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MINI-SYMPOSIUM: TRACHEOSTOMY IN CHILDREN

Tracheostomy care in the home

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KEYWORDS
child;
domiciliary care;
endotracheal suctioning;
monitoring;
teaching programme for caregivers;
tracheostomy

Summary There are hardly any controlled studies in paediatric tracheostomy care; instead, most established standards, procedures and details have been elaborated at the bedside by trial and error. Once the appropriate tube is chosen, tube care consists of tube change, fixation, management of secretions, humidification of inspired air and application of medications. The stoma requires cleaning, protection and dressing. Child care may be structured into monitoring, feeding, bathing and clothing. Preparing the home and family environment are important prerequisites for discharge from the hospital. Last but not least, the family of the child or other caregivers must undergo a structured and detailed training programme to become competent in long-term home care.

INTRODUCTION

Since tracheostomies in children are almost exclusively used as a long-term artificial airway, long-term caregiving concepts have had to be developed. Children with a chronic tracheostomy face the potential hazards of airway compromise, and optimal care aims at reducing this risk.[1–3] Most caregiving strategies, standards, procedures and details have been developed by trial and error at the bedside; even nowadays, recommendations for optimal care stem rather from the consensus of experts rather than from controlled studies.[4]

In many ways, long-term management depends on the indication for tracheostomy. In a chronically obstructed upper airway, tracheostomy is used for bypassing the stenosis; in the presence of tracheomalacia, a tracheostomy tube may also be used to stent the airway. Where there is a chronic need for invasive ventilatory support as well as for management of secretions, tracheostomy is used for directly accessing the airway.

Most tracheostomies performed for the former indication can be removed once the underlying pathology has been corrected surgically or has ameliorated with growth and development of the airway; tracheostomies for ventilatory support can also be removed once ventilation can be applied non-invasively. Long-term management differs between these two groups in terms of decannulation protocols and control investigations; however, tube selection (discussed elsewhere), tube care, stoma care and the education and training of caregivers are essentially the same.[5–7]

TUBE CARE

Change of tube[4–7]

The frequency of tube change depends on the material of the tube and the presence of infection and/or secretions. The polyvinyl chloride material, most widely used for paediatric tracheostomy tubes, allows the tubes to stay in place for several weeks, although inspissated secretions occasionally call for more frequent changes. If tubes are reusable, it is essential to inspect the tube for possible damage and for reduced flexibility with time and repeated sterilisation.

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In the case of a very tight stoma, the tissue layers between skin and trachea tend to close or narrow the stoma channel by shifting differently; therefore, changing the tube may be difficult. It can be accomplished by threading the new tube over a guiding structure such as an appropriately sized suction tube. A smaller tube and ambubag should be within easy reach in case of insertion problems.

Fixation of tube[6,7]

Various materials, such as Velcro ties, twill tapes, elastic straps with hooks and stainless steel chains, are available to secure the tube in place. In children, especially in those with tracheostomies for bypassing an obstructed upper airway, preventing accidental decannulation is vital. Hence a twill tape, securely tied with triple square knots to both sides of the neck flange, is the most reliable option. As these tapes tend to shrink with moisture and might then cause skin irritation or even compromise of the venous return, threading the tape through a silicone tube is recommended. This protects the skin and allows for easy cleaning underneath. When a fresh tape is needed, a recommended procedure, which is safe even in a young active baby, is to tie the new over the old one and cut the latter only once the tube has been secured by the new tape. Velcro tapes are reserved for children in whom accidental decannulation would not cause serious adverse events. Elastic straps with hooks as well as chains should not be used in children.

Tapes should be tight enough to prevent accidental decannulation yet loose enough to allow for a change in neck size during laughing, crying and feeding. The correct tension is given when one finger can be slipped without force beneath the tape at the back of the flexed neck (Fig. 1).

All adjuncts fitted onto the tracheostomy tube, such as breathing circuits, heat and moisture exchangers, as well as speaking valves, should be secured in a way that avoids tension on the tube (Fig. 2).

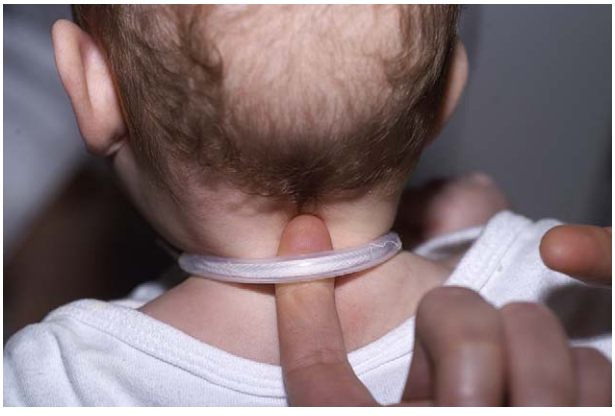

Figure 1 Tube fixation. Checking for the correct tension of the neck tie.

Management of secretions[4–12]

In children with a tracheostomy, airway patency is maintained by suctioning of the tube.

Frequency (timing) of suctioning

Suctioning is best performed on an as-needed basis, the frequency depending on the child's ability to generate an effective cough and on viscosity and amount of secretions. Consequently, caregivers must be trained to assess competently the need for removal of secretions, and suction equipment must be with the child at all times. Suctioning on a routine basis is restricted to children with hardly any secretions and should then be performed at least in the morning and evening in order to ensure continued patency of the tube.

Depth of suctioning

Shallow suctioning. A pre-measured length of the catheter is inserted to a depth where the side-holes reach the tip of the tube. This technique avoids mucosal damage and irritation; however, it also carries some risk of encrusted secretions and consecutive tube obstruction in case the catheter does not fully reach the end of the tube. Exact measurement of tube length and catheter insertion depth are prerequisites for correct suction technique.

Deep suctioning. This means inserting the catheter until resistance is met and applying suction only on withdrawal. Because of the risk of epithelial damage, this technique should never be used as a routine; however, in selected situations, it can be necessary for clearance of secretions located beyond the tube.

Suction equipment

Suction pump. Depending on his or her mobility, the child has to be equipped with two or three different suction pumps. A stationary suction pump must have a manometer for setting the suction pressure and should be capable of generating the preset vacuum rapidly. It should be equipped with an easily removable bottle that is big enough for holding a day's suction volume.

An additional portable suction pump must be able to run on batteries for a considerable time span, should be light-weight and ought to be equipped with a valve mechanism to prevent spill-over of secretions into the motor during transportation. Finally, a hand or foot pump is necessary to allow for suctioning independent of electricity.

Suction catheters. Catheters, marked longitudinally for easy control of insertion depth, are preferred. They must have an ideal combination of flexibility and stability to facilitate a quick and easy pass. A rounded end-hole and several side-holes close to the end of the catheter clear

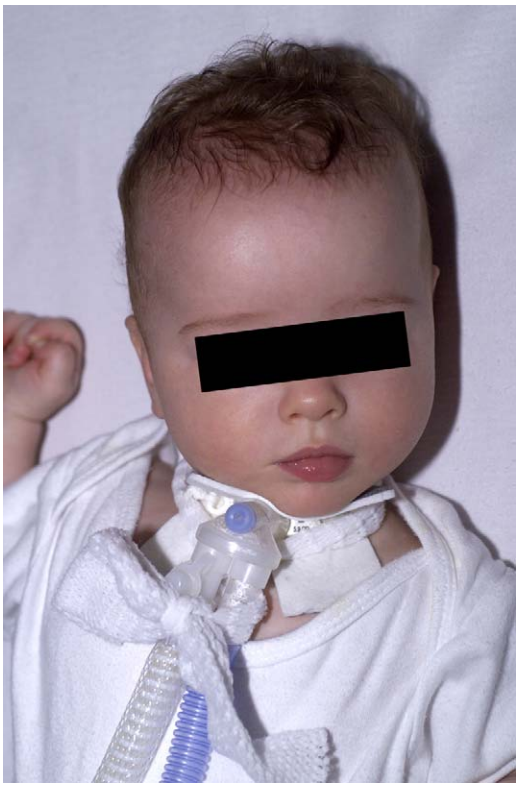

Figure 2 Set-up for mechanical ventilation. Observe the extra fixation of the tubing and the padding of the chin by the stoma dressing.

secretions from the tip and the inside of the tube. The top end of the catheter should carry a hole that can be opened or occluded by the operator's thumb for interrupting or recommencing suction as needed.

Suction pressure

Depending on the length and internal diameter of the catheter, the suction pressure at the end of the catheter is variable. Suction pressures should be set between 80 and 150 mm Hg; gauging the pressures is essential.

Clean versus sterile technique

In the home, a clean technique (freshly washed hands and a sterile, non-reusable catheter) will most likely suffice. In the hospital, as well as out of the home, when hand-washing is not possible, a sterile technique (sterile glove and catheter) should be used.

Duration of suction

A rapid technique reduces the risk of development of atelectasis. With adequate suction pressure and a firm catheter with longitudinal marks, effective suctioning can be performed in a few seconds.

Saline instillation

When no secretions are present in the tube, a sterile 0.9% sodium chloride solution can be instilled in order to elicit a cough, which transports secretions from the peripheral airways towards the tube. When secretions are present in the tube, there is no need for saline instillation. In fact, saline instillation could then have the negative effect of washing secretions down into the lung periphery, thereby increasing resistance and decreasing oxygen saturation. If saline is used, it should never be bagged down the tube because of the risk of carrying infectious material into the peripheral airways.

Bag ventilation/reinstitution of functional residual capacity after suctioning

In spontaneously breathing children who need lengthy suctioning, restoration of lung volume is essential to prevent atelectasis and reduce dyspnoea after suctioning. An adequately sized bag, equipped with a positive end-expiratory pressure (PEEP) valve (with an individually set PEEP level), is connected to the tracheostomy tube, and, in coordination with the child's respiration, several slow inspirations are applied.

Suction procedure

Tube length and depth of insertion to the tip of the tube are noted before suctioning. When secretions are present in the tube (suctioning on demand), the catheter is inserted to the premeasured depth with already applied negative pressure in order to prevent pushing secretions further down the airway. Using a catheter with an outer diameter of approximately 75% of the tube's lumen provides for a rapid removal of secretions. For routine suction, a smaller catheter (outer diameter approximately 50% of the lumen) is inserted without negative pressure in order to prevent loss of lung volume during a more lengthy search for secretions.

On withdrawal, the catheter is twisted between the fingers for clearing secretions from as much of the inner wall of the tube as possible. After the tube has been cleared of secretions, bag ventilation is used to restore lung volume.

Humidification[4,13–15]

Since the upper airway is bypassed by the tracheostomy, the inspired air will be neither sufficiently warmed nor humidified, thereby compromising ciliary action and inspissating secretions. Occasionally, it might therefore be necessary to actively humidify the tracheostomy. For this purpose, pressurised air is directed through a heated water bath into tubing connected to a tracheostomy collar. Ideally, inspired air should contain approximately 36–40 mg of water per litre of air at 32 °C. Such conditions can only be achieved with cumbersome technical equipment; con-

sequently, such a maximally effective humidification is only practicable in a sedentary child or during sleep. Otherwise, the tracheostomy should be equipped with a passive humidifier ('artificial nose') that traps exhaled vapour and temperature and redelivers some of this during inspiration.

Weight, resistance, dead space and hygroscopic capacity are important characteristics of these humidifiers. For children, wearing a speaking valve for longer periods of the day, humidifiers will not work because exhalation does not use the same route as inhalation. If dryness of secretions is evident, a speaking valve equipped with a filter inside the valve can ameliorate the problem.

Application of drugs[4,16,17]

Various drugs can be administered via a tracheostomy for a local or systemic therapeutic effect.

Aerosols

Bronchodilators and anti-inflammatory drugs can be administered effectively by a metered-dose inhaler (MDI) equipped with a valved holding chamber. A special holding chamber with a non-rebreathing valve and a connector to fit onto the tube can be used in children with inspiratory flows that are sufficient for opening the valve and emptying the chamber. In children who are unable to generate these flows, an ambubag connected to the holding chamber can facilitate drug delivery. An MDI plus holding chamber is better than a nebuliser for aerosol deposition distal to the tracheostomy tube.

Liquid drugs

Antibiotics that are not available as a per os formula can be instilled for local infection control. Diluting the drug to an optimal osmolality, warming it, and instilling it slowly drop by drop prevents irritation and helps to avoid coughing or demand for suctioning. Bagging the droplets carefully down towards the lower airways can be useful in tubes with a small ID.

By the drug's direct action in the lung, the effective dose might be lower than the comparable i.v. dose.

Emergency intravenous drugs

In emergency situations, where no intravenous access is readily available, drugs such as atropine, epinephrine and lidocaine show a systemic effect when administered endotracheally.

STOMA (SKIN) CARE[6,7]

Cleaning

The skin around the neck is cleaned with a wet but not dripping cloth. Encrusted secretions under the neck plate can be removed with a cotton wool swab and normal saline. Around the stoma, the skin should be kept dry and liquid creams avoided. In case of fungal infections or inflammation, adequate ointments can be used cautiously for a short period of time.

Protection/dressings

A partially slit dressing, with a key hole for accommodating the tube and made of non-fluffy and water-permeable material, helps to keep the skin around the stoma dry. In case of a short distance between the chin of a baby and the cannula, these dressings also serve as padding when used with the closed side under the chin (Fig. 2). In case of discharge from the stoma, the dressing can provide some protection for clothes when it is slipped under the neck plate from below.

Sometimes granulation tissue around the stoma interferes with the snug fit of the tube; this problem can be tackled with silver nitrate dressings or silver nitrate sticks.

CHILD CARE[3,4,6,7,18–20]

Monitoring

When the continuous presence of a competent caregiver is not available, the child should always be connected to a monitoring device. Ideally, a monitor should provide for an early and reliable warning of airway compromise. Alarms need to be set individually, and caregivers should be trained to stay alert despite the occurrence of unavoidable false alarms.

Feeding

Even if swallowing is no problem and a baby is capable of holding a bottle, he or she should only do so under supervision, because accidental disconnection of the sucker may result in massive aspiration via the tracheostomy.

In children who are tube-fed for a certain length of time, oral food intake may cause some problems. In these, as well as in children with additional neurological disorders, speech therapists should be consulted.

Bathing/showering

A bath with a water level not higher than the child's abdomen is safe for the young patient who is under constant supervision. Care must be taken to prevent aspiration of splash water. Bath toys such as buckets and water pistols should not be allowed. When washing hair, a waterproof protector (like a collar) should be used if the child cannot extend or flex the head far enough to direct the water away from the stoma. Showering that carefully avoids the head and neck is safe for older children.

Clothing

Clothing should not consist of furry or fluffy materials. To prevent accidental decannulation, dressing and undressing must not be over the head. High necks could occlude or dislodge the tube and should therefore be avoided.

Preparing the home environment

The home into which a child with a tracheostomy is to be discharged often needs adaptations that have to be planned with the help of the health-care team well in advance.

Adaptations

Additional electricity sockets around the bed and in the child's living area, as well as some extra space for storing disposable utensils, are needed. Bath/shower facilities must be adapted to provide safety and to suit both child and caregivers. Occasionally, a clever rearrangement of rooms will substantially facilitate caregiving and monitoring. In case of room-sharing between siblings, one must consider the disturbance of the co-sleeper by alarms and various care measures. Transporting the child together with all necessary equipment often calls for adaptation of staircases, car seats, prams, etc.

Safety

Hazards for the child with a tracheostomy need to be identified and removed wherever possible. Exposure to feathery or furry pets, garden sprinklers, fountains, swimming pools, sand pits and powdery building or cleaning material, as well as air pollution by pollen, smoke, mist and household sprays, must be avoided.

Contacts

Well before discharge, communication with the family doctor, paediatrician, pharmacist, nurse specialist, when applicable also speech pathologist and physiotherapist as well as equipment supplier should be established. A telephone connection and power supply must be secured.

Family environment[6,21,22]

Home tracheostomy care is a considerable burden and challenge for any family; commitment to provide optimal care in the home and a conviction that home care is the best for the child's social, communicative and motor development helps caregivers to cope with this challenge and strive for a family life as near to normal as possible. As a prerequisite for tracheostomy home care, caregivers have to acquire the necessary knowledge and become competent in a spectrum of practical skills.

Once the child is in the home, parental responsibility is massive; anxiety and preparedness for an emergency may cause substantial stress. Increased attention to the child and insecurity concerning disciplinary measures can cause jealousy and resentment in the rest of the family; social isolation as well as physical and emotional overload may follow. To prevent burnout, additional caregivers have to be recruited and trained, and community resources utilised. It often helps caregivers to consult with support groups and establish links with other families who have successfully cared for a child with a tracheostomy. Provision needs to be made well in advance for accommodating the child in playgroup, kindergarten and school.

When, due to the underlying pathology, voice generation fails, other ways of communication, such as an electrolarynx, sign language or a letter board, need to be considered in order prevent isolation of child and family.

TRAINING FOR CAREGIVERS[4–7,15,20,23,24]

A structured training protocol, tailored to the needs of the individual child and equipment, has proved to be useful. The achievements of the trainee caregivers are monitored step by step in an appropriate log book.

Education is started preferably before elective tracheotomy; topics include indications for tracheostomy, the relevant anatomy and physiology, and differences form 'normal' breathing. Models, drawings and videos provide support for understanding the often complex situation. During the postoperative period, parents are encouraged to spend as much time as possible with their child in order to gain confidence in mastering the expected challenge of having a child with a tracheostomy at home.

Feeding, bathing, lifting the child out of bed, cuddling and carrying are demonstrated and gradually taken over by the parents. Once they feel confident with handling their child, teaching progresses to stoma and tube care as well as to monitoring vital signs. Special emphasis is directed towards a correct suction technique, and mock emergency situations as well as the appropriate resuscitation measures are discussed and practised over and over again. The equipment purchased for domiciliary care should already be used on the ward to practice correct handling, cleaning, maintenance and trouble-shooting.

Once all necessary knowledge and skills have been obtained and the child is ready to go home, the caregivers are admitted together with their child onto a side ward, where they can practise the home situation day and night and see for themselves whether they are competent and confident enough. An emergency package should be with the child at all times. This must contain a spare tube of same size and one size smaller, scissors, ties, suction catheters, normal saline, gloves and an ambubag with appropriate mask, together with an information card to quickly identify brand, size and length of tube, catheter insertion depth, the reason for the tracheostomy, potential individual risks and

the names and telephone numbers of physicians, therapists, nurses and service and maintenance companies.

CONCLUSION

In summary, caring for a child with a chronic tracheostomy in the home provides a challenge that can be met confidently by a package of optimal medical management, motivated caregivers, adequate training and education, a well prepared and equipped home environment, support from the extended family and community, and well-established communication with the health-care team. With these prerequisites, domiciliary tracheostomy care is as safe as, and in many other aspects superior to, long-term hospitalisation.

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PRACTICE POINTS

- Tracheostomy care can be safely performed in the home.
- It is essential that all caregivers are appropriately trained in all aspects of tracheostomy care and the management of relevant emergency situations.
- All necessary equipment for routine and emergency care, together with a competent caregiver, must be with the child at all times.
- The home environment should be adequately adapted and equipped ahead of time once the decision to carry out future domiciliary care is made.
- Family burnout can be prevented by the recruitment and training of additional caregivers and the utilisation of community resources.

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