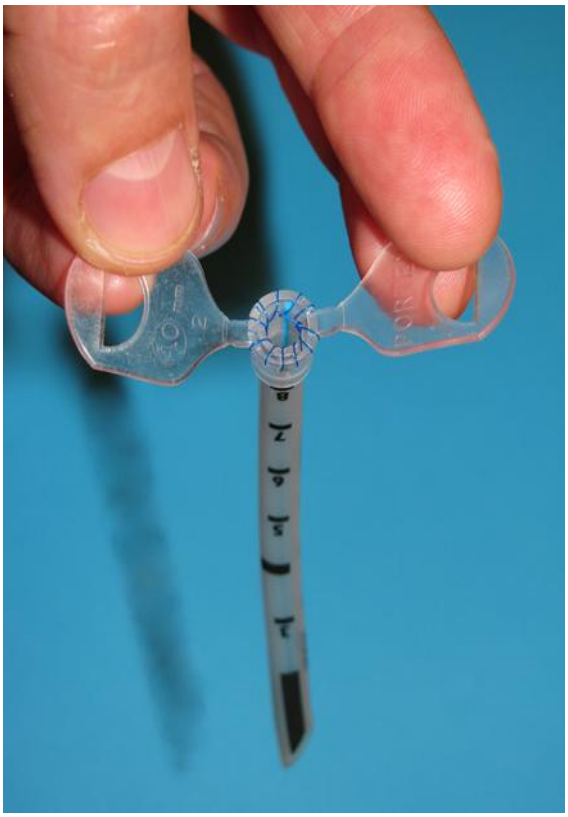


Figure 7: Completed PNA

- Recheck and note the length, and reinsert the PNA
- Secure the flanges to the sides of the child's face with tape *(Figure 8)*

Figure 8: PNA in situ and taped to the face

- If tube holders are unavailable, the proximal end of the ETT longer can be split lengthwise to create two flanges that can be secured to the face *(Figure 9)*

Figure 9: If tube holders are unavailable, one can leave the proximal end of the ETT longer and split it down its length to create two flaps that are taped to the face

- Note: If commercial PNAs are used, the length is standard for every ID size (but can be trimmed if necessary). The proximal "button" end can be secured by passing sutures which are then taped to the face *(Figure 10)*

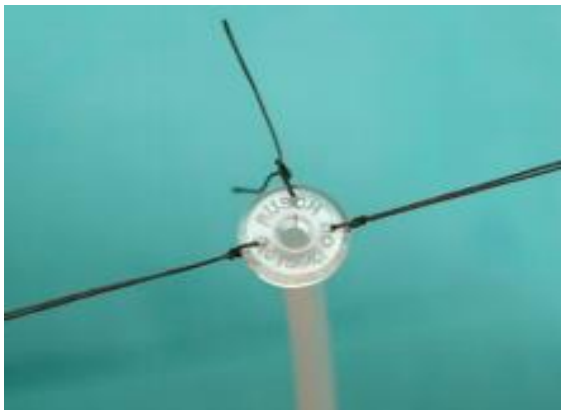


Figure 10: Commercial pre-made PNAs can be secured by passing sutures through the proximal "button" which are taped to the face

Inserting an PNA

- Topical nasal decongestant drops may be applied
- Bend the PNA into a downward curve with the bevel facing medially
- Lubricate the PNA with saline or a lubricant
- Insert it into the nose
- Direct it along the floor of the nose
- Avoid excessive force, though gentle twisting can assist its passage into the nasopharynx
- If inserted in the operating room, direct inspection of the pharynx should show the tube projecting 1cm below the free edge of the soft palate
- Alternatively, a flexible nasendoscope can be passed through the tube to measure exactly where the tip of the PNA should be located
- In some cases, such as with retrolingual collapse, the tip of the PNA can be positioned more distally above the epiglottis, if tolerated by the patient

Additional modifications

A standard 15mm adapter can be used with an PNA customised from an ETT, for connection to mechanical ventilation. Some have adapted commercial PNAs for this purpose.

Caring of PNAs

Maintaining patency: PNAs should be suctioned as required to prevent blockage. The suction catheter should not be inserted more than 0.5cm beyond the distal end of the PNA. Instillation of saline drops helps to soften secretions and facilitates toilet. Patency can be grossly checked by a mirror fogging / misting test. If an PNA becomes obstructed and cannot be unblocked with suction, the tube is removed and replaced, especially if the patient becomes distressed. Parents should always keep spare PNAs of the same and smaller sizes.

Fixing PNA: Tapes should be checked regularly to avoid accidental displacement of the PNA. The skin around the nostrils and cheeks must be regularly checked and cleaned to avoid infection and pressure ulcers.

Changing PNA: Routine changes of the PNA depends on the amount of secretions, but usually ranges between every 1 - 4 weeks. Initial insertion and the 1st PNA change should be performed by a member of the otolaryngology team. If insertion is easy, subsequent changes can be performed by trained staff or family members. Family should be advised that if PNA reinsertion becomes difficult, but the patient is stable, no further attempts should be made until an experienced health professional has been consulted.

Cleaning: PNAs can be washed with soap and water, or discarded and replaced, depending on available resources.

Mucosal granulations can develop at the distal end of the PNA. This should be suspected if partial distal blockage is encountered, especially if bleeding is observed. A flexible nasendoscope can be passed through larger PNAs for visual inspection. Management may include vasoconstrictor and steroid drops, shortening the tube or switching it to the contralateral side.

Homecare: When PNAs are used long-term, parents and caregivers must be properly trained and have access to the necessary equipment such as a portable suction unit, and materials including suction catheters, spare PNAs, saline, lubricants, gauze, and tapes prior to discharge from hospital.

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