3

Electrical Interventions

Quick Contents

Patient outcomes from cardiac emergencies are often intimately connected to the “time to treatment”. For each minute that a patient has been pulseless, chances of effecting a return of pulse decreases by 7-10%. After 12 minutes of a cardiac arrest...well, resuscitation is very unlikely.

In general, electrical therapy is warranted for hemodynamically unstable patients with heart rates that are either too slow or too fast. For the pulseless patient in ventricular fibrillation or ventricular tachycardia, electrical intervention is vital.

The rationale and procedures necessary to administer external non-invasive electrical interventions are examined. These include automatic external defibrillation, manual defibrillation, synchronized cardioversion and transcutaneous pacing.

This chapter’s primary intent is to reinforce the rationale and procedures necessary to competently deliver electrical interventions. As a cardiac care practitioner, timely application of electrical interventions may save your patient’s life.

I wasted time, and now doth time waste me.

William Shakespeare

Rationale for Electricity

The use of electrical therapies to convert dysrhythmias has been studied since the late 1800s. It was not until the 1960s that (somewhat) portable defibrillators were available. The inclusion of portable transcutaneous pacing capabilities has existed for only the past 20 years.

Over the past 40 years, periodic updates by the American Heart Association (AHA) of their guidelines has gradually elevated electrical therapies to their current position of prominence. Meanwhile, our infatuation with medication use for the pulseless patient is waning. For the live patient, whether stable or unstable, synchronized cardioversion (rate too fast) and transcutaneous pacing (rate too slow) are at least equal in efficacy to their pharmacological counterparts.

Sudden Cardiac Death and Defibrillation

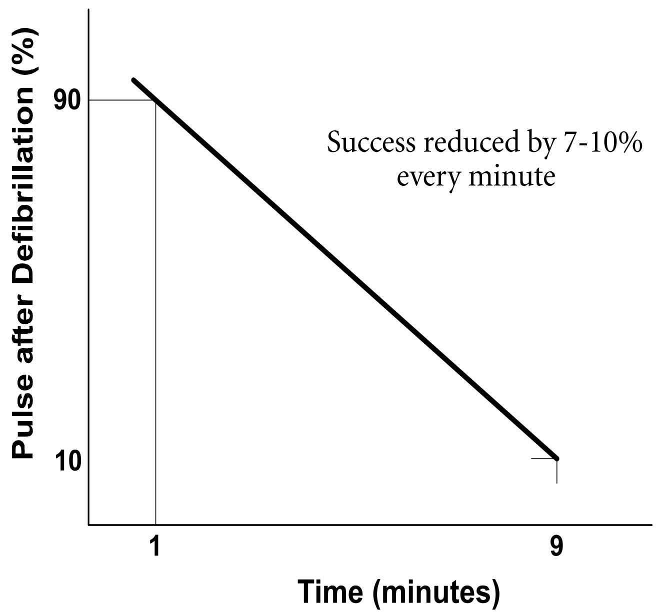
Sudden cardiac death (SCD) claims about 1/2 of all those who die of coronary artery disease, most within 2 hours of the first symptoms. This accounts for over 350,000 deaths annually in North America alone. Most deaths due to SCD follow a brief episode of cardiac ischemia. For most people with coronary artery disease, a SCD is the first symptom.

The most frequent cardiac rhythm first seen with SCD is ventricular fibrillation. Pulseless ventricular tachycardia (VT) may also be an initial rhythm of SCD, but VT tends to convert quickly to ventricular fibrillation (VF). The window of opportunity is very limited. Within minutes, ventricular fibrillation will terminate in asystole making resuscitation much less likely.

Research has shown a direct relationship between survival from SCD and timely defibrillation. Studies have also demonstrated unequivocally that CPR, IV access and intubation - while beneficial when used with defibrillation - are not able to re-establish a perfusing rhythm without defibrillation. **Ever**. Effective CPR buys us time - but contrary to its claim, it does not "resuscitate" a patient.

As mentioned earlier, despite early CPR the chances of a successful defibrillation to a perfusing pulse diminishes by 7-10% every minute that the arrest continues (see Figure 3.1 on page 75).

Figure 3.1 Successful Defibrillations Versus Time



Early defibrillation is absolutely necessary. No cardiac drug can claim the efficacy of early defibrillation (see Figure 3.1).

With about 95% of SCD occurring outside of hospital, it is important to have defibrillation capabilities outside the hospital. Until recently, only ambulances were equipped with cardiac defibrillators. With the average time to defibrillation in some centres being 10-12 minutes for the ambulance, it is not surprising that survival from VF outside of hospital is as low as 1-3%.

With advances in technology came automatic external defibrillators or AEDs. The AED has the ability to recognize lethal dysrhythmias that require defibrillation (VF and VT). With voice prompting, the AED directs non-medical personnel to safely defibrillate. The 2000 Advanced Cardiac Life Support guidelines of the AHA advocate for an AED in centres that have a cardiac arrest on average once every 5 years. The AHA also advocates the use of an AED by non-medical personnel.

Early research on the AED and public access defibrillation has produced incredible results. Episodes of SCD on airplanes and in casinos where close monitoring (early detection of the arrest) is common are associated with successful resuscitation for 50% of the cases. Training in the use of an AED is now part of a basic CPR course. Hospitals are also looking at the AED for non-critical care personnel, as response times for the critical care arrest team are often over 5 minutes (from call placed to first shock).

Electrical Therapy for the Stable and Unstable Patient

While defibrillation is vital in restoring a perfusing rhythm from pulseless SCD, synchronized cardioversion and transcutaneous pacing are well accepted treatments for symptomatic tachycardias and bradycardias respectively. Time is again an important factor. A hemodynamically compromised patient can quickly succumb to a cardiac arrest. For example, about 25% of cardiac arrests are preceded with periods of extreme bradycardia followed by VT or VF.

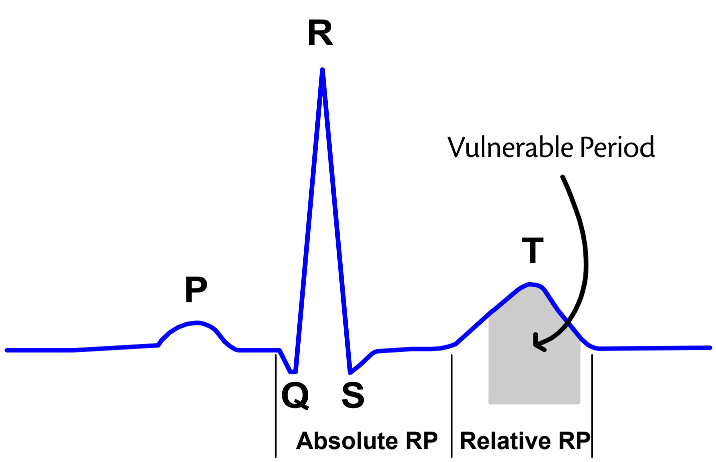
Synchronized cardioversion and transcutaneous pacing are electrically distinct from defibrillation. With both cardioversion and TCP, the QRS complex of the underlying rhythm is sensed or flagged. For cardioversion and TCP, the 'R' wave controls whether electricity is delivered or not and when in relation to the patients' own rhythm. With defibrillation, a shock is delivered immediately upon discharge of the paddles. Why? The answer lies in the inherent risks of R-on-T phenomenon.

R-on-T Phenomenon

Electricity applied to the ventricles during the later stages of ventricular repolarization - represented on an ECG as a T wave - can suddenly change the cardiac rhythm to VF or VT. How this occurs is provided in the following brief explanation (skip the next few paragraphs if you wish).

The cardiac cell's cyclical process of depolarization occurs rapidly (less than 10 milliseconds). Repolarization of cardiac tissue takes much longer (over 300 milliseconds). During early repolarization, the cell enters an absolute refractory state where no electrical impulse of any strength could cause the cell to fire (depolarize). The **absolute refractory period** ensures that cardiac cells depolarize in a highly coordinated manner.

Figure 3.2 Absolute and Relative Refractory Periods



At the beginning of the T wave, during the **relative refractory period**, strong electrical stimuli can produce depolarization but overall the cells remain resistant to firing. As the cell continues to repolarize, the cell enters the vulnerable period. The cardiac cells are now vulnerable to early depolarizations at a time when the ventricles are not fully ready to accept an electrical wave. What can result, particularly for those with heart disease, is a rapid ventricular tachycardia that can that can quickly evolve into ventricular fibrillation.

At least three incidences of sudden cardiac death to youths have occurred at hockey rinks in Canada over the past few years. In each instance, the young hockey player was struck in the chest by a puck. The impact of the rubber puck produces electrical energy (similar to a precordial thump). We can only postulate that the timing of the impact correlated with the T wave and ventricular fibrillation ensued.

What this means in practice? **If the patient has a pulse, make certain that any external electricity applied to the heart occurs away from the T wave**. The safest instant to cardiovert would be during the absolute refractory period, synchronized with the 'R' wave. For transcutaneous pacing, sensing for an 'R' wave helps to ensure that electrical impulses are not delivered on the T wave.

If the patient is pulseless while in VT or VF, an asynchronous shock cannot make matters worse. Pulseless is as bad as it gets. Therefore, defibrillation is the electrical method of choice.

Paddles and Adhesive Hands Free Pads

The high energy electrical interventions mentioned in this chapter (defibrillation and cardioversion) deliver electrical current through standard hand-held paddles or through self-adhesive pregelled disposable pads. Transcutaneous pacing utilizes the self-adhesive pregelled disposable pads only.

Optimizing Paddle and Electrode Contact

For effective paddle use, a conductive medium must be used between the paddles and the skin to reduce resistance, minimize burns and increase the likelihood of a successful response to treatment. Conductive gel pads or paste are commonly used. Check the gel pad package for the expiration date prior to use. To prevent electrical arcing, gel pads or adhesive pads should be placed at least 5 cm apart.

The use of ultrasound gel is not ideal as it does not conduct electricity as well as gel pads or paste designed specifically for electrical conduction.

Figure 3.3 Correct Anterior Gel Pad Placement

Adhesive hands free pads come in air tight packages with expiration dates. Use pads from undamaged packages before the expiration date. Press from one edge of the pad across to express any air pockets to ensure full contact between the pads and the skin. Smooth the edges of the pad.

For both paddles and pads, contact with the skin is optimized if the skin is prepped beforehand. The skin should be dry to minimize conductivity across the skin (which reduces the current through the heart). Abundant hair should be quickly removed with a safety razor.

Of particular importance for hand-held paddle use is the application of sufficient pressure on the paddles to achieve good contact and increase conductivity. The application of 25 lbs. of pressure on each paddle is often cited in the literature. Perhaps a more practical guideline is the application of a firm pressure, so that your hands cannot be knocked off the chest easily.

Paddle and Pad Placement

Whether using hand-held paddles or adhesive pads, two configurations are suggested for placement. The anterior placement of paddles or adhesive pads is convenient for the unconscious and/or pulseless patient while the anterior-posterior (A/P) configuration may be preferable especially for TCP, since some reports state better electrical capture with this placement method.

For anterior placement, the sternal paddle (or pad) is placed just right of the sternum below the clavicle. The apex paddle is placed left of the nipple with the center of the paddle along the midaxillary line. Note that the paddles or adhesive pads, though labelled sternum and apex, are just as effective with positions reversed.

Figure 3.4 Anterior Placement of Adhesive Pads

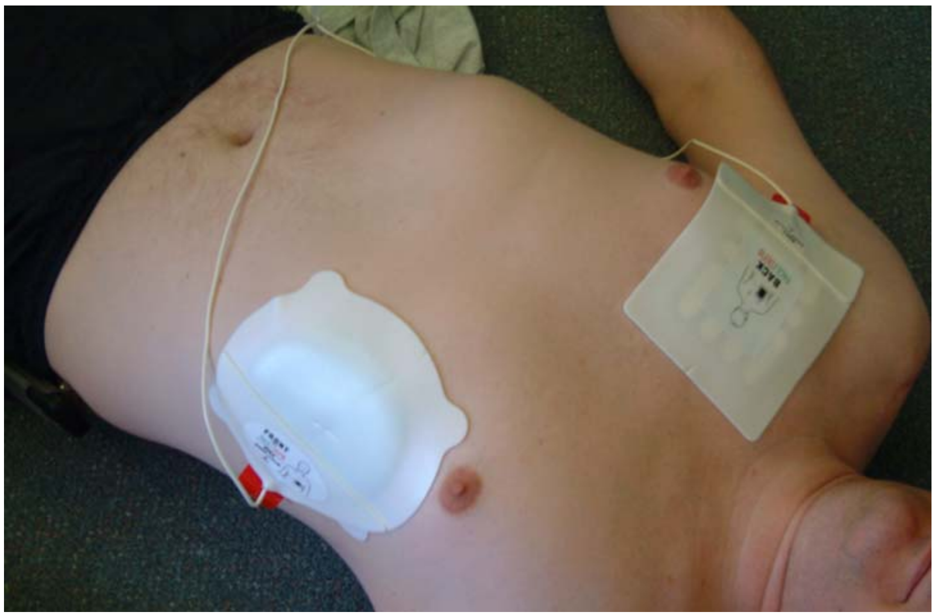


Figure 3.5 Anterior Placement of Hand-Held Paddles

The second paddle configuration, the anterior-posterior (A/P) position, sandwiches the apex of the heart. The anterior paddle is placed over the apex just to the left of the sternum below the nipple. For females, place the anterior paddle under the breast. The posterior paddle is placed just left of the spine below the scapula.

Figure 3.6 Pad Placement Using the A/P Configuration

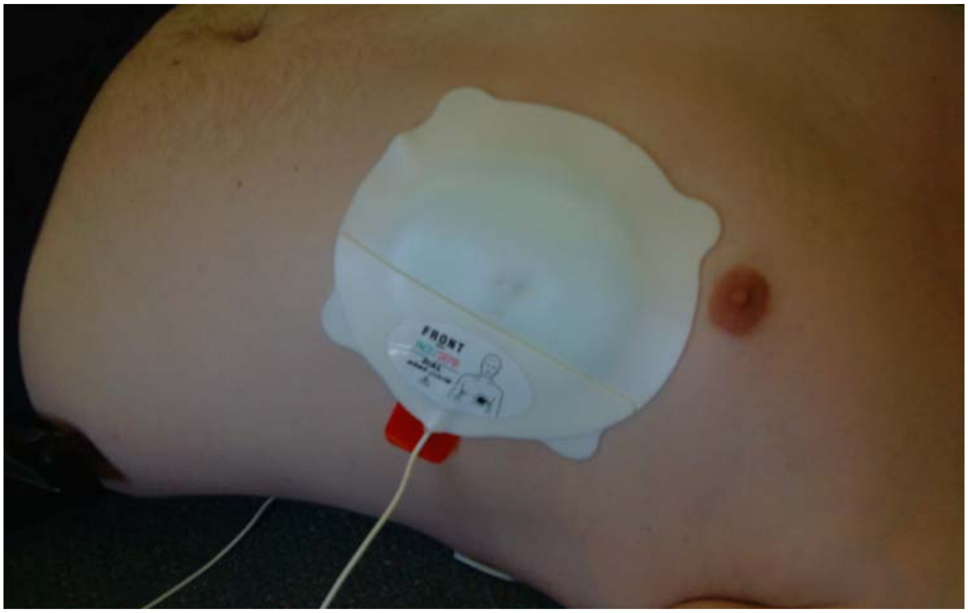


Figure 3.7 Posterior Pad Placement Using the A/P Configuration

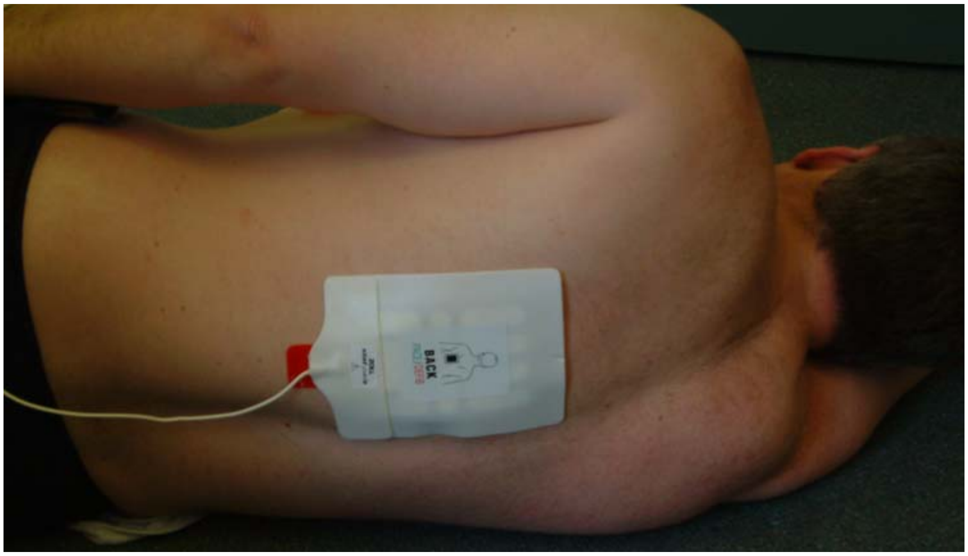


Figure 3.8 Paddle Placement Using the A/P Configuration

Whether anterior positions or A/P positions are used often depends on convenience and familiarity. Note that repeated unsuccessful discharges using anterior positions may warrant use of alternative pad (or paddle) placement. We have had success using A/P paddle placement after repeated unsuccessful defibrillations using anterior placement of paddles.

Special Circumstances

The standard placement of paddles or pads may not be optimal in certain circumstances. For patients with permanent pacemakers or automatic internal cardiac defibrillators (AICD), paddles and electrodes should be applied away from this electronic equipment. Alternative positions include the A/P configuration or sliding the sternal paddle (pad) down and away at least two inches from the pacemaker or AICD.

For small adults, the large adult adhesive pads or gel pads may cover too large an area, causing the paddles or pads to be less than 5 cm apart. For this situation, options include using the A/P paddle or pad position or using the pediatric paddles or pads. Adhesive pads or gel pads placed too close together may lead to electrical current following a path across the skin via an electrical arc (rather than through the chest wall into the heart).

Defibrillation Overview

Defibrillation is the therapeutic use of a significant electrical current delivered over about 6-10 milliseconds to depolarize the heart for the purpose of terminating pulseless VF and VT. Hopefully, the return of a perfusing rhythm occurs thereafter.

The rationale for early defibrillation has been well established. For patients experiencing sudden cardiac death, the chances of a successful defibrillation decreases by 7-10% each minute that the arrest continues. On a more positive note, defibrillation within 2-3 minutes of a sudden cardiac death can resuscitate the majority of victims.

Defibrillation is delivered by either a monitor defibrillator or an AED. The AED is an automatic device, equipped with defibrillator pads, a speaker, removable batteries, and operational buttons (on/off, analyze and shock). A display screen for viewing rhythms is only rarely included in an AED. The AED is a portable light-weight device designed to be operated with minimal training.

Figure 3.9 An Automated External Defibrillator

The monitor defibrillator is a manual device operated by critical care personnel. Typically, hand-held paddles and/or hands free pads are standard features of any monitor defibrillator. The monitor defibrillator is able to display and print rhythms, deliver electrical current - synchronous and asynchronous - and often pace transcutaneously.

The standard monitor defibrillator does not analyze rhythms although newer models can have an integrated AED function. Electrical current is adjusted via energy select buttons on the main monitor and/or on the hand-held paddles. Unlike the AED, charging of the paddles is initiated by a charge button on the monitor defibrillator and/or the paddles.

Figure 3.10 Monitor Defibrillator

The likelihood of a successful defibrillation is dependant on the following 5 factors:

1) time between onset of VF (or pulseless VT) and defibrillation;

2) paddle position;

3) energy level;

4) transthoracic impedance; and

5) the physiological status of the patient.

Of the 4 factors, time is by far the most important. Correct paddle position ensures that the electrical current will primarily cross the heart. Paddles placed on the sternum, for example, are associated with diminished results as bone is a poor electrical conductor.

The higher the energy level the better the chance of a successful defibrillation. But don't start automatically at high energy settings (i.e. 360 Joules). Studies have linked higher energy shocks to increased "stunning" of the heart. A heart that is stunned by external electrical energy becomes more rigid (less compliant) which can exacerbate heart failure and low cardiac output states. Always start with the lowest recommended energy setting.

Transthoracic impedance is simply the electrical resistance between the paddles. As resistance increases, electrical current and the likelihood of a successful defibrillation decreases. Transthoracic impedance decreases with successive shocks, with less time taken between shocks, with increased paddle size, and with increased pressure applied to the paddles (if used).

How then is transthoracic impedance managed in the hands free pad system since no pressure is being applied by the operator? New defibrillator systems measure transthoracic impedence prior to defibrillation and adjust the current delivered based on the findings. The operator may as an example select 200 Joules on a defibrillator but after shocking the patient the screen on the machine states that 230 Joules was deliverd. This would be an example of the detection of a higher than average impedence. Likewise in a frail patient the defibrillator may only deliver 150 Joules when the operator selected 200 Joules

The physiological status of the patient can greatly affect the chances of a successful defibrillation. For example, a patient who eventually succumbs to respiratory failure with its associated acidosis is much less likely to respond favorably to defibrillation than the otherwise healthy patient who experiences a sudden cardiac arrest. Efforts to improve the patient's physiological status via CPR, airway management and IV fluids may increase defibrillation success.

Defibrillator Safety

The delivery of large amounts of electrical current to a pulseless patient has the potential to electrocute those near the patient. Defibrillation safety can be compromised by equipment failure and operator error. Equipment failure can be minimized with scheduled checks and regular maintenance. Operator error is a distinct possibility at any cardiac arrest.

Particularly at the beginning of cardiac arrests, personnel are often not functioning optimally. The cardiac arrest team are themselves experiencing significant adrenergic stimulation - cognitive, auditory and visual abilities are often diminished for at least the first couple minutes. It is during this initial period that team members are at the highest risk of also being shocked.

Simple measures can dramatically reduce incidence of bystander electrocution. The operator of either the monitor defibrillator or the AED must ensure that the team members are not touching the patient. This is accomplished by announcing "clear" at least 2 times and by visually panning from head to foot. A commonly stated cadence to ensure defibrillation safety is:

I'm clear. You're clear. We are all clear.

The operator of the paddles must also be clear. While this isn't much of a factor with hands free pad use, hand-held paddles can electrocute the operator if the paddles are wet or have paste on the paddles other than on the defibrillation surface. Make certain that the paddle handles are dry and free of excess conductive medium.

Because defibrillation can produce an electrical arc (spark), the presence of high flow oxygen in close proximity presents the risk of fire or even an explosion. It is good practice to remove the bag-valve-mask with high flow oxygen from the patient during defibrillation.

Defibrillation Using an AED

Operating an AED can be a simple exercise. Because the AED analyzes the rhythm, steps necessary to minimize **artifact** (extraneous non-cardiac electrical activity produced by movement of the electrodes or the surrounding muscle) are important.

The prime directive, though, is to a**pply the AED only to people who are pulseless and not breathing.** Since the ability to detect a pulse is often difficult (for both health care providers and lay persons) many experts believe that looking for signs of lifelessness should be the inclusion criteria for AED use, not a pulse check. If the patient looks dead, is not moving and is not breathing then attach the AED.

The AED is designed to defibrillate VF and rapid VT only. The AED will deliver escalating amounts of electrical energy often at 200 Joules, 300 Joules and 360 Joules, self-analyzing between each shock.

Procedure

1. Confirm that the patient is unresponsive. Call for help. Check for a pulse and other signs of life such as breathing.

2. If pulseless (lifeless), open the AED and turn it on by **pressing the ON/OFF button**.

3. A voice prompt will direct you to connect the hands free pads to the chest. Expose the chest, ensuring that the area for the pads is dry and free of medication patches or excess hair (shave if necessary).

4. Connect the pads. Pictures on the pads encourage anterior placement (sternum and apex).

5. The AED will either begin to analyze automatically or prompt you to push the analyze button. **Push the ANALYZE button** ensuring that all bystanders are clear of the patient. Rhythm analysis takes about 5-10 seconds.

6. If the AED determines that the rhythm is either VF or VT, the AED will state that a shock is advised and will commence charging (usually to 200 Joules). Once the AED completes charging, it will prompt you to ensure that **all are clear** of the patient and to **push the SHOCK button**.

7. This cycle of analysis and shock will occur 3 times at escalating energy levels. If all 3 cycles are completed or if the rhythm changes, the AED will prompt you to check the pulse. **Check the pulse**. About 10 seconds later the AED will then prompt you to **begin CPR if there is no pulse.**

Note that after a minute of CPR, this procedure will begin again.

Defibrillation Using a Cardiac Monitor Defibrillator

While the AED can be operated with minimal training, defibrillation using a cardiac monitor defibrillator is often the domain of critical care professionals. This is not because the monitor defibrillator (M-dF) is complicated to use but rather because skillful rhythm analysis is required of the operator.

Procedure

1. Turn on the monitor defibrillator. Connect the lead electrodes to the patient's chest allowing also for the placement of defibrillation paddles or electrodes. **Change the lead select to lead II** if not already displaying lead II. Note that a M-dF commonly defaults to either lead II or paddles. Know your M-dF.

2. Expose the chest, ensuring that the area for the electrodes is dry and free of medication patches or excess hair (shave if necessary).

3. If using paddles, **apply conductive paste** to the underside of the paddles or place gel pads on the chest in the designated positions.

4. Select the appropriate energy setting (200 Joules for most M-dF). Press the paddles firmly to the chest in the sternal and apex positions. **Charge the paddles on the patient.**

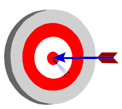
5. Ensure all personnel including yourself are clear of the patient, the bed and any equipment that may be connected to the patient.

6. Discharge the M-dF by pushing both discharge buttons (front of paddle) simultaneously. Release the buttons.

7. Observe the patient and the monitor. If the rhythm is unchanged, another shock is delivered at the same or higher energy setting (often 300 Joules) following steps 4-7. A third shock is provided at a higher energy level if the rhythm does not change.

8. If the rhythm changes, or if 3 successive shocks are delivered, check the pulse. If no pulse, begin CPR.

Defibrillation should be performed thereafter every minute as long as the rhythm remains VF or pulseless VT. If using electrodes rather than paddles, simply charge from the M-dF, and deliver the shock as per the directions of the M-dF.



Most newer cardiac monitors and AEDs deliver biphasic current rather than the monophasic current of older equipment. With the biphasic defibrillators, standard energy settings are not established as yet. Manufacturers recommendations include: a) 200J, 300J and 360 J - the same as monophasic; b) 150 J, 150 J, 150 J; and c) 120J, 150J and 200J.

Synchronized Cardioversion

Synchronized cardioversion is appropriate for both stable and unstable tachycardias. Because the patient has a perfusing rhythm, prevention of further deterioration to VF merits attention. The shock must delivered on the R wave and away from the T wave (see R-on-T phenomenon earlier in this chapter). Second, the patient should be suitably sedated prior to the procedure.

This first task - providing the shock on the R wave -is accomplished by ensuring that the SYNC button is pressed and that the M-dF is flagging the R waves. The M-dF might incorrectly identify large T waves when the QRS is small. Increase the ECG size on the M-dF or try different lead settings to ensure that the R wave is indeed being flagged (some indication on the monitor close to the R waves).

Conscious sedation prior to synchronized cardioversion is generally accepted. Short acting sedatives such as midazolam (Versed) or Propafol are commonly used. The use of analgesics such as Fentanyl is often given as well.

Issues of operator safety with synchronized cardioversion is identical to defibrillation (see the section on defibrillation). Common adverse effects of cardioversion include the appearance of other dysrhythmias (including VF), hypotension and respiratory depression (largely due to medicated sedation).

Because the patient has a perfusing rhythm, electrical energy settings begin lower than those of defibrillation. For example, atrial flutter often converts with energy settings as low as 10 Joules. In British Columbia, a simplified approach to energy settings for synchronized cardioversion begins at 100 Joules. Escalation to higher energy levels often follow the steps of 100 Joules, 200 Joules, 300 Joules and 360 Joules.

Between each successive shock, pulse checks should be performed. For example, deterioration from VT with a pulse to VT without a pulse would necessitate only defibrillation not synchronized cardioversion.

Procedure

If elective cardioversion, the patient should have nothing by mouth for at least 6 hours prior to the procedure. Explain the procedure to the patient, obtaining consent. Obtain a baseline 12 lead ECG.

1. Turn on the monitor defibrillator. Connect the lead electrodes to the patient's chest allowing space for defibrillation paddles or electrodes. **Change the lead select to lead II** if not already displaying lead II.

2. Expose the chest, ensuring that the area for the electrodes is dry and free of medication patches or excess hair (shave if necessary).

3. Provide sufficient sedation and analgesics. Monitor for hypotension and respiratory depression. Manage the airway as required.

4. If using paddles, **apply conductive paste** to the underside of the paddles or place gel pads on the chest in the designated positions.If using electrodes, apply the electrodes to the chest in either the anterior or A/P positions.

5. Press the SYNC button. Ensure that the M-dF is synchronizing on the R wave. If the R wave is not sufficiently tall, either increase the size of the ECG (as per directions of the M-dF) or try different leads.

6. Select the appropriate energy setting (100 Joules for most M-dF). Press the paddles firmly to the chest in the sternal and apex positions. **Charge the paddles on the patient.**

7. Ensure all personnel including yourself are clear of the patient - the bed and any equipment that may be connected to the patient. Discharge the M-dF by **pushing both discharge buttons (front of paddle) simultaneously waiting until the shock has been delivered**. Note that the M-dF will deliver a shock the instant it finds the next R wave.

9. Observe the rhythm and check the pulse. If the rhythm is unchanged, another synchronized shock is required. **Note: you may need to push the SYNC button again to synchronize.** Escalating energy levels of 100J, 200J 300J and 360J are commonly used.

10. If the rhythm changes to VF, check pulse. If pulseless, perform asynchronous shocks. Otherwise, assess and monitor the patient.

Non-Invasive Transcutaneous Pacing

Non-invasive transcutaneous pacing (TCP) is an effective temporary adjunct for patients whose are experiencing symptomatic bradycardias or early, witnessed asystole. Because TCP can be painful, TCP is usually reserved for those who are hemodynamically compromised. TCP is a stop-gap measure designed for periods of less than 6 hours until either the cardiac conduction system resumes normal functioning or transvenous and permanent pacemakers are established.

Electrical current is passed through large pacing electrodes through the chest wall and heart with the intended outcome of causing repeated depolarizations of the heart. TCP is simple to initiate and is relatively safe to use.

Demand and Non-Demand Modes

Most, if not all, M-dF units that offer TCP default in **demand mode**. In demand mode, an electrical impulse will only be delivered if it is needed. If an intrinsic beat occurs prior to the interval set to pace, the TCP will sense but will not fire. **Sensing** is the following of the patient's QRS complexes and is seen on the display screen by dots, squares or inverted triangles flagging the R waves.

Non-demand mode delivers electrical current to the heart at a set rate irrespective of the heart's intrinsic activity. It is used only if the sensing of the QRS complex is erroneous despite troubleshooting measures. For example, if the M-dF senses T waves or artifact instead of the QRS complex, the TCP may not function effectively.

Only if attempts to correct the problem - adjusting the size of the ECG, switching leads or repositioning electrodes on the chest - fail and the patient is grossly unstable should non-demand mode be used. The risk of using the non-demand mode rests primarily in the possibility of delivering electrical current during the vulnerable period. Note that this risk may be significant only for those experiencing cardiac ischemia.

Capture and Failure to Capture

While TCP is fairly simple to operate, a few measures are necessary to ensure pacing is effective. During TCP a spike appears on the monitor due to the discharge of current for pacing. This spike should initiate ventricular depolarization resulting in a QRS complex.

If a spike is immediately followed by a QRS complex, this is called electrical **capture**. With capture, the TCP is electrically effective. By checking the pulse, we can determine if the captured QRS complex resulted in a perfused pulse.

If the current delivered is insufficient to consistently cause QRS complexes to appear, this is called loss or **failure to capture**. A logical and expected response to loss of capture would be to increase the current until capture is achieved. Note that with most M-dF the maximum pacing current available is 200 milliamperes. Capture for most adults is reached with currents of 40-100 milliamperes.

Procedure

Explain the procedure to the patient, obtaining consent. Obtain a baseline 12 lead ECG if time permits.

1. Turn on the monitor defibrillator. Connect the lead electrodes to the patient's chest allowing space for pacing electrodes. **Change the lead select to lead II** if not already displaying lead II.

2. Expose the chest, ensuring that the area for the electrodes is dry and free of medication patches or excess hair (shave if necessary).

3. Prepare sufficient sedation and analgesic for the patient to be given once the patient is hemodynamically stable (after the TCP is functioning).

4. Apply the electrodes to the chest in either the anterior or A/P positions.

5. Turn on the TCP. Ensure that the TCP is in demand mode. Confirm the correct sensing of the QRS complex (troubleshoot if necessary).

6. Set the current at minimum. Select the pace rate (rates of 70-80/minute are common)

7. Adjust current upward until consistent capture is achieved. For hemodynamically compromised patients, increasing quickly to 50 milliamperes and then adjusting to capture may be practical. For the asystolic patient, adjusting the current quickly to the maximum and then adjusting down is accepted practice.

8. Monitor the patient for discomfort. Administer sedation and analgesic as tolerated. Monitor for hypotension and respiratory depression. Manage the airway as required. Monitor the resulting rhythm for consistent capture.

Summary

Advances in technology have improved access to timely and non-invasive electrical interventions for patients experiencing dysrhythmias. The delivery of defibrillation has progressed from the domain of the physician to trained non-medical personnel with the user-friendly AED.

Defibrillation is the therapeutic use of a significant electrical current to depolarize the heart, hopefully followed by the return of a perfusing rhythm.For patients experiencing sudden cardiac death, the chances of a successful defibrillation decreases by 7-10% each minute.

The delivery of large amounts of electrical current to a pulseless patient has the potential to electrocute those near the patient. Ensuring that no one is touching the patient, the bed or any equipment connected to the patient virtually eliminates the possibility of electrical accidents.

Synchronized cardioversion is now seen to be at least as effective as antiarrythmic medications for terminating tachycardias. Issues of safety with synchronized cardioversion is identical to defibrillation. Common adverse effects of cardioversion include the appearance of other dysrhythmias (including VF), hypotension and respiratory depression (largely due to medicated sedation).

Non-invasive transcutaneous pacing (TCP) is an effective temporary adjunct for patients whose cardiac conduction systems have failed. Because TCP can be painful, TCP is usually reserved for those who are hemodynamically compromised.

TCP is a stop-gap measure designed for periods of less than 6 hours until either the cardiac conduction system resumes normal functioning or transvenous and permanent pacemakers can be utilized. Continual monitoring for consistent capture is required while TCP is being used.

The application of electrical interventions in a timely fashion is often vital to saving lives.

Chapter Quiz

1. Synchronized cardioversion rarely requires sedation

True or False

2. Defibrillation is provided quickly to the pulseless patient in:

a) atrial fibrillation
b) ventricular tachycardia
c) pulseless ventricular tachycardia
d) asystole

3. The automated electrical defibrillator (AED) will shock people who are in SVT and asystole.

True or False

4. Before defibrillation attempts, pulse checks are necessary despite the use of a cardiac monitor because rhythms such as VF can be also produced with loose electrodes.

True or False

5. For every minute in VF, chances of successful defibrillation are reduced by:

a) 3-5%;
b) 7-10%;
c) 12-15%;
d) 60%

Answers: ***1.*** *False;* ***2.*** *c);* ***3.*** *false;* ***4.*** *true;* ***5.*** *b);*

6. For hemodynamically unstable tachycardias, synchronized cardioversion is the treatment of choice.

True or False

7. Approximately (20%,30%, 40%, 50%) of deaths from an MI, are caused by lethal rhythms within the first 2 hours of symptoms.

8. Transcutaneous pacing is optimally performed in (demand, non-demand) mode to reduce the likelihood of (Brugata phenomenon, R-on-T phenomenon).

Suggested Readings and Resources

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AED Challenge Simulator.Physio-Control Corporation. Found at http://www.medtronicphysiocontrol.com/products/aed_challenge.cfm

Crockett, P. et al. (2001). Defibrillation: What You Should Know. Redmond, Washington: Physio-Control Corporation. Found at http://www.physiocontrol.com/documents/defib_booklet.pdf

Del Monte, L. and Gamrath, B. (2001). Non-Invasive Pacing: What You Should Know. Redmond, Washington: Physio-Control Corporation. Found at http://www.physiocontrol.com/documents/pacing_booklet.pdf

Guidelines 2000 for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. (2000). American Heart Association.

What's Next

While electrical interventions deserve special consideration in many cardiac emergencies, most acute cardiac events also demand proper attention to airway management and the delivery of supplemental oxygen. For those experiencing cardiac ischemia, oxygen delivery to the ischemic region may limit the extent of injury. For the arrested patient, appropriate basic and advanced airway management can improve the likelihood that electrical interventions are successful and that neurological recovery is optimized. **Chapter 4: Airway Management** addresses these considerations, focusing on the rationale and techniques necessary in a cardiac emergency. Take a deep breath...

Answers: ***6.*** *true;* ***7.*** *50%;* ***8.*** *demand, R-on-T phenomenon*