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Pre-hospital emergencies

hypothetically speaking

The role of pre-hospital emergency responder is a lot of things. It is challenging. It is daunting. It is tiring. It is incredibly satisfying. It is unique in many ways. It is a bit first aid, a bit doctor, a bit social worker and almost always jack of all trades. The call outs never stop coming and you never quite get to that point where you have seen it all. University education is common in the modern pre-hospital era but that only prepares you to start your learning. When you finally start you would once have been an ambulance driver or officer but now more likely a paramedic or emergency medical technician. Whatever you get called there is one certainty – you will be a novice in this working world that is like few others. You have precious few diagnostic tools, language barriers, extremes of emotion, the elements against you with uncertainty your constant companion.

There is an expression that says experience is something you get just after you need it. Experience is something every pre-hospital responder needs. You will gain a lot of it over the years of a career. Much of it will come under duress and the hard way through error or your partner putting you right just before. But what if you could learn through sharing the experience of others? You might avoid some of those errors or close call moments. You would certainly be much better prepared for the differing situations as they arise.

These hypotheticals are all based on real call outs, real patients and real situations. These are the cases where experience came just after it was needed the first time. It doesn’t have to be this way for others though. They encompass typical medical and traumatic emergencies as confront pre-hospital responders and look beyond the simple written guidelines and protocols provided. They are not based on the practices of any one organisation and reference to the applicable specific guidelines should be sought before putting these experiences into action.
Right ventricular infarct
hypothetical

You are just settling into the couch after lunch and have pulled out your clinical practice guideline book for a read. Your partner flicks the kettle and wordlessly you transmit the idea that a white with one would be very welcome. However, the dispatcher devils have other ideas and the bleating of the portable radio suddenly intrudes into your thoughts. You hear the words chest pain amongst case number and address details and you reflect momentarily on just how many cups of tea or coffee must have been poured down the sinks of ambulance stations over the years, many of them by you. Disappointingly, that telepathic link you had with your partner only moments ago seems broken as you almost collide in your attempt to move out to the ambulance.
On arrival at the address provided you find a 55 year old man lying supine on the couch in his lounge room. His very concerned wife says that he was outside mowing the lawns when, after about half an hour, he staggered inside complaining of chest pains. Overcoming her husband’s staunch male ‘stubborn resistance’, the lady called for an ambulance straight away. As you look across at this somewhat overweight man, with cigarette stained fingers and grey, sweaty skin, you cannot help but feel that this action might be the very picture of why the wife can be knowingly referred to as the ‘better half’.

Right ventricular infarct hypothetical

(1) What would you want to know immediately?

You introduce yourself to the patient and he tells you his name is Frank. He describes the pain he is experiencing as feeling like heaviness across his anterior chest continuing up into his neck. He has never had it before though he does have a little trouble with high blood pressure and cholesterol uncovered during his infrequent visits to the doctor. He is uneasy in the chair with his hand running slowly across his chest and a very unwell appearance to look at.

You know that the man is complaining of chest pain. The paramedic golden rule is to always treat for the worst case scenario. In this case the worst case ‘payoff principle’ states that all chest pain should be considered myocardial infarction or acute coronary syndrome until proven otherwise. You also know that to ‘prove otherwise’ reliably you need at least twelve lead electrocardiograph and specific blood analysis for cardiac enzymes. Physical examination is also of some use in this process.

(2) Time is of the essence in acute coronary syndrome. If you could ask only five questions to help ‘prove otherwise’ what might they be?

These five questions will not give you a detailed assessment or history but they do not intend to. They are excluding any possible options out of defaulting to cardiac cause of the pain nothing more. They won’t cover allergies, past history and a multitude of other important questions. They simply allow safe payoff decision making point to build everything else from. The decision to exclude non cardiac pain is the first major fork in the assessment road with this patient and there are few options to do
Correctly deciding to treat the event as if it is cardiac in nature, your partner attaches the cardiac monitor and the pulse oximeter. The latter indicates a normal reading of 99% so you decide there is no need to apply an oxygen mask. The patient is not complaining of shortness of breath nor in any respiratory distress. You check that the patient is okay to take aspirin. You reach for the nitrate tablets as the patient tells you the pain is ‘really bad’. He looks obviously uncomfortable and you want to begin to do something to help him. You look down at the cardiac monitor and notice that his heart rate has slowed to a sinus rhythm of 40 per minute. His palpable pulse matches that rate as you palpate it at the wrist. The patient tells you that he has started to feel quite nauseous and dizzy now.

(3) What is likely happening?

Not surprisingly you find the blood pressure has dropped to 80/50mmHg. The man leans forward and vomits his lunch into the vomit bag you have hastily handed him and you experience increasing angst wondering where this is going. As he slumps back against the couch, seemingly finished for the moment, you decide to get him to lay flat with his feet slightly up. That’s always good for low blood pressure after all isn’t it?

(4) Is that position always good in the cardiac setting?

Increasing the preload on a failing left heart will very likely provoke or worsen pulmonary oedema. However if the hypotension is caused by the right ventricle not supplying enough blood to the left side, the left side will not be able to pump enough blood for effective circulation. Increasing the preload to the right ventricle will in this case be just the thing to do. A surge of blood returning to the right ventricle will cause the myocardial muscle fibres to stretch. In response the right ventricle will increase its contraction force, blood ejection and hence supply to the left ventricle. As such, the key to managing hypotension caused by failure of the heart is to work out first which side is most likely the cause. This will be very imprecise but the key clue is to identify if there is any prospect of left ventricular failure present. If not, start with the working assessment that the right side is the culprit.

Frank states that he has no shortness of breath and his chest is clear on auscultation. For the moment, you go on the belief that there is no left sided
heart failure to deal with. You lay him comfortably supine with his legs slightly raised and he very quickly says he feels a little better. Although this is a desired outcome, it was not guaranteed. If the blood pressure had not returned you would have needed to provide further preload support. To do this there must be another way to cause the right heart to increase its force of ejection. The so called ‘fluid challenge’ would work here whereby one or two pushes of two to three hundred millilitres of intravenous fluid could be administered rapidly. This too can stimulate the failing right heart to increase its output and so better supply a starved left ventricle much as leg elevation has done. This ‘surge’ of blood just mentioned can then be produced by a quick bolus of intravenous fluid or sudden re-posturing with the feet elevated.

Going on the basis that chest pain and hypotension are never a good combination, you decide to waste little time in transferring this man to a cardiac care centre. The usual nitrate therapy is out of the question of course. Nitrates reduce the pre-load and the after-load on the heart and so reduce the myocardial workload where blood pressure is adequate. This is the opposite of the ‘fluid challenge’ effect and will decrease the returning blood stretching the ventricle. This will reduce cardiac output and potentially blood pressure. This can be partly offset by the reduction in afterload making it easier for blood to be ejected. Decreasing workload means decreasing demand for oxygen. It can also make it easier for the left ventricle to eject blood and improve cardiac output. This only works to a point though since if blood pressure becomes too low the coronary arteries, filled during diastole, will not be well enough perfused. Nitrates are not a friend where hypotension is found though a slow release transderm patch may be okay where there is borderline hypotension. Nitrates decrease pre-load to the right ventricle and should only become a part of right sided and inferior myocardial management where there is a much higher blood pressure than found here. You set up to insert an intravenous needle and consider analgesia and an antiemetic.

One other very important argument to not administer any nitrate therapy is the bradycardia. With reduced cardiac output caused by inadequate ejection of blood from the ventricle, any other factor that further reduces cardiac output will cause great risk to blood pressure. This patient has little ability to compensate for the vasodilation given the bradycardia and so nitrates should be avoided.

(5) What is the best plan of management now? Are there any problems with some options?

Many patients have difficulty providing an accurate medical history during examination. Some can be stressed and distracted by the circumstances. They may not understand your medical questions, your accent or language
(just as you may not understand theirs) or appreciate what is relevant or important. Be prepared to re-ask questions in different ways and to further explore answers provided to ensure understanding. Though Frank has never complained of chest pains before, he does state that he had an angiogram a couple of years ago after his younger brother died of a heart attack. You now know this because you have found a ‘little blue hospital book’ in his wife’s hand. Leafing through the pages it says there is evidence of some seventy per cent occlusion of his right coronary artery (RCA). Now things start to make a little more sense.

(6) How does this help your understanding of the current presentation?

You recheck the cardiac monitor to assess the rhythm and to see if there is any ST segment changes in the inferior leads. You can gain a reasonable impression of the inferior surface of the heart with the two major leads in II and III. There is certainly a tall T wave and maybe some elevation of the ST segment in both II and III.

(7) Is this important to know?

Whilst your partner is bringing in the ambulance trolley, you insert an intravenous needle into the patient’s forearm. You have questioned him for allergies and sensitivities and provided him with a small increment of opioid and a bolus of antiemetic. You load the patient into your ambulance and arrange to rendezvous with an intensive care paramedic unit en route.

Minutes later and safely parked on the side of the road in a service lane, the intensive care paramedic quickly agrees with your assessment. She quickly performs a 12 lead ECG, looks quickly at it and nods knowingly. She immediately transmits it to the receiving hospital. A notification by radio occurs simultaneously.

(8) What is the reason for doing this?

Reperfusion is the ultimate aim of acute coronary artery syndrome management. Blockages of coronary arteries occur for a number of reasons with arguably the most common theory being the progressive development of a lesion inside the artery over time. Adhesions such as cholesterol plaques can adhere to the inner lumen of the
coronary arteries. This forms a wound on the vessel wall that the body attempts to heal by covering with a clot and then new intimal layer. However this means that there is a lump left even after the clot is lysed in the normal clotting process. This lump partly reduces blood flow past. It also forms a natural obstruction for further plaques to adhere to so that the process continues repeatedly until eventually flow is reduced to the point where symptoms appear. This may be the onset of angina. If it continues or if the blockage is sufficiently large blood flow past may effectively be stopped leading to myocardial infarction. If the artery is large enough and supplies a significant amount of heart muscle then it may cause injury to the full thickness of the ventricular wall. If it is a smaller artery it may cause lesser amount of injury to only partial wall thickness. This will vary the ECG changes that appear on the 12 lead and how the problem is ultimately managed.

The clotting theory of acute coronary syndrome has arguably two major implications for pre-hospital responders. Firstly any cause of delay will simply mean that more time passes before the necessary reperfusion strategy can be employed. Pre-hospital time wasting is not appropriate. Secondly there is one therapy that can be employed that can directly help in improving blood supply to the affected part of the heart.

(9) What is this one therapy?

The heart rate remains slow at 40 beats per minute and the blood pressure has only slightly improved after being supine positioning. The intensive care paramedic administers an intravenous bolus of atropine and allows a rapid bolus of 250 millilitres of crystalloid fluid to run in. The heart and pulse rate increases to a sinus rhythm of 70 beats per minute, with a blood pressure now of 120/70mmHg. The man still says he has five out of ten severity pain even after a small bolus of intravenous opioid though thankfully his nausea has eased.

(10) What have the intensive care paramedics done for him?

These are important management points. The slow heart rate needs to be managed early to ensure that cardiac output is adequate. Where there is ischemia a slow heart rate causing compromised perfusion should not be tolerated making it worse. Increasing heart rate and hence blood pressure should improve coronary artery perfusion and help reduce ischemia and ischemic pain.

The deliberate manipulation of the right ventricle in this instance is a critical point of understanding. If the right coronary artery is believed to be involved (perhaps from the 12 lead ECG), the right ventricle or the inferior surface of the left ventricle are likely
to be also involved. Since the right ventricle is thinner than the left (it has to do less work pumping only through the lungs unlike the left) it is less commonly involved in infarct as other areas with thicker muscle mass will be more likely be affected first. That said, perfusion to the right ventricle can still be compromised. When the right ventricle is involved, its role of pushing blood to the left can be compromised. If this is the case, encouraging the right heart to increase its work effort is a good plan and preload increasing strategies can help achieve just that.

(11) What does this imply should not be done to any such patient?

It is easy to get caught up in the drug therapies and cardiac monitors and forget all about the patient so you keep reassuring him. You focus on pain management for now. The blood pressure is okay for the time being and you still have a large margin for further opioid administration.

(12) What should you do next?

The inferior/right ventricular infarct is relatively easy to predict in the pre-hospital setting, even if the right ventricular infarct can be difficult in itself to diagnose. Look for the clues. Nausea is common as is a bradycardia or heart block. Hypotension is also common. These patients do not usually complain of shortness of breath or respiratory distress since there will be no congestion behind the left ventricle. Quite the reverse in fact as the left heart is being starved of supply. You may identify acute ECG changes on your rhythm monitor in leads II and III. The patient may have a diagnosed presence of a diseased right coronary artery. Acknowledging that the right heart does a different job from the left will lead to a better and tailored plan of management for this type of acute coronary syndrome.
Suggested Answers

(1) All approaches to a patient start with primary survey. This man responds to you and so you move quickly on to the vital signs. This man appears grey and sweaty to the eye. Any person grey and sweaty should be assumed to be sick until proven otherwise. It is likely it can indicate a blood pressure that is less than ideal with that would be high on the list of concerns. Whilst your hands determine vital signs your mind is also asking, “What has happened?” and “Why did you call for help today?” Working out what is the main presenting problem and why you are here will be an early priority.

(2) If the patient has the answer already find it out. Your first question should be to ask if the patient has had this pain before. If it is already diagnosed, don’t reinvent the wheel. Beware though of the patient who has been not properly diagnosed - such as the patient drinking Mylanta for self diagnosed ‘indigestion’ or the patient who has been diagnosed by a friend or family member supposedly with the same problem, or worse, by Doctor Google. Though payoff forces erring in caution, you can still confidently exclude two types of pain presentation at initial examination from being cardiac: that which is clearly pleuritic and that which is traumatic in origin. So since you are managing the patient on the payoff assumption, you may as well exclude those two from the outset.

Question 2: Is the pain clearly pleuritic? Well that question cannot be asked of the patient directly. A pleuritic or chest wall pain is very different from a visceral or organ pain. Think about a broken rib if you want to picture clearly pleuritic. So question two is actually questions two, three and four. These are what does the pain feel like, where exactly is the pain located and does the pain change on deep inspiration. You aren’t really looking for answers like heavy, aching, burning, pressure and so on for what it feels like. You don’t need to be convinced it’s cardiac and any of these could easily be. You are, however, looking for answers like sharp, stabbing, knifelike, well localised to one point with one finger and yes it hurts a lot to breathe in and I won’t be taking a deep breathe again. If the answers appear a mixed bunch and inconclusive default back to cardiac until proven otherwise. If they are all found together and there is no doubt then the pain is chest wall or pleuritic.

The final question you ask, number five, is how did the pain start? If the patient fell over and struck the kitchen bench for instance, this is a traumatic mechanism. A sudden onset for no apparent reason suggests not. These questions use the common pain mnemonic DOLOR – description, onset, location, other signs and symptoms and relieving factors - but are more purposeful in decision making.

(3) The bradycardia has likely caused the blood pressure to drop since cardiac output is the product of the stroke volume and the heart rate. Quickly determine what the blood pressure with any cardiac rhythm change is. The nausea is possibly due to the newly lowered blood pressure. Of more concern to you will be why
this has happened in the first place. Don’t be tempted in the slightest to dismiss this as some sort of vaso-vagal moment or simply a reaction caused by the pain. Though not impossible options a more plausible scenario is that this cardiac event involves the blood supply to the cardiac conduction system which is now adversely affected. Any change of the cardiac rhythm should make the paramedic take particular interest and consider that something serious is very possibly happening. Chest pain is one thing. Chest pain and other problematic features such as clamminess, rhythm or perfusion changes is far more concerning.

(4) The maintenance of blood pressure is dependant on a number of variables. The three most important aspects though are the blood vessels or vascular tone, the blood volume itself and the effectiveness of the heart as a pump. The heart is of course two pumps being the left and the right side simply strapped together. If the peripheral blood vessels are dilated such as might be found with sepsis, anaphylaxis or spinal injury or the blood vessels are under filled with the good red stuff, such as in hypovolemia or dehydration, feet upward position is good. This allows the most to be made of what circulation is left. If it is the pump that is broken though it isn’t this simple. You will first need to decide whether it is the left side or the right in trouble. If the left is not working properly (left ventricular failure) it will not be able to effectively pump out the blood that it is receiving back into the body. As such, blood will back up (congest) behind the left ventricle and atrium hence fill first the pulmonary interstitium and then the alveoli with fluid. Increasing the venous return and the preload in this situation will only worsen the problems. If however it is the right side that is in trouble, blood will congest back into the periphery and not be a problem for the lungs at all. You don’t want to cause more blood to be poured into a failing left ventricle. So, listen to the lungs for signs of cardiac failure such as crackles or wheezes. Just as importantly, ask the patient if they feel short of breath. Shortness of breath is a complaint (symptom) whilst respiratory distress is what you can observe. Both are always significant in any cardiac setting, even if it appears minor. They should always be considered a possible warning of left ventricular failure. These vital clues can easily be lost as seemingly unimportant when distracted by pain.

(5) Firstly identify the problems that need to be addressed. Pre-hospital time offers little advantage to the patient so delay only to perform important therapies. An antiemetic for the nausea is okay, as is an opioid for the pain. Morphine is a common choice for acute cardiac pain. Amongst the many actions of morphine however are the possibility for slowing of cardiac conduction through the AV node and an increased propensity for nausea. It would not be too hard to slow an existing bradycardia further and so produce a worse rhythm than the one already present. Administer morphine then with caution. This patient needs effective blood pressure management now also.

(6) The RCA supplies, in the majority of cases, the sino-atrial (SA) node, the atrio-ventricular (AV) node, the inferior and posterior surfaces of the left ventricle and the right ventricle. Involvement of the RCA would predispose to problems
related to these structures. Ischemia of the SA node can cause it to become less functional producing a range of bradycardia problems. Similarly ischemia of the AV node will reduce its ability to transmit electrical impulses also predisposing to bradycardias and heart blocks. The right ventricular function can at times be impaired if it is ischemic. The right ventricle has one job. To pump blood through the lungs to the left heart. If it fails to do that, the left ventricle cannot do its job and hypotension will soon follow. Trick question: what is the difference in blood volume ejected between the left and the right ventricle in the healthy heart? Answer: it is a trick question, there is none. They must be the same or else backward congestion will be the result behind the smaller ejection ventricle.

(7) If something really obvious is there, okay acknowledge it. The cardiac monitor is there to monitor rhythms and really nothing else. That said, there are two good leads to see the inferior heart on a three lead monitor so you may see something of importance when you look. There are many reasons for ST changes such as ventricular aneurysms, conduction defects and drugs such as digitalis. Further, changes can be actually mirrored, or reciprocal, to the real change on the other side of the heart. It is very difficult to diagnose from three monitor leads only and the device was not intended for such use. Go on history more than a monitor.

(8) In the setting of ST elevation myocardial infarction (STEMI), there are two well supported reperfusion therapies for acute management. One relies on an intervention such as angioplasty, insertion of a stent or even coronary artery bypass graft surgery. These are well regarded therapies and aim to reopen any blocked blood vessel. They do have one major down side – they must be performed in a hospital with cardiac catheter laboratory facilities. This unfortunately rules out many hospitals and regions, particularly rural locations. Where this is the case, as long as the event is reasonably acute, thrombolytic therapy can be administered alternatively to provide some reperfusion. The time to perform either is critical in saving myocardial muscle. By transmitting the 12 lead from the ambulance to hospitals, critical minutes in calling suitable medical personnel and setting up catheter laboratories before the ambulance (and patient) arrives can be saved. The transmission of the 12 lead ECG is vital and slightly contradicts the time honoured maxim pressed upon paramedics to ‘load and go’ to hospital. Whilst the 3 lead ECG is not for diagnostic purposes, the 12 lead on the other hand is. A few minutes of pre-hospital time in this regard can be a big investment in time to necessary treatment.

(9) The administration of aspirin is important. It doesn’t lyse or remove the new clot and it does not affect any previously existing blood vessel occlusion. What it does do though is interfere with the development of this new acute clot addition. Clot formation is a complex cascade of coagulation and platelet adherence. By administering aspirin the platelet addition to the new clot is interfered with reducing the effectiveness of the clot developing and increasing the time available to provide reperfusion therapies.
decompress the other side of the chest if it hasn’t been already. The traumatic
cardiac arrest has a poor prognosis but not no prognosis at all. The key factor
here is that this patient will require surgical intervention to survive. But to make
it to a theatre to avail to this spontaneous circulation will need to be established.
The decision to cease resuscitation will be a subjective one and have to consider
such factors as time to transport, responses to therapy, resources waiting in the
hospital and even, severity of visible injuries.
Newborn emergencies
hypothetical

“Come on mate let’s go”, your colleague calls to you with just a little more animation than usual. “It’s an obstetric case, imminent child birth. I haven’t delivered a baby yet and I want to get there before it all happens without us”. You drive out of the garage with renewed enthusiasm for a night shift. You know that there is as much chance that this baby will be born before you arrive as after. In many cases the baby will not even be born for some time until safely well after arrival in the maternity hospital.

You arrive at the house in question with more than a growing hint of excitement. An anxious husband and expectant father to be meet’s you half way down the driveway and says he thinks the baby is very close to being born. He gestures for you to follow him without even waiting for you to gather your equipment.
Following him into the lounge room you immediately see the soon to be mum kneeling on the floor leaning against an armchair. She is almost naked as she has just got out of the shower after feeling that might help to provide some relief for her pain. You settle in to asking her the rehearsed obstetric questions including “Is this your first child?”, “Have there been any antenatal problems identified?” and “How are the contractions progressing?” Her answers all seem unremarkable with no problems anticipated, her pregnancy being almost full term, this is the first child and her contractions are now almost minutely. Her waters have broken.

“Okay” you say to the woman with a surreptitious wink at your partner, “it appears we are very soon to be joined by this impatient little one.”

You unpack your obstetric kit just as mum turns herself onto her back. She cries out with the pain of the contraction and says she needs to push. Positioning your hands ready you anticipate delivery with this contraction. You all smile at each other as nothing happens then frown a little as this is repeated at the next contraction. The smiles return though with the next contraction as a little tuft of hair on the newborn scalp appears. A little gentle pressure is applied to prevent too rapid delivery and a moment later the crowning head delivers fully. Within moments the baby rotates a little and the whole delivery is suddenly complete.

“Time of birth eleven forty”, your partner notes and you meet the unspoken question to all in the room “It’s a boy.” You place baby up onto mum’s belly but uncertainly feel a chill run through you. The baby hasn’t moved at all and you suddenly have a bad feeling. You know that APGAR scores are useful and are assessed typically at the one and then five minute mark after birth.

(1) If there is a problem, is the APGAR the guide for resuscitation?

So the APGAR contains useful resuscitation guides but is not useful in its grouped and numerical format. The newborn at birth can be classified into one of two categories being either vigorous or non vigorous. That is, the newborn can appear to have life within or it can appear to have very little if any life within it. Most newborns will be generally pinkish in colour but have a degree of cyanosis evident, notwithstanding the natural pigment colouration of the child. This cyanosis is quite normal and can last for several minutes making it concerning for the novice but not a particularly useful guide for the need for resuscitation.
However the presence of muscle tone in the limbs is not so ambivalent and should be
evident from the initial moments. A lack of muscular tone and activity is concerning
with total limpness of the newborn most undesirable. The APGAR does contain
these two features along with the presence of grimacing or crying. Of course some
newborns are simply quieter than others and not all of them will cry. Strong crying
is a good thing of course and suggests good muscle activity and breathing though
it must be remembered that the ritualistic buttock slapping of a bygone era remains
just that - bygone.

The presence of a pulse and patient breathing is always a really good thing to find
as well and these criteria round out the APGAR. However the heart rate will not be
immediately noticeable and will be directly dependant on the effectiveness of the
breathing that is occurring. A newborn typically has a respiratory rate of between
forty to sixty per minute and a heart rate of between 120 and 160 per minute. The
presence of breathing and its effectiveness is the other critical observation in the first
moments of life.

(2) Next, a really obvious question. What is the definition of a newborn?

The vigorous newborn takes those first few vital breaths moving air into the lungs.
Breathing is significant for every human life but never more so than for the newborn.
These first breaths change the pressures within the alveoli as they move from being
fluid filled to air filled. That commences the process of gas exchange of course but
does so much more. The foetal circulation, first established with the intention to
bypass the lungs given their non contribution to gas exchange in utero, now quickly
transforms to rely on the lungs and not the placenta. The ductus venosus, connecting
the umbilical vein to the inferior vena cava constricts. The ductus arteriousus that
connects the right ventricle to the aorta and so minimising blood delivery to the lungs
also closes. The foramen ovale that allows blood to move from the right atrium to the
left also closes. Hence the in utero lung bypass circulation now becomes a post birth
lung dependant circulation. It is essential that breathing, or assisted ventilation if that
fails to occur, takes place to induce these changes.

This transformation needs to happen as soon as possible post birth. If the newborn fails
to take those first breaths the changes will not begin to occur and cardiorespiratory
disaster looms. The first thing to assess for with the newborn is the presence of
breathing and for signs of movement or crying. Yes these are in the APGAR but you
are being more targeted in the value of each criterion at this first critical point.

If breathing is present and there is movement or crying, things are very much looking
up. Keep in mind that typically this will be what will overwhelmingly found when a
newborn enters the world.
(3) If breathing and movement is routinely found, what is routine care then?

Three questions come to mind most frequently immediately after childbirth. Does the airway need suctioning, when does the cord get cut and does the placenta need to be delivered? It may be advantageous to consider these one at a time.

(4) Does the airway of the newborn require suctioning?

Newborns are usually quite effective at clearing their own airway. If suctioning is required it should be using a small catheter and with gentle suction. Start with the mouth first as newborns are nasal breathers and may with the first gasp inhale whatever is in the mouth if you clear the nose first. The newborn airway is incredibly delicate in comparison to older patients and requires a very gentle touch. Suctioning can cause trauma and may produce laryngospasm and bradycardia if prolonged or too rough. Suctioning attempts should be only a few seconds long. Also, devices such as oropharyngeal airways are usually not required and will only be called upon in the rare situation of some form of airway deformity. The newborn airway typically needs very little intervention.

In contrast though it is likely that if the newborn is non vigorous and was born through meconium stained liquor that suctioning, perhaps even under laryngoscopy, and intubation may be likely. Resuscitation efforts will likely be called for in this scenario.

(5) What is basic routine care, if it can be called that, for the non vigorous newborn in the first moments after birth?

This will be one of those occasions where undoubtedly preparation in advance will prove to be a bonus. The newborn needs to be kept normothermic and most ambient air will be your constant enemy in this. Skin to skin is good for this and mum’s skin is best of all. However the non vigorous newborn will require separation to allow for resuscitation to occur. Warm room air and a warm surface for resuscitation are essential ingredients if success is to be had in newborn management. Given that much of the pre-hospital time will be spent in the outside or someone else’s home, control of the air temperature can be a significant challenge.

(6) How do you keep the premature baby warm?

It feels like a huge amount of patient assessment, critical decision making and resuscitation activity has gone on and yet it hasn’t even passed the thirty second mark of the baby’s life. With the newborn found limp and not effectively breathing the first actions have been to provide rubbing and tactile stimulation to arouse it. The first reassessment point has been reached
with as little time as only thirty seconds going past. There are still only two critical priorities for the non vigorous newborn. Is the baby breathing now (remembering that without breathing the internal circulation does not transform for life) and does the newborn have a heart rate greater than 100 beats per minute?

The big hope at this point is that the newborn has improved its breathing and a good heart rate can be detected. If this has happened, and it may have, then a move to simple routine care as already described can be made. Remember, even though it is an APGAR feature the newborn may well remain partly cyanosed in appearance for several minutes post birth. Only if the newborn remains centrally cyanosed after about ten minutes should any supplementary oxygen be provided and even then only at a couple of litres per minute via a nasal cannula. It is not unusual for oxygen saturation to take more then ten minutes to improve over 90%. A reading of 80% remains common even up to five minutes post birth keeping in mind that it starts from a level as low as 60% during the birthing process.

Sometimes though the script for the baby is not a good one and the non vigorous newborn may not improve with basic stimulation. The non vigorous newborn that requires further resuscitation at this point will have a heart rate less than 100 and inadequate breathing. The breathing is essential as the central tenet to setting in motion the cardiovascular transformation so the answer here is simple – you have to fill in for the baby's missing breathing with assisted ventilation. Ventilate with a newborn sized bag/valve/mask for the next thirty seconds at a rate of forty to sixty ventilations per minute and reassess again.

(7) When is the right time to cut the cord?

The non vigorous newborn at this point has by now ideally been placed on a soft flat surface with good surrounding warmth available. Keeping the newborn warm will be a critical part of care and a constant battle. The mother and father will need plenty of reassurance and explanation and the challenge for rescuers will be to not ignore or forget about them. The baby should be placed in a neutral position and will likely need a small layer of padding beneath the shoulders to compensate for the relatively large occiput newborns and infants have. Head shape may vary considerably following the moulding that occurs during birthing. If the shoulders are not lifted with the occiput on the same surface the head will pushed into a partially flexed position.

Up until now movement and muscle tone along with effective breathing have been important. These are in the APGAR but we haven’t been worried about the APGAR itself as a tool. The heart rate has been considered but only as a line in the sand. Anything 100 or over is acceptable meaning of course that anything less than this figure is not acceptable. After a thirty second period of ventilation it will be time to
reassess the same features of breathing and movement along with the heart rate again. This time though a more discerning look will be taken at the heart rate.

Look again at the adequacy of breathing and for signs of returning motor activity and muscle tone. Then reassess the heart rate. If the heart rate remains less than 100 but not less than 60 per minute with the breathing still inadequate, the thirty second ventilation patterns intermingled with regular reassessment should continue until improvement is noted. When the breathing becomes closer to normal and the heart rate picks up to over 100 per minute, the newborn can now be treated again with simple basic care. It would almost go without saying though that a very close level of scrutiny would be then kept on the child until medical handover. Heart rate can be assessed by auscultation for sounds over the apex of the heart.

The big question remaining is what happens if after the first thirty seconds of basic stimulation followed by the next thirty seconds of assisted ventilation this little distressed newborn still only has a heart rate less than sixty and with breathing still ineffective? If you hadn’t thought so already this is certainly serious resuscitation time now. You have already commenced bag/valve/mask ventilation and this continues. The difference now is that cardiac chest compressions begin also. The first minute of resuscitation has revolved around physical stimulation, possibly airway care and thirty seconds of fast assisted ventilation. Chest compressions will be rarely required and will only follow all of this where the heart rate remains less than sixty. This differs from all other resuscitations where chest compressions begin right at the start rather than come later. Newborn CPR also differs from all others age groups with its rate of one ventilation for every three compressions. It is also reassessed every thirty seconds which contradicts the usual rule of minimal interruption to CPR in cardiac arrest.

**Why is newborn CPR different to all other ages?**

Chest compressions are invariably going to be performed differently on the newborn patient as it might also with infants. The chest is still compressed mid sternum to a depth around one third of the chest diameter. Two methods of application are suitable. Both hands of the operator can be wrapped around the child’s chest with the thumbs placed touching each other in the middle. The thumbs can then be pushed down together and this is likely to prove a better option where there are two rescuers. Alternatively, two fingers together side by side can be placed mid sternum and compressions performed with use of only the one hand. This is preferred where there is only a single rescuer as it reduces time to move between ventilations and the compressions.

Invariably the question of electrocardiograph monitoring arises. Newborn skin is very delicate, particularly that of the preterm newborn. Cardiac monitor electrodes should only be attached if absolutely necessary and never just for routine monitoring purposes. Pulse oximetry monitoring may be a more useful method of monitoring the heart rate of the newborn.
The worst case scenario is that the newborn will remain unresponsive to all of these resuscitation endeavours. The cycles continue to be repeated with 1:3 ventilations to compression ratio. Reassessment will happen every thirty seconds continually looking for some sign of improvement. If the initiation of compressions does not prove helpful soon then advanced pharmacotherapy becomes warranted.

(9) **When should intensive care support be sought in newborn resuscitation?**

You did not get an opportunity to have any other support from the outset but were lucky enough to have a nearby intensive care paramedic unit clear another case allowing them to quickly arrive to support you. The two of them assist immediately with resuscitation of the child whilst your partner feels freed enough to tend to mother and family. Anxiety is plentiful and all around you and part of you really wishes you weren’t here right now. Grimly you betray none of these true feelings and professionally persevere.

(10) **Intensive care therapy will in part be pharmacological and venous access is integral to that end. Is the umbilical vein of use in this regard?**

For the novice practitioner in new born resuscitation, a description that surely includes most pre-hospital responders, intravenous or even intraosseous access is far preferable to umbilical vein cannulation. Failing that endotracheal drug administration is also a supported route option. Intraosseous injection can be used for small newborns but must be very carefully applied in the premature baby where there will be particularly small targets areas not suited to most such injection devices and methods.

(11) **What factors increase the likelihood of a newborn requiring resuscitation?**

Drug therapy in resuscitation is similar to that for any other age cardiac arrest patient but with a few notable differences. The CPR ratios are already noted to be different as is the focus on ventilation and reassessment. If the newborn remains unresponsive, more considered airway support will be required.

(12) **How does the advanced newborn airway management differ in management?**

For the newborn requiring intubation, the endotracheal tube will usually be well tolerated given the comparatively poor airway reflexes that exist at that age. Sedation is not usually envisaged as it might be in the same circumstances with patients of other ages.
As with all cardiac arrest resuscitations, adrenaline forms the mainstay of drug therapy. It will similarly be administered in weight based doses and at regular intervals. The newborn may benefit from a bolus of crystalloid fluid to expand blood volume and promote increased contraction of the right heart and so this option can also be employed. Most other drugs, such as sodium bicarbonate and atropine are no longer used in resuscitation of the newborn.

One of the often cited and discussed reasons for failure of the newborn to breathe is the administration of opioid drugs to the mother during labour and the subsequent effect on the foetus. Though naloxone has been used in the management of some newborns so affected, it is best avoided. Evidence is quite thin on this but there is conjecture that there is actually value in the role of endogenous opioids within the newborn and these would be interfered with. Further, there are reports of seizures being induced following naloxone therapy.

On a more positive note though the increased flow of blood through the liver following the newborn circulatory and blood flow changes after birth leads to mobilisation of glycogen stores. The newborn usually has a lower blood sugar level than other age groups and can easily become hypoglycaemic. Typically this is said to occur if the blood sugar level is below 2.6mmol/L which is substantially less than other ages. If there is any concern with the conscious state, APGAR score or the newborn requires resuscitation, blood sugar should be subsequently assessed. It can be managed with either dextrose or glucagon though and this would typically be only following a neonatal consultation for advice and doses provided.
Suggested Answers

(1) No the APGAR is not. The APGAR is a tool for scoring the presentation of the newborn after birth and then designated time intervals. It is based on very important and legitimate criteria for evaluation of the newborn. However, it has two major shortcomings. It provides a score that is only useful in classifying the condition of the child rather than specifically guiding the needs and process of resuscitation. The criteria within the APGAR are very relevant but the scoring process itself should be for post evaluation records and looking back.

(2) Starting with the really obvious, a newborn is a baby that has just been born. The definition must also include from that starting point to the period where the lungs and foetal cardiovascular structure make the transformation into post birth structure that will then carry it through life. This may even take as long as 96 hours though up to 24 hours would be a typical definition accepted for almost all newborns.

(3) Assuming the child is born at greater than 28 weeks gestation, as they most commonly will be, routine care is only to gently dry the newborn and keep it warm. Placing the baby onto the mother’s chest is a good starting point as mum usually has a good level of warmth to offer and actually she wants the child to be just there. The newborn can lose body heat very quickly. Wrap the child with a soft blanket or similar. Let your partner do the shaking of hands with dad and tell everybody if it is a boy or a girl. Cigars are outside your scope of practice of course so stay focussed on mother and child. Seriously though, provide plenty of reassurance that all appears well as you go about an immediate assessment of the remaining APGAR points and note the time of birth.

(4) The newborn baby does not usually require any airway clearance at all. If the newborn is born vigorous, the only indication to suction the airway is if meconium stained amniotic fluid has been noted and the baby now has visible signs of respiratory difficulty. The latter would in particular include such things as gasping breathing or intercostal retraction. The non vigorous newborn will already have poor respiratory effort as respiratory failure is one important element and so the criteria are already half met. Again, if meconium has been observed in the liquor this will be the only other time suctioning is likely to be necessary.

(5) At birth, the newborn was assessed for the two essential criteria – the presence of breathing and signs of movement or crying. If these were not satisfactorily noted, the child is considered to be non vigorous. The immediate steps at this point, and immediate means inside the first thirty seconds from birth, is to suction the airway only if necessary as described already then to provide tactile stimulation. This can be done by simply drying the child and gentle movement of the limbs and slapping of the feet soles. There is a careful balance here between very gentle handling appreciating just how delicate the tiny newborn can be and yet still providing the necessary stimulation. Stimulate the child but don’t cause it an injury.
Most premature babies will be big enough to be treated much like any other newborn. However, the earlier they are born, the less adipose tissue there will be and really premature babies will be little more than a layer of semi transparent skin covering over internal bones and organs. If the newborn is very small or less than 28 weeks gestation, it should be placed without even drying into a polyethylene bag with only the head left out. If available, a small baby cap or similar covering should be placed over the baby’s dried head. The precious little package should then be placed onto mum’s chest and covered with blankets. If resuscitation is required for the non vigorous newborn, then effort must be made to bring warmth to the child. If you employ a heater ensure the newborn cannot be burnt in any way.

Cutting the cord is in most cases regarded as not urgent. It can be done usually a few minutes after birth and when the cord stops pulsating. There is argument back and forth about the advantages and disadvantages of timing in cord cutting with this timing regarded as the current favoured for the vigorous newborn. The position for the non vigorous newborn is quite different. Resuscitation efforts need to be commenced early and remaining attached to a cord that may no longer be providing any support is of little value. The cord will likely be cut after basic stimulation fails to improve the baby’s presentation and bag/valve/mask ventilation needs to be initiated. This will also allow the resuscitation to occur not right within immediate proximity to the mother but a little bit out of sight. The mother may not want to be parted from her baby but she will likely want to witness the resuscitation almost on top of her even less.

The newborn is dependant on ventilation to bring about the circulatory changes. Chest compressions on the non transformed circulation will largely be shunting blood around the newborn without good effect. So the compressions are, as opposed to other ages, less beneficial than the ventilations. Keep reassessing the effect of the ventilations each thirty seconds looking for improvement. There is a lot more ventilation than all other ages compared to compressions as these remain critical.

As early as possible, ideally well before any resuscitation commences. When you are dispatched to a case that sounds like there may be a risk to mother or newborn some backup should be sought right at that point. When things go wrong, an immediate effective response is required. You will have to look after a worried and potentially unwell mum, reassure other family members and provide an effective resuscitation team for the newborn. This needs to be assembled with equipment ready for use from the moment the clock begins to tick so call from the moment of dispatch. If you suspect there is a possible need for further support, such as if the call is for a premature labour or one where complications have been foreshadowed, assemble the help early. There will always remain those cases that take you by surprise and don’t allow for preparation in advance though however you will always be starting from behind in those cases.
(10) Yes and no. The umbilical vein is a legitimate venous access port and may be so used by some. However it is not without difficulties. There is usually one vein and two arteries intertwined in the umbilical cord. The vein may be slightly larger and identifiable but it is quite possible for there to be only one artery. There is a very real prospect that the practitioner will not know which vessel to choose reducing it to a lottery. Intra arterial injection is however most unhelpful raising the stakes of this lottery considerably. Further, use of the umbilical vein raises the prospect of life threatening air embolism, infection introduction and bleeding if it cannot be properly secured with the cannula inserted. It is the sort of access route best reserved only for those who know what they are doing and are trained in its use.

(11) The risk factors associated with increased likelihood for newborn resuscitation include maternal factors, fetal factors and labour factors. Maternal factors include pregnancy induced hypertension, previous maternal complications, particularly young and older mums and illicit drug taking. Foetal factors include prematurity, multiple births or known abnormality with the foetus such as large for dates. Labour factors include breech or prolapsed cord, prolonged labour and bleeding or placental complications.

(12) The newborn at this point will likely require intubation if some improvement is not observed. The trachea will be comparatively very small and the endotracheal tube equally as small. A straight blade epiglottis manipulating technique is used for view rather than the curved vallecula approach applicable for other ages. This involves gentle direct manipulation of the epiglottis itself rather than manually lifting it and the tongue and lower jaw as one. Given that the epiglottis is relatively larger than in the older patient this may be the easiest method of sighting the cords. Great gentleness is required. Gentle suctioning of the pharynx may be required if meconium was present at birth.