



Derry Fire Department CQI News

Excellence through Integrity, Professionalism, and Compassion

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Understanding Defibrillation Waveforms

Before we start, let's define a few terms:

Energy: Energy in a defibrillator is expressed in Joules. Joules is the unit of work associated with one amp of current passed through one ohm of resistance for one second.
Current: Current is what actually defibrillates the heart. It is also expressed as Voltage/ Impedance (resistance)
Impedance: Resistance to Flow; there is resistance in the electrical circuit itself as well as in the patient. The amount of impedance in a patient is difficult to determine as it relates to body mass, temperature, diaphoresis, quality of the contact with paddles or pads. Impedance is expressed in Ohms.

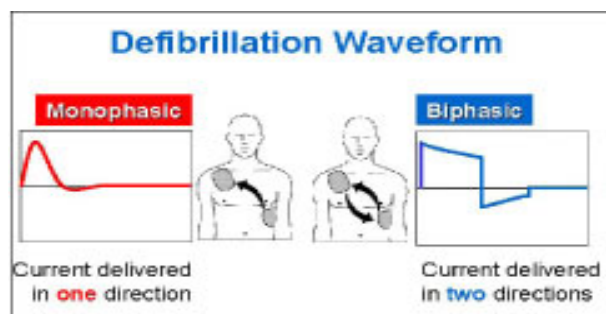
Monophasic Waveforms: (Old School) A type of defibrillation waveform where a shock is delivered to the heart from one vector. Typically energy flows from one pad to the other.

In this waveform there is no ability to adjust for patient impedance and it is generally recommended that all monophasic defibrillators deliver 360J of energy in adult patients to insure maximum current is delivered in the face of an inability to detect patient impedance. American Heart recommends that older monophasic defibrillators should default to 360J per shock.

Biphasic Waveforms: A type of defibrillation waveform where a shock is delivered to the heart via two vectors. Biphasic waveforms were initially developed for use in implantable defibrillators and have since become the standard in external defibrillators.

While all biphasic waveforms have been shown to allow termination of VF at lower current than monophasic defibrillators, there are two types of waveforms used in external defibrillators.

Monophasic verses Biphasic Waveforms:



Different defibrillator manufacturers have approached biphasic defibrillation differently. Both Physio Control and Philips use the biphasic truncated exponential waveform originally developed for internal defibrillators, though they use different energy settings with the waveform. Physio Control uses what they term a "high energy" biphasic waveform which they term ADAPTIV™ Biphasic. Physio Control energy settings go up to 360 Joules of energy and they essentially distribute the voltage and current available over a wider range of energy settings. Additionally they vary the voltage and extend the duration of the shock in higher impedance patients.

Philips Medical also uses the biphasic truncated exponential waveform in their SMART Biphasic but in this case distribute the voltage and current available over a more narrow range of energy with the maximum current delivered at 200J roughly equivalent to that delivered by the Physio Control device at 360J.

The Rectilinear Biphasic Waveform (RBW) is used by ZOLL medical and it differs from either of the BTE waveforms. ZOLL fixes voltage at maximum and varies resistance in order to deliver constant current across the broad range of patients. Like Philips, 200 Joules is the maximum setting on the ZOLL defibrillator, however this maximum represents more voltage on the capacitor than either Physio Control or Philips has available.

Submitted by Chuck Hemeon



Monophasic versus Biphasic Animal Study

Chest (2001; 120: 948-954)

Interventions: VF was induced in 20 anesthetized domestic pigs receiving mechanical ventilation. After 10 min of untreated VF, the animals were randomized. Defibrillation was attempted with up to three 150-J biphasic waveform shocks or a conventional sequence of 200-J, 300-J, and 360-J monophasic waveform shocks. When reversal of VF was unsuccessful, precordial compression was performed for 1 min, with or without administration of epinephrine. The protocol was repeated until spontaneous circulation was restored or for a maximum of 15 min.

Measurements and results: No significant differences in the success of initial resuscitation or in the duration of survival were observed. However, significantly less impairment of myocardial function followed biphasic shocks. Administration of epinephrine reduced the total electrical energy required for successful resuscitation with both biphasic and monophasic waveform shocks.

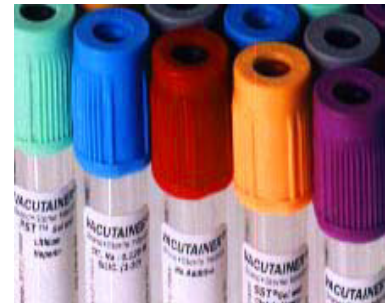
Conclusions: Lower-energy biphasic waveform shocks were as effective as conventional higher-energy monophasic waveform shocks for restoration of spontaneous circulation after 10 min of untreated VF. Significantly better postresuscitation myocardial function was observed after biphasic waveform defibrillation. Administration of epinephrine after prolonged cardiac arrest decreased the total energy required for successful resuscitation.



It's a "Bloody" Good Time!

Remember your order of blood tubes when drawing up blood for your patients heading to PMC. PMC asks that they be drawn as follows :

- Blue
- Red
- Green
- Purple



A word of Cardioversion: Synchronized cardioversion used in the treatment of unstable tachycardias (rate > 150/min) presenting with serious signs and symptoms related to the tachycardia, (hypotension, altered mental status, signs of poor perfusion)

Synchronized Cardioversion: LP-12, both monophasic and biphasic waveforms are acceptable.

- For V-Tach, A-Fib, PSVT- 100J, 200J, 300J, 360J
- For A-Flutter – 50 J, 100J, 200J, 300J, 360J
- For Polymorphic V-Tach – 200J, 300J, 360J

Biphasic and monophasic shocks are of similar efficacy in achieving sinus rhythm. Cardioversion of atrial fibrillation (AF), "a biphasic shock waveform has greater efficacy, requires fewer shocks and lower delivered energy, and results in less dermal injury than a monophasic shock waveform." But over the course of four cardioversion shocks, biphasic performance (maximum of 200 J) was similar to monophasic performance (maximum of 360 J) (success rate 91% v 85%). Thus, in terms of achieving sinus rhythm the outcomes were similar in both shock waveforms. Remember, Physio Control uses biphasic truncated exponential waveforms, what they term as "high energy" biphasic. Physio Control energy settings go up to 360 Joules of energy and they essentially distribute the voltage and current available over a wider range of energy settings.

Note: It is really not a good idea to try to compare manufacturers' biphasic waveforms as each is appropriate for the device in which it is found and none have been shown to be superior to others despite a number of clinical trials.

Submitted by Chuck Hemeon

Submitted by Parkland Medical Center

12 lead EKG's, So Easy a "CAVEMAN Can Do It"

Preparing a Patient for a 12 lead EKG is something that all personal on the Medic Unit should know how to do. It has been a misconception for years that an EMT- Basic and Intermediate should not have to perform this skill and that this has to be done by the Paramedic. This is not the case. An EMT Basic/Intermediate should be able to perform this skill with little to no difficulty and be able to deliver the printed EKG to the Paramedic for interpretation.

Let's Review

Step 1: Remove excess hair

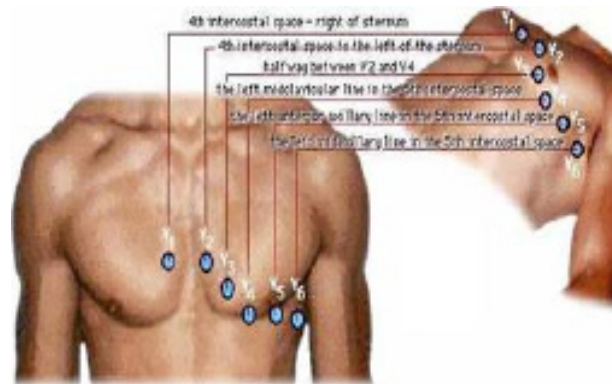
Step 2: Prep the area, Remove excessive skin oils with

Step 3: Place the limb leads on the Patient, LIMB LEADS GO ON THE LIMBS!!!

Step 4: Place the Chest leads on the Patient

- find the Angle of Louis
- move just to the right of the sternal border and find the second rib
- just below the second rib is the 2nd ICS
- move down 2 ICS to the 4th ICS
- place electrode V1 here
- move directly across the sternum to the 4th ICS left side and place V2 here
- move down 1 ICS (5th) and move to the midclavicular line place V4 here
- V3 is midpoint between V2 and V4
- draw an imaginary horizontal line from V4 to the midaxillary line
- place V5 in the anterior axillary line where the arm joins the chest
- place V6 in the midaxillary line

Submitted by Ron Sebastian



AHA Resting ECG Electrode Placement

PATIENT PREPARATION

1. Ensure the patient is warm and relaxed
2. Shave electrode site before cleaning if excessive hair is present
3. Normal skin - wipe with soap and water, then dry
4. Oily skin - wipe with alcohol, then dry

CHEST PLACEMENT

LEAD ELECTRODE PLACEMENT

- V1 Fourth intercostal space at right margin of sternum
- V2 Fourth intercostal space at left margin of sternum
- V3 Midway between position V2 and position V4
- V4 Fifth intercostal space at junction of the left midclavicular line
- V5 At horizontal level of position V4 at left anterior axillary line
- V6 At horizontal level of position V4 at left midaxillary line

LIMB PLACEMENT

- Place on nondominant arm
- Place on dominant arm

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The Moro Who?...

Seizure or Reflex

Recently Battalion 3 responded for a pediatric seizure. The case presents a 2 week old that was being carried up a flight of stairs by mom who said she stumbled nearly dropping the child. Immediately after the incident, seizure activity was witnessed by the parents and EMS was called.

Auburn first responders report a full term 2-week-old healthy baby boy. PAT assessment finds normal appearance, work of breathing and circulation of the skin. A TICLS assessment was also completely normal. Mother reports a long complicated delivery but fails to provide further detail about those complications. The patient takes no medications and has no allergies to medications or other pertinent medical history.

So was it a seizure or something else?

Hospital diagnosis, Moro reflex.

The reflex occurs when the infant is suddenly startled by a loud noise or experiences the sensation of falling. Evaluation of the reflex includes a startling stimulus immediately followed by abduction or adduction of the arms and in many cases crying. The response should only last seconds and has no other seizure related activity.

The Moro reflex was discovered by Dr. Ernst Moro and is one of the infantile reflexes found in healthy infants during the first 4 or 5 months of life. A positive response beyond this age indicates severe neurological defects. Furthermore patients with inadequate or asymmetry in their reaction may have also been diagnosed with Brachial plexus palsy, have a fractured clavicle or some other central nervous system neurological abnormalities that will require further follow up.

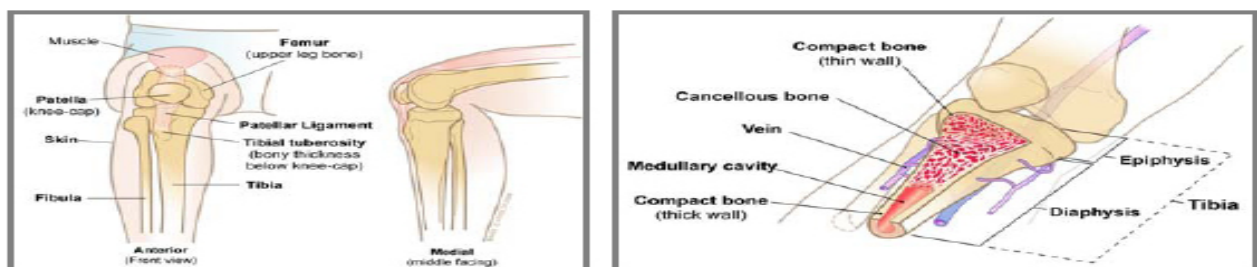
Submitted by Ed Gannon

Intraosseous Review EZ-IO



Immediate Vascular Access
When You Need It Most

Proximal Tibial Anatomy



Adults are >40 Kilograms. As a general rule, if the patient fits on a length based tape think pedi IO set.

Indications for Proximal Tibial Insertion:

- Altered Level of Consciousness
- Respiratory Compromise
- Hemodynamic Instability

Examples of disease states often meeting the criteria include, but not limited to:

Cardiac arrest, Status epilepticus, All shock states, Arrhythmias, Dehydration, Burns, Overdose, DKA (diabetic) Renal failure, Stroke, Coma, OB complications, Thyroid crisis, Trauma, Anaphylaxis, CHF, Emphysema, Respiratory arrest, Hemophilic crisis.

Contraindications for Proximal Tibial Access:

- Fracture in or distal (target bone)
- Previous orthopedic procedure near insertion site (IO within 24 hours)
- Infection or burns at insertion site
- Inability to locate landmarks or excessive tissue

Confirm and Clean Insertion Site:

EZ-IO landmarks, the tibia (anterior of the upper and lower leg bone), Patella (knee cap), Tibial tuberosity a bump, or raised area on the anterior aspect or front of tibia).

Site of choice:

Proximal tibia, 1-2 cm medially and 1-2 cm distal to the tibial tuberosity on the anteromedial surface.

Note: Big Toe-EZ-IO, EZ IO is placed on the medial aspect of the leg – the big toe is found on the medial aspect of the leg.

Insert Needle Set:

Position the EZ IO Drive at a 90 degree angle to the bone. Do not force the needle set into position"allow the driver to do the work"

IMPORTANT- Stabilize the needle set prior to any attempt at removing the driver. Failure to stabilize the catheter may cause inadvertent dislodgement.

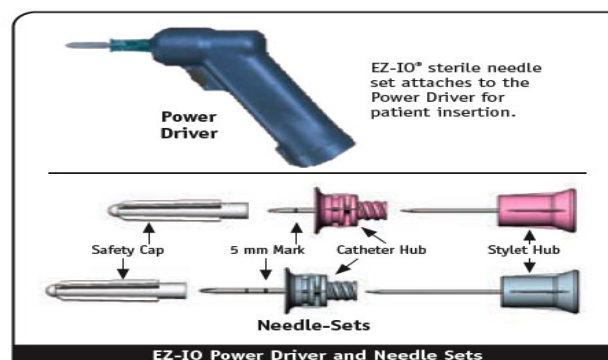
Remove the stylet and syringe flush catheter:

Syringe flush the catheter with 10 cc of sterile solution.

- Attach the EZ IO extension set to the standard luer lock & confirm placement of the catheter. This is accomplished by:
 1. Catheter is firmly seated and does not move
 2. Observed blood on the stylet tip (note by wiping tip on a 4x4) prior to placing stylet in the shuttle or bio-hazard container
 3. You note blood at the catheter hub
 4. You are able to aspirate blood or marrow from the catheter
 5. Drugs or fluids flow without difficulty – there are no signs of extravasations (leakage) in or around the tissue.
 6. NOTE: Conscious patients will experience PAIN with infusion prior to Lidocaine. Don't forget to medicate first.
 7. You observe the desired effects of the medications administered
 8. X-ray confirmation

Four Important Points to Consider once the EZ IO has been established:

1. Routinely reconfirm that the EZ-IO catheter is secure and in position
2. Maintain appropriate protection at the insertion site guarding against accidental bumping or dislodgement
3. Frequently monitor EZ-IO, the fluid and extremity
4. Remove EZ-IO within 24-hours



Avoid rocking the EZ-IO catheter during usage:

Use the EZ-IO Connect extension set supplied with the needle set to avoid complications

Begin infusion with pressure:

A pressure bag or infusion pump will improve the flow rate

If blood samples are required, draw blood directly from the EZ-IO EZ Connect

Prior to drug or fluid administration be certain to syringe flush the EZ-IO catheter with 10 cc of fluid. There is a distinct difference between the "syringe flush and a bolus" The pressures generated by the syringe – clearing the "pathway for treatment" (Which is necessary because of the anatomy and nature of the IO space) versus the relatively slow, low pressure "supportive administration" of fluids given over time.

No Flush= No flow Failure to syringe flush may result in a limited or no flow situation

Administer Lidocaine:

If the patient is conscious slowly administer 20-50 mg of 1% prior to the initial bolus. IO fluid administration will cause severe pain for conscious patients and is related to intramedullary pressures. Lidocaine has proven to be extremely effective treatment for this pain.

Adult 2-5 cc (20-50 mg) 1% Lidocaine

To remove EZ-IO:

EZ-IO is rarely ever removed in the field; however hospital staff should be advised that the EZ-IO should be removed within 24-hours. Many area hospitals (PMC, CMC, and And Elliot) have been in-serviced on the EZ-IO.

Removal of EZ-IO is simple. Grasp the hub directly or attach a sterile syringe. The syringe will serve as a larger handle for the catheter hub and is preferred.

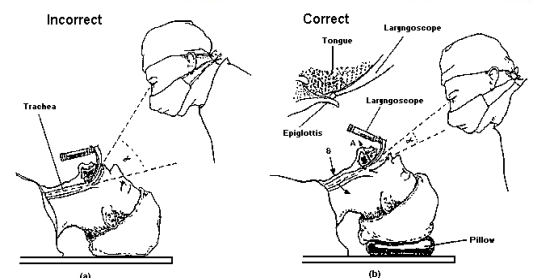
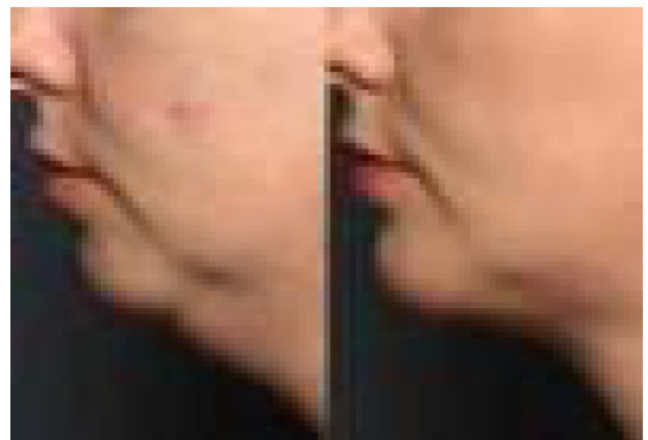
Support the patient's extremity, maintain a 90 degree angle while rotating the catheter clockwise and gently pulling.

Rotating the hub during removal reduces catheter to bone friction and will allow for an easier removal process. Be certain not to rock the catheter while removing. Rocking or bending the catheter with a syringe may cause the catheter to separate from the hub.

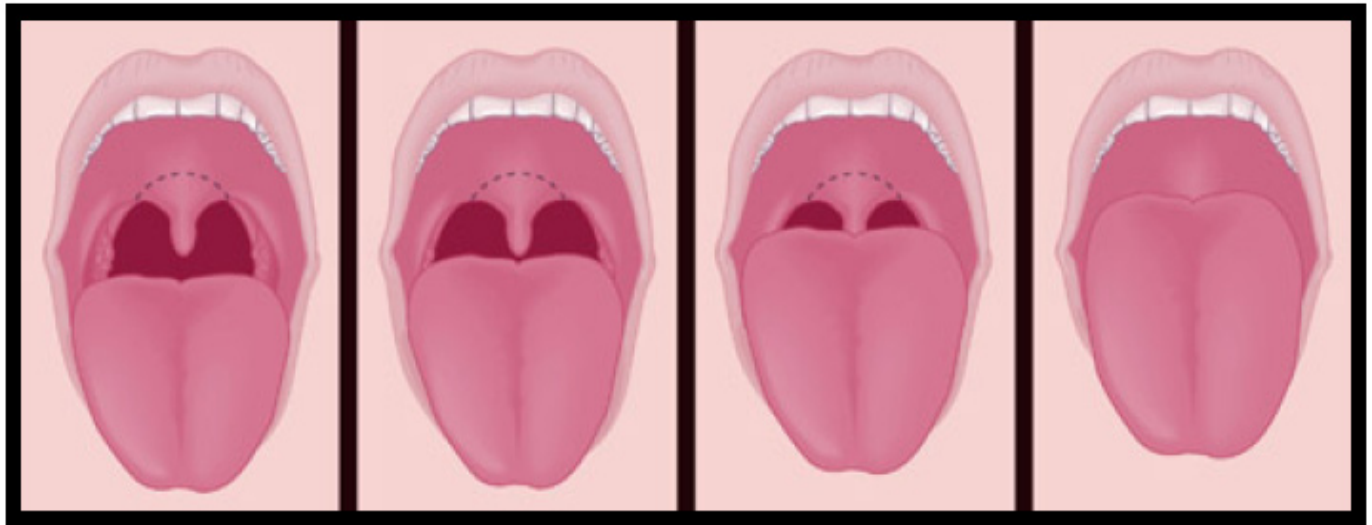
Submitted by Chuck Hemeon

Rules and terminology for External Grading for intubation.

- Evaluate 3-3-2
 - Temporal Mandibular Joint
 - Should allow 3 fingers between incisors
 - 3-4 cm
- Evaluate 3-3-2
 - Mandible
 - 3 fingers between mentum & hyoid bone
 - Less than three fingers
 - Proportionately large tongue
 - Obstructs visualization of glottic opening
 - Greater than three fingers
 - Elongates oral axis
 - More difficult to align the three axis
- Evaluate 3-3-2
- Larynx
 - Adult located C5,6
 - If higher, obstructive view of glottic opening
 - Two fingers from floor of mouth to thyroid cartilage



- Mallampati Score – To perform appropriately requires a conscious patient who is able to sit up and open mouth. Providers are not able to perform on an unconscious patient.
- Evaluates ability to visualize glottic opening
 - Patient seated with neck extended
 - Open mouth as wide as possible
 - Protrude tongue as far as possible
 - Look at posterior pharynx
 - Grade based on visual field
- Grades 1,2 have low intubation failure rates
- Grades 3,4 have higher intubation failure rates



Class I

Class II

Class III

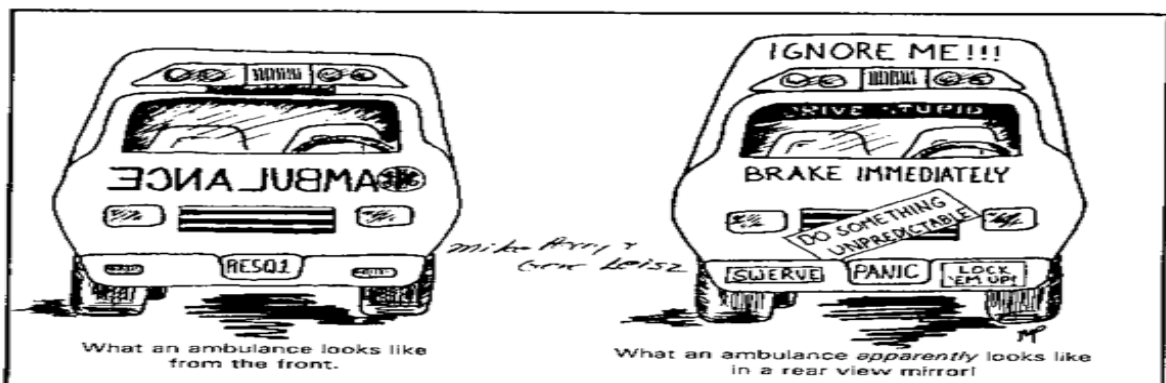
Class IV

- Classification 1:
 - Visualization of the soft palate, uvula, anterior and posterior pillars
- Classification 2:
 - Visualization of the soft palate, uvula
- Classification 3:
 - Visualization of the soft palate and base of the uvula
- Classification 4:
 - Soft palate is not visualized

Remember to document your 3 – 3 – 2 and Mallampati Classifications.

Submitted by Shawn Haggart

Siren? Where???



Professionalism Personified

Great job Battalion 3

In the month of July at approx. 1300 hrs members of Battalion 3 (Eng. 1 & Medic 1) were dispatched to a residence for "Breathing Problems". Upon arrival the crews along with DPD found an unconscious not breathing 80 year old male in sudden Cardiac Arrest, CPR was quickly initiated along with other ALS care. Pt was in the care of our members for approx. 25 minutes. Upon arrival to PMC's emergency department the Pt had converted back into a normal sinus rhythm.

Highlights to this call

- Four Minute response time
- 21 Minute total on scene time
- 25 Minute total Pt contact
- Good BLS
- Good ACLS

Follow Up: The patient had significant Hx, looks like he had an MI precipitating the Code, ended up with significant neuro deficit and multi organ failure. Made a DNR next day and died third day. Dr.Wagner who took the patient, had no concerns and thought the crew did an excellent job.

Submitted by Ron Sebastian

Mechanically Ventilated Patients at Home

Air goes in; air goes out. Taking a breath is something we do thousands of times a day without thinking but due to incidences of paralysis or neuromuscular diseases some people require the assistance of mechanical ventilation...and are more commonly going home with ventilators.

During our EMS training we learn about providing assisted ventilations in terms of rate and volume. The early generations of mechanical ventilators were also designed around these principles; today's prehospital "resuscitation" ventilators still are. However, over the years it was realized that rate and volume are only part of the equation. Flow and pressure adjustments are now incorporated to make mechanical "breaths" safer and feel more natural. An adjustable pressure or flow-based trigger tells the ventilator when the patient is initiating a breath so it can respond accordingly. As a result ventilator-patient synchrony is greatly improved. This translates into better patient comfort. Alarms let us know when measured rate, pressure or volume falls outside set parameters.

When a patient is initially placed on mechanical ventilation in the hospital the rate is typically started at 10 and the volume (in milliliters) is set for approximately 10 times their ideal body weight in kilograms (90 kg = 900 ml). Adjustments are made to assure safe airway pressures, physiologically normal flow and optimal inspiratory/expiratory ratios. An arterial blood gas is drawn to determine oxygen and carbon dioxide levels and the ventilator settings are readjusted accordingly. By the time ventilator-dependent patients are discharged the settings to meet their needs have been well established.

Ventilator Modes

There are four basic modes of ventilation. The prescribed mode is based on the level of ventilatory support needed by the patient.

Assist/Control (A/C) Ventilation

Synchronized Intermittent Mandatory Ventilation (SIMV)

Continuous Positive Airway Pressure (CPAP – sometimes described as Pressure Support Ventilation; PSV)

Pressure Control Ventilation (PCV)

Ventilators in A/C mode will deliver the selected volume at the selected rate. If the ventilator senses the patient triggering a breath it will deliver the additional breath at the selected volume. This mode provides the most ventilatory assistance and is typically used with patients who are either critically ill, paralyzed or otherwise have little or no drive to breathe. SIMV provides a lesser degree of support. It is utilized with patients who have a normal, intact drive to breathe but lack the neural or muscular ability to sustain adequate ventilation. As with A/C, mechanical breaths are delivered at the selected volume and rate. However, when the patient triggers an additional breath he gets whatever volume he takes. A Pressure Support level is usually set to augment spontaneous breaths with a boost of pressure. This helps achieve a satisfactory tidal volume and minimizes extra work of breathing imposed by the resistance of the ventilator circuit and artificial airway.

A ventilator in CPAP mode will maintain a set distending pressure in the patient's airway but will not deliver breaths to the patient. As with SIMV, pressure support is used to augment spontaneous breaths. The ventilator will alarm if the patient's breathing falls below set minimums. Most ventilators will allow a back up rate and volume to be set which will automatically activate if the unit senses apnea. While this mode is used frequently in the hospital as a means of weaning patients from mechanical ventilation, it is rarely used for the "in home" environment.

PCV mode is used for patients with low airway compliance and is also rarely used in the home setting. A/C and SIMV modes represent volume-based ventilation. When a specific tidal volume is delivered, a certain amount of pressure is required to force that volume into the lungs. This pressure will vary with airway compliance. Airway pressures can rise based on patient positioning or decreasing compliance due to advancing disease processes, pulmonary edema, pneumonia, mucus or other obstruction. PCV requires setting a delivery pressure instead of a volume and is used for patients with chronically low airway compliance (stiff lungs). In this mode the volumes will vary somewhat breath to breath but the pressure will not exceed the set limit.

PEEP

In all modes a PEEP level (Positive End-Expiratory Pressure – functionally the same as CPAP) is also set to maintain a normal intrathoracic pressure and prevent alveolar collapse between breaths. This replaces the physiological expiratory resistance of the patient's upper airway structures which are now bypassed by an artificial airway.

Oxygen

Most patients who go home with a ventilator do not routinely need supplemental oxygen. If you determine oxygen is indicated and the patient does not already have the capability it can quickly be added by placing a nebulizer "T" in the ventilator circuit. Connect an empty nebulizer to the "T" and run oxygen through the nebulizer at the desired flow.

Alarms

Mechanical ventilators approved by the FDA for home use have several alarms that are set to assure that the patient/ventilator system remains within safe parameters. Here are the more common alarms:

- High Pressure
- Low Pressure
- Low Volume
- High Rate

The High Pressure alarm is the most commonly activated alarm. This alarm is typically sets the airway pressure limit to about 50% higher than that of the patient's normal breaths. This alarm may activate due to decreased compliance, coughing, trying to talk, or airway obstruction. It often indicates a need to have the airway suctioned. Inspiratory airflow will stop when the high pressure limit is reached even if the set volume is not met.

The Low Pressure alarm activates when the ventilator cannot reach a minimum air pressure in the circuit when it attempts to deliver a breath. Depending on the ventilator model this limit may be manually set or automatically calculated based on the set PEEP level. It usually indicates a disconnection somewhere in the ventilator circuit preventing air from reaching the patient.

When the volume of air to or from the patient is measured to be less than a set minimum the Low Volume alarm will activate. It will also be triggered by a disconnection in the vent circuit but can also provide a warning of fatigue when activated by low spontaneous volumes for patients using SIMV and CPAP modes. Additionally, it identifies decreased compliance or the need for suctioning of patients using PCV mode.

The High Rate alarm is pretty self-explanatory. A high respiratory rate can be an indicator of agitation, pain, increasing temperature or other metabolic disturbance causing a shift in acid/base balance. Coughing, laughing and "talking" may also trigger a High Rate alarm.

Use your clinical judgment when assessing a ventilated patient. It is not unreasonable, based on the situation, to consider that the ventilator may not be meeting the needs of the patient. Whenever in doubt, disconnect the ventilator and provide ventilations with a BVM.

With advances in medical technology, more ventilator-dependent people can be expected to be living at home and traveling through our communities. This primer will hopefully serve to gain familiarity and reduce anxiety when dealing with their equipment.

Submitted by Paul Blais AFD

Lt. Paul Blais, NREMT-P, RRT-NPS
EMS Coordinator; Auburn Fire-Rescue



In Memory of our Fallen Brothers

We Will NEVER Forget



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*Firemen never die, they just burn forever
in the hearts of the people whose lives
they saved. ~Susan Diane Murphree*

