CPR IN THE HOSPITAL UNDER UNUSUAL CIRCUMSTANCES
Part II

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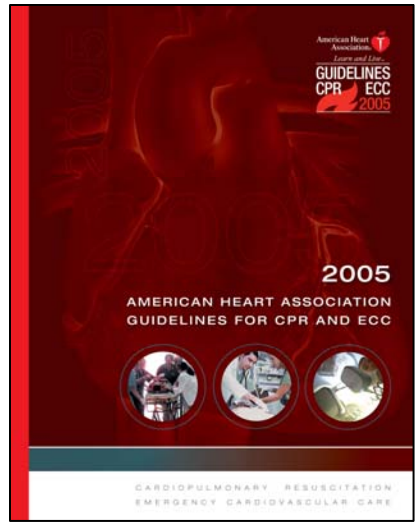


In this issue of Code Communications, the discussion will continue on how to perform CPR in the hospital when the circumstances are unusual. The 2005 American Heart Association (AHA) Guidelines for Cardiopulmonary Resuscitation (CPR) and Emergency Cardiovascular Care place much emphasis on improving patient outcomes through the performance of better quality CPR.[3] All health care providers who are certified in Basic Life Support (BLS) should know the answers to the following questions:

- Does it make a difference in the quality of CPR if the patient is on the floor versus the bed?
- If the patient is lying on a dynamic, pressure-relieving surface when s/he arrests, should the bed surface be deflated?
- Is it important to place a hard compression board under the patient during CPR on a standard hospital bed?
- How should CPR be adjusted if the patient is pregnant?
- How can the provider gain access to the chest and ventilate if the patient is in a Halo fixation system?
- How should ventilations be performed if the patient has a tracheal stoma?

The Effect of Various Support Surfaces on the Efficacy of Chest Compressions

Last month's issue of Code Communications ended with a discussion of how to perform CPR when the patient is in a small, confined area such as the bathroom. Once this patient is moved to a larger floor space where multiple members of the response team can encircle the victim and provide care, the question often arises about whether the victim should be placed up on the hospital bed for the remainder of the resuscitation. It is awkward for the responders to get on their knees and perform the various standard interventions at floor level. The various cables attached to medical devices may be easily stepped on and disconnected. It takes coordination of team members to lift the victim off the floor and carry him/her to the bed – and during this time essential compressions are not being performed. But a major question is whether compressions are performed better on a bed or on the floor.

Much of the research about the performance of CPR on the floor compares it to CPR on the bed with various support surfaces and to the bed at various heights. An early small study by Tweed compared compressions on a variety of surfaces: floor; foam mattress; alternating pressure air mattress (inflated and deflated); and a low-air-loss mattress (inflated and deflated).[12] Most air-filled mattresses incorporate a fast-deflate mechanism for use in cardiac resuscitation since the Guidelines recommend that compressions be performed with the victim on a hard surface,[3] but the need for and effects of emergency deflation for CPR have not been studied in detail. In Tweed's study 4 doctors and nurses, each of whom had been assessed in BLS within the previous 12 months, carried out compressions in a 15:2 ratio for four cycles using a manikin, while another colleague interposed ventilations. A computer-generated score was obtained based on the depth of compression, compression rate, compression/relaxation ratio and hand position as compared to the current consensus guidelines; all components had to be performed correctly if the compressions on the support surface were judged to be "correct". See Table 5 for the results.

Table 5 Compression Percent Correct and Depth for Participants on Various Supporting Surfaces (Tweed)

Surface	Mean % Correct Compressions	Mean Compression Depth (mm)
Floor	94.5	42.5
Foam	44.0	37.5**
Overlay (inflated)	27.5*	33.0**
Overlay (deflated)	39.75	35.5**
Alternating pressure (inflated)	66.75	38.0
Alternating pressure (deflated)	69.5	38.75
Low-air-loss (inflated)	55.75	37.5**
Low-air-loss (deflated)	55.75	37.5**

* % correct less than for floor, p<0.05; **depth less than for floor, p<0.05

The participants achieved effective compressions with the manikin on the floor. Compared with the floor, the proportion of correct compressions was less for the overlay inflated mattress. The depth of compressions was less effective for the overlay inflated/deflated, low-air-loss inflated/deflated and foam mattress. The authors conclude that there were no differences in compression variables between the support surfaces, whether air-filled or inflated or deflated. Thus, the results call into question the routine deflation of air-filled mattresses to undertake CPR.

In a later study Perkins compared CPR with a manikin placed on the floor to CPR on the bed at mid-thigh height with a foam mattress and also on an air-filled mattress while inflated, deflating and deflated.[13] The UK Resuscitation Council states that the "optimal height of the bed places the patient level between the knee and mid-thigh of the person performing compressions. The force of the compression should come from flexion of your hips and your shoulders should be positioned directly over the patient's sternum."[14] Twenty critical care physicians/nurses were recruited, all of whom had completed in-house training in BLS within the preceding 6 months. Participants were randomized to perform 75 seconds of 2-person CPR at a ratio of 15:2 on each surface with 5 minutes rest in between. See Table 6 for the results.

Table 6 Compression and Ventilation Parameters for CPR on Various Surfaces (Perkins)

	Floor	Foam Mattress	Inflated Mattress	Deflated Mattress
Compression depth (mm)	44.2	35.2*	37.2*	39.1*
Compression rate (minute)	121.8	124.7	126.5	125.7
Duty cycle (%)	45.5	47.6	44.6**	44.2
Number of shallow ventilations (<400 ml)	11	12	12	12
Number of deep ventilations (>600 ml)	0	0	0	0
Correct ventilations (%)	12.1	0	4.17	0

* = p<0.05 vs. floor; ** = p<0.05 vs. foam mattress

Chest compression rate and duty cycle did not vary among surfaces, but the depth was significantly less on all mattresses than on the floor ($p<0.001$). Depth of compression met that recommended in the Guidelines, 1½ - 2 inches or 38-51 mm,[3] only when compressions were performed on the floor. The number of attempted ventilations was similar although most were of inadequate tidal volume (<400 ml). The 10-20% reduction in chest compression depth between the floor and mattresses described in this larger study would seem likely to cause a reduction in the cardiac output associated with CPR, which could potentially have an adverse effect on outcome. Perkin's study also showed that there was no difference in compression rate, depth, and duty cycle or correct ventilations between the inflated and deflated mattress.

Another study out of the University of Birmingham, U.K., by Allan evaluated whether the bed height effects the efficacy of chest compressions.[15] Twenty BLS-trained medical students were randomized to perform 3 minutes of continuous compressions on a manikin placed on a standard foam mattress with the bed at mid-thigh height (65 cm), its lowest height (45 cm), and its maximal height (85 cm). Maximal compression force declined significantly ($p<0.01$) with increasing bed height; see Table 7.

Table 7 Relationship of Bed Height to Compression Force (Allan)

Bed Height	Compression Force
Floor	38.5 kg
Bed at 45 cm	36.1 kg
Bed at 65 cm	34.5 kg
Bed at 85 cm	30.5 kg

This challenges the current recommendation that CPR be performed with the bed at middle-thigh level. Since depth of compressions is often inadequate, it seems reasonable that the rescuer should be in a position to apply the greatest force. There were no differences in compression variables at standard height versus lower height. See Table 8.

Table 8 Difference in Compression Variables Between Bed at Standard Height versus Lower Height (Allan)

	Bed at Standard Height (65 cm)	Bed at Lower Height (45 cm)
Depth (mm)	31.1	32.6
Rate (minute)	100.2	99.7
Duty cycle (%)	48.5	48.9

Perkins then studied the effect of a backboard on the quality of chest compressions.[16] With the current emphasis on continuous compressions, the authors pose that insertion of a backboard is time consuming and interrupts compressions which can adversely affect outcome. Twenty medical students were randomized to perform 3 minutes of continuous compressions on a manikin placed on a bed adjusted to mid-thigh height. See Table 9 for the results in each of the following scenarios:

- Standing on the floor next to the bed ("standard")
- Standing on the floor next to the bed with the manikin placed on a backboard
- Kneeling on the bed next to the manikin with no backboard

Table 9 Compression Variables for CPR Related to Use of Backboard (Perkins)

	Standing, No Backboard	Standing, With Backboard	Kneeling, No Backboard
Depth (mm)	29	31	30
Rate (minute)	92	97*	93
Duty cycle (%)	42	42	44

*p<0.05 versus standing, no backboard

There was no difference in compression depth or duty cycle between standard CPR and CPR performed on a backboard. Compression rate was slightly slower with standard CPR than with backboard CPR when standing. This laboratory study demonstrates that in contrast to current Guidelines, the use of a backboard does not improve chest compression quality on a manikin lying on a standard hospital bed with a foam mattress.

The latest study by Anderson found opposing results: There was a significant increase in chest compression depth when applying a backboard over a standard foam mattress; see Table 10.[17] The bed height was the same for the 23 male orderlies who performed CPR on the manikin, but they stood on a footstool.

Table 10 Chest Compression Variables for CPR Related to Use of Backboard (Anderson)

	With Backboard	Without Backboard	P value
Compression depth (mm)	48	43	<0.0001
Proportion of compressions with correct depth (mean %)	48	51	NS
Depth >40 mm (mean %)	92	69	0.0007
Compression rate (per minute)	125	124	NS
Duty cycle (%)	46	46	NS
Incomplete release (%)	38	16	0.09

NS = not statistically significant

So what does all this mean? Given the scenario of a patient arresting in a small, confined space such as the bathroom, it appears that compressions are more effective related to depth if the resuscitation continues with the patient on the floor. When the victim is in a bed, the recommendation to perform compressions with the bed at mid-thigh level may not hold up to scientific rigor. Air-filled mattresses may not need to be deflated for effective CPR. Often CPR training is performed with the manikin on the floor, but since most hospital patients undergoing resuscitation are in beds, shouldn't training occur with the manikin in a bed instead?

All these studies were done with a manikin, so it is not known how this translates into performing CPR on humans. More research needs to be performed in this area as it relates to compression depth as well as force, and the effect on cardiac output. The studies described question the benefit derived from performing CPR with the bed at mid-thigh height, the routine use of a backboard during CPR over the usual hospital mattress, and activating the fast deflate button on an air-filled mattress when CPR is performed. Would compressions be more effective if the provider stood on a stool at the side of the bed – or kneeled next to the patient? Can the use of feedback devices guide the rescuer to compress at the correct depth? These questions remain unanswered.

CPR When the Patient is Pregnant

Cardiac arrest occurs only about once in every 30,000 late pregnancies; thus care providers are not usually familiar with how to adjust BLS and Advanced Cardiac Life Support (ACLS) when this unusual circumstance arises. During attempted resuscitation of a pregnant female, rescuers have two potential patients: the mother and the fetus. The best hope of fetal survival is maternal survival. Rescuers must provide appropriate resuscitation care, with consideration of the physiologic changes caused by pregnancy. These changes are outlined in Table 11.

Table 11 Physiologic Changes in Pregnancy that Influence Resuscitation

Cardiovascular	• Increased blood volume by 40-50% • Increased cardiac output of 30-50% by 32 weeks' gestation • Increased heart rate (usually by 15%) • Increased resting oxygen consumption • Decreased systemic vascular resistance due to hormones relaxing vasculature smooth muscles • When female lies supine, compression of the inferior vena cava and abdominal aorta by the gravid uterus, obstructing venous return to the heart
Respiratory	• Increased resting oxygen consumption by 20% • Edema of the upper airway • Reduced chest compliance due to rib flaring, splinting of the diaphragm by the abdominal contents, hypertrophied breasts • Diaphragm displaced upward by 1½ -3 inches • Increased respiratory rate • Compensated respiratory alkalosis during late pregnancy
Gastrointestinal	• Smooth muscle relaxation of the gut • Slowed intestinal motility • Relaxation of the cardiac sphincter between the esophagus and stomach • Delayed gastric emptying[18]

Generally, the resuscitation algorithms during cardiopulmonary arrest are the same for pregnant as for non pregnant patients with a few exceptions. Ventilation is made more difficult by the increased oxygen requirements and reduced chest compliance in pregnancy. Administer 100% oxygen quickly since hypoxia occurs sooner than when the victim is not pregnant. When providing positive pressure ventilation, cricoid pressure should always be applied due to the increased risk of aspiration until the airway is protected by a cuffed tracheal tube. It will be more difficult to observe for the rise and fall of the chest with ventilations in pregnant patients.

It is imperative that tracheal intubation be carried out as soon as equipment and competent practitioners are available to maximize oxygenation and minimize the risk of aspiration. Intubation may be more difficult due to the laryngeal edema and full breasts, and specialized equipment for advanced airway management may be required. Be prepared to use an endotracheal tube 0.5 – 1mm smaller in internal diameter due to airway edema.[3] The device used to confirm correct endotracheal tube placement should be an end tidal CO_2 detector since the esophageal detector device is more likely to suggest esophageal placement (the aspirating bulb does not reinflate after compression) when the tube is actually in the trachea.[3]

With the patient lying supine, aortocaval compression causes compromise of maternal perfusion and decreases cardiac output by 25-30%. If the patient is at greater than 24 weeks' gestation, the uterus should be displaced to relieve aortocaval compression prior to the initiation of compressions. Morris describes several methods to achieve this goal of 15-30° tilt:[19]

- Roll the patient onto her left side using a Cardiff resuscitation wedge, a wooden frame inclined at a 27° angle; see Figure 10.
- Tilt the patient onto her left side balanced against a rescuer's thighs ("human wedge").
- If the patient is on the floor, tilt the patient onto the back of an upturned chair; see Figure 11.
- Position the patient onto her left side using pillows or hospital-built wedges.
- A rescuer can move the uterus to the left and toward the patient's head by lifting it with two hands; see Figure 12.

Figure 10 Pregnant Patient Inclined Laterally Using the Cardiff Wedge (Morris)

Figure 11 Pregnant Patient Inclined Laterally Using Upturned Chair (Morris)

Figure 12 Rescuer Manually Displacing Uterus (Morris)

Rees and Willis measured the force achieved with chest compressions performed on a manikin in the decubitus position at various angles of inclination.[20] The resuscitative force decreased from 67% of the rescuer's body weight with the manikin in the supine position to 36% in the full lateral position. At an angle of 27° the maximal possible resuscitative force during CPR was 80% of that which could be achieved with the supine position. This study led to the development of the Cardiff resuscitation wedge, a wooden frame inclined at a 27°angle and specifically designed for performing CPR on pregnant patients. The wedge should be available in the intensive care unit, the operating suite, and the emergency room as well as in labor and delivery suites, because all of these sites may be the location of an arrest in a pregnant patient. While the patient is tilted, increased force will be required when performing compressions to achieve adequate depth.

Chest compression on a pregnant woman is made difficult by flared ribs, raised diaphragm, obesity, and breast hypertrophy. Since the diaphragm is pushed upwards by the abdominal contents, the hand position for chest compressions should similarly be moved higher on the sternum, slightly above the center of the sternum.[3] Because of the relative inefficiency of external compressions with the victim turned laterally, some authors advocate the use of early open cardiac massage to increase organ perfusion. However, prospective data are lacking to support its true efficacy, and its use should be guided on a case by case basis.[21]

Defibrillation and drug administration are in accordance with ACLS recommendations. It is difficult to apply a defibrillator paddle in the apical position with the patient rolled onto her left side, so the use of disposable adhesive electrodes in the anterior-posterior position are a good alternative. Remember to remove any internal fetal monitoring equipment that might conduct the electricity to the fetus. The femoral or other lower extremity vein should not be used for venous access since drugs administered through these sites may not reach the maternal heart unless or until the fetus is delivered.[3] Increasingly, magnesium sulphate is used to treat and prevent eclampsia. If a high serum magnesium concentration has contributed to the cardiac arrest, consider giving calcium chloride.[19] It is difficult to interpret maternal blood loss and provide volume resuscitation due to the volume expansion by 40-50% during pregnancy. The clinician must be wary of a falsely reassuring hemodynamic state masking ongoing hemorrhage.

Physicians must decide whether to attempt emergent cesarean delivery at the bedside in the resuscitation of pregnant patients in whom initial resuscitative efforts are not immediately successful. Timing and speed of the procedure are keys to optimizing outcome and limiting adverse neurologic sequelae in survivors. Katz reviewed the medical literature about perimortem cesarean deliveries that were reported through 1985.[22] Based on their findings, he recommends initiation of cesarean delivery within 4 minutes of maternal cardiac arrest if circulation has not been restored and fetal delivery within 5 minutes. These recommendations have been supported by other investigators and form the basis of the "4-minute rule." CPR must be continued during delivery, and the procedure should not be delayed for attempts to obtain consent from next of kin. Most experts agree that in the setting of maternal cardiac arrest, the doctrine of emergency or implied consent applies, and the best interests of the child take precedence.[23]

Estimated gestational age is an important factor in predicting prognosis for infants after perimortem cesarean deliveries. The threshold for expected fetal viability may vary slightly between institutions but generally is considered to be around 24 weeks of gestation. But the gravid uterus reaches a size that will begin to compromise aortocaval blood flow at approximately 20 weeks of gestation and thus affects the efficacy of CPR. It is a difficult decision to perform an emergency hysterotomy to enable successful resuscitation of the mother if the gestational age is 20 to 24 weeks. The AHA Guidelines state: "The critical point to remember is that you will lose both mother and infant if you cannot restore blood flow to the mother's heart."[3] With delivery of the fetus, there will be an increase of 25-56% in the circulating blood volume after the uterus is emptied. Ventilation will be easier now that the fetus is no longer causing elevation of the diaphragm, and compressions will be more effective. After 24 to 25 weeks, cesarean delivery allows an attempt at resuscitation of the infant as well as contributing to saving the life of the mother.[23]

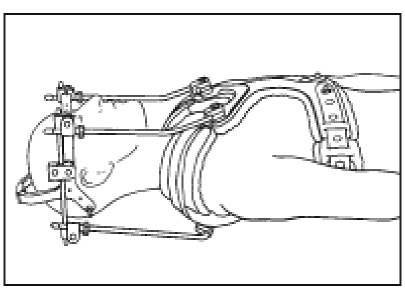
In conclusion, initial resuscitation efforts of the victim who is pregnant should be directed toward adequate oxygenation, ventilation, and compressions. Intubation should occur as quickly as possible and venous access assured. Resuscitation team leaders should activate the protocol for an emergency cesarean delivery as soon as the cardiac arrest is identified in the pregnant woman. Equipment and supplies for an emergency cesarean delivery should be readily available, as well as skilled personnel to perform the procedure and care for the infant. Speed and decisiveness are required for this unique circumstance.

Resuscitation of a Patient in a Halo Fixation System

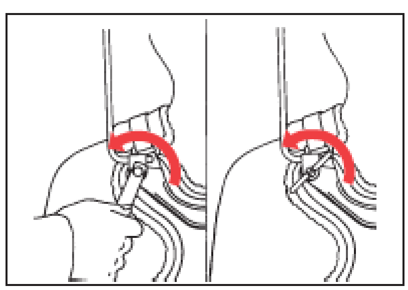
When a patient who is in a Halo fixation system experiences a cardiopulmonary arrest, resuscitation is made difficult related to several factors:

- Access to the patient's chest for performance of adequate compressions is denied.
- Access to the patient's chest for quick and correct placement of the defibrillation electrodes is limited.
- The patient's head may not be in position to perform adequate ventilations, nor to visualize the vocal cords for intubation.

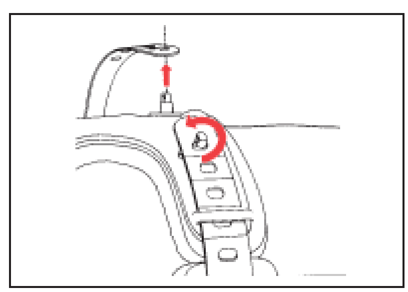
Those who care for patients in a Halo fixation system should be familiar with how to expose the chest for resuscitation. Manufacturers will provide simple instructions about how to open the vest portion, and often posters are available to place at the patient's bedside. DePuy Spine has provided the following instructions related to CPR with the Bremer AirFlo Vest.[24]



1 Place patient supine on posterior portion of the Vest.

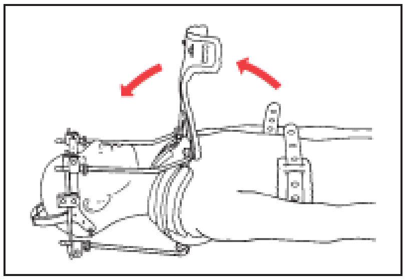


2 Loosen the two anterior Vest bolts using the 7/16" (11mm) wrench or, if attached, the ICU Knobs.



3 Release the thoracic bands by turning the locking posts and pull the bands out of the way.

Note: *If plastic cable ties are in place, cut them with scissors and remove prior to turning the locking posts.*



4 Rotate the anterior shell of the Vest away from the body exposing the chest.

5 Using the posterior Vest shell as a "crash board" perform CPR and/or Life Support as necessary.

Note: *Some stability of the cervical spine is maintained as long as the patient's body remains on the posterior Vest shell, the posterior Vest uprights are secure, and the transverse bars remain firmly attached to the Bremer Halo Crown/Adjustable Ring.*

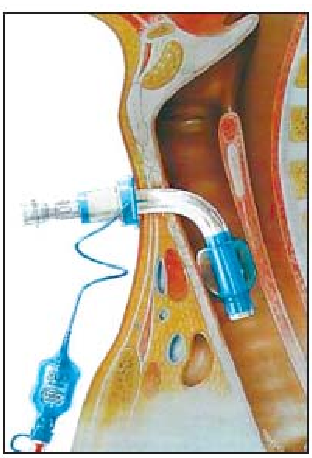
The wrench supplied with the vest should be attached to the vest, superstructure, or patient's bed at all times. The staff caring for the patient should practice this procedure using the vest on a resuscitation manikin so access to the chest can be achieved quickly. A cricothyrotomy kit and staff skilled in performing the procedure should be quickly available if adequate ventilation and/or intubation cannot be achieved.

Airway Management for Patients with a Tracheal Stoma during CPR

Written by John R. Steinkraus, BS, RRT, and Stephen M. Burlew, RT*

Performing CPR on a patient with a tracheal stoma is discussed only briefly in the 2005 Guidelines, and may not even be mentioned within the context of BLS and ACLS courses. Mouth-to-stoma ventilation is still suggested and remains the basic mode of resuscitation if there is no other equipment to use. However, in the hospital environment the healthcare provider is able to use universal precaution equipment as well as provide supplemental oxygen during resuscitation of a patient with a tracheal stoma. When tracheal stomas are created in the neck by various surgical procedures such as complete laryngectomy, partial laryngectomy, and tracheostomy, the advanced practitioner has various options for providing a secure airway during resuscitation.

Figure 13 Portex® Plastic Tracheostomy Tube with Cuff Inflated



(courtesy of Smiths Medical)

All Tracheostomy Tubes are not Alike

In hospitals the most common type of temporary surgically-placed intratracheal airway is a **plastic tracheostomy tube**. No matter what surgical procedure prompted the placement of the tracheostomy tube, using this tube to ventilate a patient in respiratory distress or arrest is most efficient. Balloon cuffs on trach tubes should always be inflated for resuscitation; see Figure 13.

How do you know if the tube is in proper placement and patent? Go back to what you learned in the basics of CPR and look for chest rise! Ventilation can be accomplished with the use of either a resuscitation mask attached to a one-way valve and mouthpiece or a bag-valve-mask (BVM) device – by removing the mask. Either unit will attach directly to the outside of the trach tube. Appropriate sized BVM's should be on every arrest cart and also placed at the bedside of patients with trach tubes.

Some trach tubes have **fenestrated inner cannulas**. Typically, positive pressure ventilation with a self-inflating bag or resuscitation mask will not be adequate unless the fenestration is closed. Air will leak out through the upper airways. Therefore, a non-fenestrated inner cannula must be placed inside the trach to cover the opening in the outer cannula. It should be standard practice to keep an extra complete trach set of the same size at the bedside of any patient with a tracheostomy.

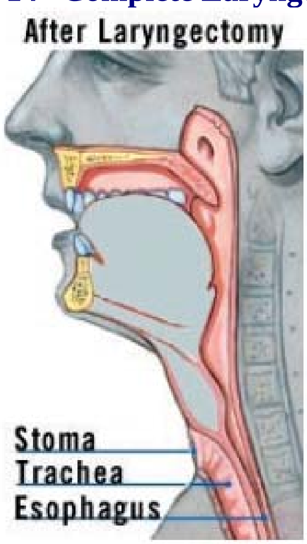
If the trach tube is capped, a non-fenestrated inner cannula should be placed into the trach tube for resuscitation.

Metal tracheostomy tubes (frequently called Jackson style) and metal laryngectomy tubes, although not frequently utilized in hospitals, will often not have a connector for attachment to BVM devices. There are 3 options for ventilating the patient in this case:

- Plug the small adaptor from the end of an appropriately sized endotracheal tube (ETT) into the opening of the trach tube. This will allow a connection directly to the resuscitation device.
- Attach a mask to the resuscitation device, form a seal around the stoma with the mask, and ventilate mask-to-stoma.
- Remove the metal tube and replace it with a new tube (ETT or plastic trach tube).

All Stomas are not Alike Either

Figure 14 Complete Laryngectomy



(from www.med.nyu.edu)

Patients with **complete laryngectomies** will have an open stoma typically placed much lower on the neck near their operculum (the small indentation in the center of the neck between the terminus of the clavicles). These patients have had their trachea exteriorized, their larynx removed, and there is no air movement through the upper airways, pharynx, mouth, or nose. See Figure 14. Initially, they must be ventilated through their stoma with a BVM (a pediatric mask may provide the best fit) and supplemental oxygen. Once experienced providers arrive at the resuscitation, they may place an ETT through the stoma if a more secure airway needs to be established. When placing the ETT into the stoma, passing the cuff just inside the trachea is important so as not to intubate the right main stem bronchus. The ETT will be sticking out of the stoma a fair distance and care should be taken if attempting to shorten the tube not to cut the pilot tube from the cuff.

Partial larygectomies may or may not have communication with the upper airways. Healthcare providers having direct care of the patient should check with the person who performed the procedure to learn the status. A BVM over the stoma should work in either case, however some air may escape out of the nose or mouth if there is some connection to the upper airway as a result of the surgery. Closing the mouth and pinching the nose may be necessary to facilitate proper chest rise during BVM ventilation to the stoma until an ETT can be placed in it. The surgical procedure that the patient has undergone may significantly alter the anatomy of the upper airway such that direct laryngoscopy through the mouth may be difficult, although still possible. Due to the anatomical anomalies present post-operatively, tracheal intubation through the stoma may be preferred over oro-tracheal attempts in these patients.
Some patients with a laryngectomy may use a trans-esophageal phonation device inserted via a small surgical passage or tracheoesophageal puncture (TEP). Patients with a TEP must have the nose and mouth securely sealed to prevent air leakage during stoma ventilation with a BVM or resuscitation mask – or require intubation. Care should be taken to watch for aspiration of the phonation device during resuscitation.[25]

Tracheotomy, the surgical procedure for creating a stoma into the trachea (**tracheostomy**), may be performed for many reasons including long term ventilation, occlusion of upper airway, obstructive sleep apnea syndrome, poor/absent cough, dysphagia and secretion removal. Figure 13 shows a patient with a tracheal stoma. With the trach tube cuff inflated, there is no communication with the upper airways, mouth and nose. As above, ventilate through the stoma with a BVM.

Complications of Ventilating Through a Stoma during Resuscitation

A plastic tracheostomy tube or a correctly placed ETT in the stoma will provide the best method for ventilating a patient in extremis as long as the tube remains patent and in correct position. Securing the airway after placement and confirming bilateral breath sounds will ensure that the airway is patent for ventilation. What happens if the tube is misplaced or occluded?

Occlusion may be overcome by suctioning the airway with the appropriate sized sterile suction catheter. Sometimes saline instillations may be necessary to help dislodge thick mucous. If the occlusion cannot be fixed, replace the inner cannula of the trach tube, or if necessary replace the whole tube. Be aware that an occluded tube may also be a **misplaced** tube. Frequently, misplaced tubes enter into the fascia around the stomal opening and the effort it takes to deliver the breaths is or becomes more difficult. Subcutaneous air (air beneath the skin) can become readily apparent in the neck if this is the problem. The tube must be removed and replaced into the stomal opening, then advanced down into the trachea. A sterile suction catheter or some other semi-rigid catheter (e.g. a nasogastric tube) may act as a guide for proper advancement. Be cautious to ensure that the tube being placed goes down toward the lungs, not up towards the pharynx. (As the stoma opening only goes straight in, a downward deflection of the tracheal tube is necessary to ensure proper placement.) Trach tubes, which are in general fairly stiff, have a natural curvature which almost ensures placement in the correct direction (as long as the curve is held in the downward position during insertion). Endotracheal tubes have only a slight bend to them and are much more flexible. Hence, correct placement may be more difficult with an ETT.

If, after removal of the blocked trach tube from the stoma, reinsertion is difficult, direct laryngoscopy may be necessary to secure the airway. The tube should be placed in this instance, such that the cuff is inflated distal to the tracheal stoma so that air will inflate the lungs and not leak out the stoma opening.

During placement of a tube, the correct size should be the largest that can fit, based on ACLS guidelines for the patient size. If a leak around the tube is suspected (because it is too small for the opening or the cuff is absent/broken), check for proper chest rise. Replace the tube only if it is absolutely necessary, using an obturator with a blunt end. If adequate ventilation can be achieved, do not change a patent airway until after successful resuscitation of the patient.

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Conclusion

It is important for healthcare practitioners in the hospital to know how to perform CPR according to the latest scientific knowledge when the circumstance is unusual. Obtaining a good outcome with neurologically intact survival may depend on having clear protocols for handling these situations, appropriate equipment close at hand, and healthcare providers who are knowledgeable and competent to adjust their performance of CPR as the situation demands. Consider how your hospital can prepare for performing CPR under these unusual circumstances. If there are additional unusual circumstances that have confounded your resuscitation efforts and you would like to learn more about how to perform better the next time, let me know about these so they can be addressed in future issues of the newsletter.

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