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The Good and the Bad of Adrenaline in Out of Hospital Cardiac Arrests: Could we make it better?

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Background

Adrenaline is used frequently in out of hospital cardiac arrests with most ambulance services including the administration of adrenaline in their cardiac arrest protocols. Though current evidence is undecided on the role of adrenaline in Out-of-Hospital – Cardiac –Arrests (OHCA) and its long term effects on patient survival.

Objective

This was written to explore the efficacy of adrenaline in OHCA, looking at both positive and negative effects of adrenaline. Also the idea that by using Beta (β) Blockers in conjunction with adrenaline, the paramedic may be able to negate some of the negative effects and increase long term survivability in patients who do suffer a cardiac arrest in the pre-hospital setting.

Method

Looking at the positive and negative effects of how adrenaline works in the setting of out of hospital cardiac arrest and looking at research that could make adrenaline more targeted so only the positive effects are achieved, was the main research undertaken to gain a greater understanding of the topic.

Conclusion

Most of the studies indicate that adrenaline helps with short term survival, but not with long term survival or favourable neurological outcomes. The detrimental effects of adrenaline on a heart was briefly explored. This report also looked at how adrenaline works on both α and β receptors and that the use of β blockers could be an area of research into the future.

Findings

It was found that there is insufficient evidence to draw any clear conclusions on adrenaline's effectiveness on the long term outcomes of patients who suffer from an OHCA. The majority of research did suggest however that it could be detrimental due to the effects of β_1 receptors. (Callaway, 2013, Reardon, Magee, 2013, Nolan, Perkins, 2013, McQueen et.al 2012, Ong et.al, 2007, Turner, 2012, Carvalho et.al, 2012, Bourque et.al, 2007, OntarioMedic, 2014)

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Ectopic Pregnancy - A Literature Review

By: Tabitha Broome. 3rd Year ECU Student—WA

Image 1.

Background

An ectopic pregnancy can be defined as the implantation of a fertilised ovum outside the uterine cavity (Houry & Keadey, 2007). Mistovich and Karren (2010) expand on this by including places of possible implantation such as the fallopian tube, the abdominal peritoneal covering, the outside wall of the uterus or cervix. Most ectopic pregnancies implant in the fallopian tube at a rate of 98% (Jurkovic & Wilkinson, 2011) . The expected pathway for early pregnancy involves the fertilised ovum travelling along the fallopian tube via the peristaltic action of the cilia located in the lining of the tube (Marieb & Hohen, 2010). The blastocyst then implants itself on the wall of the uterus and the foetus develops (Pairman, Pincombe, Thorogood & Tracy, 2006). An ectopic pregnancy occurs due to a delay in passage from the fallopian tube to the uterus. This delay can be caused by a tubal infection that destroys the cilia, tubal ligation or previous tubal surgeries (Pairman et al., 2006). Instead the blastocyst implants itself in the epithelium of the fallopian tube and the foetus develops causing a tubal pregnancy. This can either rupture at 5-7 weeks or be expelled from the tube into the peritoneal cavity at 8-10 weeks causing a tubal abortion (Pairman et al., 2006).

Objective

The purpose of this literature review was to discover what an ectopic pregnancy is and the pre hospital interventions and management guidelines for ectopic pregnancy within Australia.

Method

Search terms: “Ectopic” “Pregnancy” “Pre-hospital” “Management” “Interventions” “Clinical Practice Guidelines” “Australia” “Medical Emergencies”

Search Engines: Library One (ECU Library), Medscape, EMSWorld, Canadian Medical Journal

Books: Mosby’s Paramedic Textbook, Human Anatomy & Physiology Pre-hospital Emergency Care, Midwifery Preparation for Practice

The Review

Key Risk Factors

A group of experts agree (Navarro, 2009; Sanders, 2012; Houry & Keadey, 2007) any female of child bearing age, usually between 25-34 years, is at risk for an ectopic pregnancy. These experts also agree that this risk is increased in older females and minorities. Many more experts (Mistovich & Karren, 2010; Murray, Baakdah, Bardell & Tulandi, 2005) agree with these risk factors and expand on them by including patients with previous tubal pregnancies, previous tubal surgeries or tubal ligation, patients with a history of pelvic inflammatory disease, history of infertility and patients with a history of sexually transmitted infections. The use of the intrauterine device (IUD) as a contraceptive will decrease the risk of pregnancy however, if a patient falls pregnant with an IUD their risk of ectopic pregnancy increases (Houry & Keadey, 2007).

Pre-Hospital Management

Navarro (2009) reminds paramedics of two important principles in managing ectopic pregnancy. These are; definitive care is not always possible in the field; and caring for the mother is caring for the foetus. Houry and Keadey (2007) expand on this first point by explaining that the role of the paramedic is to stabilise the patient, insert two large bore IV gauges and transport to hospital. A large group of experts (Navarro, 2009; Sanders, 2012; Mistovich & Karren, 2010; Snyder, Kivlehan & Collopy, 2012; Greenwald & Keadey, n.d.). agree that management of the female patient, within child bearing years and presenting with possible abdominal pain and vaginal bleeding, should include; high flow oxygen therapy via a non-rebreather mask, analgesia, position of comfort and transport. This should be coupled with a high index of suspicion for ectopic pregnancy and an informative patient history.

Questions to ask during a patient history include the last date of menstruation, whether the pregnancy is known and if the patient has had any other pregnancies (Greenwald & Keadey, n.d; Navarro, 2009). Paramedics should take a full gynaecological and obstetric history including who is administering their prenatal care, is there a presence of vaginal bleeding, when is the delivery date and how many weeks pregnant the patient is (Navarro, 2009; Greenwald & Keadey, n.d.). Sanders (2012) also suggests that questions should be asked in a safe environment, away from relatives or partners as the patient may have information they do not want others to know.

Pain in ectopic pregnancy can be diffuse, cramp and non-specific (Snyder et al., 2012). In a ruptured ectopic pregnancy pain can be described as sharp, severe, constant and peritoneal in nature (Snyder et al., 2012). Sanders (2012) describe the signs and symptoms as severe abdominal pain which may radiate to the neck or shoulder whilst Mistovich and Karren (2010) describe the pain as a dull ach or knife-like.

Paramedics are often the first medical intervention patients receive. Due to a lack of equipment and specialised expert training, paramedics are unable to diagnose abdominal conditions that a patient may present with. This lack of visibility of the patient’s abdominal cavity should cause paramedics to have a high index of suspicion of ectopic pregnancy in female patients of child bearing years (Sanders, 2012). The female patient with abdominal pain, who calls the paramedics, may not know she is pregnant. A delay in the diagnosis of pregnancy may be due to the patient still menstruating while she is pregnant, a patient being asymptomatic of pregnancy or the patient may not be of socially accepted child bearing years.

Pre-hospital care of ectopic pregnancy is limited and a delay in considering an ectopic pregnancy in the differential diagnosis can result in an adverse outcome for the patient. A major complication of this condition is a ruptured ectopic pregnancy. Paramedics must be prepared to manage shock as a result of the ruptured pregnancy. In the presence of haemorrhage, shock may not be noticeable until the patient has lost approximately 40% of her circulating blood volume. Compensatory mechanisms of the mother are activated during haemorrhage to protect the foetus and mother (Navarro, 2009). This is a true medical emergency as the patient can be in pain, suffering from a haemorrhage either through the vaginal canal or into the abdominal cavity. Haemorrhage, if significant enough, can lead to hypovolaemic shock. Sanders (2012) insinuates that the management of this condition requires initial resuscitation and rapid transport to hospital for a surgical intervention.

Navarro (2009) reminds the reader that caring for the mother is caring for the foetus. As the pregnancy is less than 20 weeks into gestation, it is a non-viable pregnancy and all care must be directed towards the mother (Pairman et al., 2006). Queensland Ambulance Service clinical practise guidelines (QAS CPG) suggest that the initial care should include assessment of the ABC’s and the protocols for abdominal pain management. If the patient is in shock QAS CPG recommend that paramedics follow the shock management protocols. If the patient is not in shock, the QAS (2011) recommends that paramedics consider analgesia, anti-emetics and intra-venous fluid be administered. Notification to the receiving hospital and transport to that hospital conclude the QAS (2011) recommendations for ectopic pregnancy treatment. Research into St John Ambulance Northern Territory and Ambulance Victoria guidelines proves that there are no specific guidelines for ectopic pregnancy in these services.

Conclusion

As paramedics can only treat what they see, emergency medical responders will only ever treat a “suspected rupture of ectopic pregnancy”. The confirmed diagnosis will be made in the hospital using their diagnostic equipment. When treating abdominal pain in a female patient of child bearing age, paramedics are required to have a high index of suspicion of ectopic pregnancy and gather an informative patient history. Prior notification and rapid transport to hospital is required for patients, especially those who have life threatening symptoms.

Image 2.

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Image 1. Retrieved from: <http://www.medindia.net/drugs/medical-condition/ectopicpregnancy.htm>

Image 2. Retrieved from: <http://www.pregnancypregnant.org/abdominal-examination-in-pregnancy-step-by-step-guide.html>

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“ 50% of patients with Hyperkalemia present with no ECG related changes even with potassium levels greater than 7.5mEq/L ”

ABSTRACT

Hyperkalemia is associated with the elevation of serum potassium levels in the extracellular space and can be potentially life threatening. The signs and symptoms of hyperkalaemia are documented to be almost absent, with ECG changed and laboratory data being the only way to effectively confirm the diagnosis. Extracellular potassium is normally maintained from 4.0 and 4.5 mEq/L. **It has been shown that 50% of patients present with absolutely no hyperkalaemia related ECG changes even with potassium levels greater than 7.5mEq/L** (El-Sherif, & Turitto, 2011, p. 239) (Khattak, Khalid, Manzoor, & Stein, 2014, p. 96) .

So where does this leave Paramedics?
Clinically, if all Paramedics can only base their diagnosis on ECG related changes and history, does this give weight to doing pre- hospital point of care blood potassium level testing?

HYPERKALEMIA- Think normal ECG!

GEORGIA MELVILLE- Paramedic Student
Charles Sturt University

Hyperkalaemia = Cardiac Death

When potassium levels do increase, this causes a shift in the resting membrane potential of cells (-90mV) due to the influx of potassium. This causes slowing of conduction through the myocardium and a prolongation of membrane depolarisation. Only 50% of patients experiencing this will have progressive ECG changes which are displayed in progression strip below

Causes of hyperkalemia

- Renal Failure
- Liver disease
- Heart failure
- Medications:
- Burns
- Excessive use of dietary salts (potassium chloride)
- Crush injuries
- Chemotherapy
- Metabolic Acidosis
- Diabetic ketoacidosis
- Dialysis
- Addison's disease
- Hyperkalaemia periodic paralysis

Point Of Care Testing – (POCT)

Ahn, et al. (2011, p. 25) has shown that POCT using a blood gas analyser compared to central laboratory testing (CLT) gives a mean value which is 0.19mmol/l different. In accordance with the United States Clinical laboratory Improvement Amendment, a difference of up to 0.5mmol/l in measure potassium between CLT and POCT is the gold standard (Chacko, Peter, Patole, Fleming, & Selvakumar, 2011, p. 24). This shows that in severe hyperkalaemia cases with no ECG changes POCT is a valuable, measurable and reliable

Implications of POCT in the Pre-hospital setting

Faster time to treatment:

Bringing POCT into the pre-hospital environment specifically for the measurement of potassium levels in hyperkalaemia will significantly benefit patients who have this prognosis and are not showing any signs, symptoms or related ECG changes. It will inevitably get these patients to the correct treatment faster as specific paramedics are able to give the required medications to reverse this prognosis.

Decrease cardiac death due to elevated potassium levels:

Hyperkalaemia is a reversible cause of cardiac arrest. Knowing the level of potassium using the POCT system may prove the diagnosis and the initiation of appropriate treatment can be started earlier.

Advantages

- Evidence during a hyperkalemic cardiac arrest for the use of reversible medications
- Diagnostic tool in the pre-hospital environment for long distances transfers from patient residence to treatment facilities with patients with no ECG changes.
 - Beneficial for long inter-hospital transfers.
- Real time level of potassium and severity level can be determined (e.g. Mild, Moderate, Severe), therefore giving paramedics an understanding of what dose and treatment regime is appropriate.
- POCT and the rapid availability of results is justified by long term societal gains including prolonged life and reduces hospital stays according to Laurence, Moss, Briggs, & Beilby, (2010, p. 165)

- ISTAT Machine
- Portable
 - Produces lab accurate values for Blood Gases, Electrolytes, Chemistries Coagulation, Hematology, Glucose and Cardiac Markers (Troponins)
 - One machine for all
 - Light
 - Only 2-3 drops of blood needed
 - \$200 per unit
 - Easy to use
 - Results in 2 minutes or less
 - Allows faster diagnosis

Disadvantages

- Requires extra training of staff across the board in normal ABG potassium levels and the use of the POCT equipment (Laurence, Moss, Briggs, & Beilby, (2010, p. 174)
- The POCT unit itself can be expensive (price as above)

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- Graphics adapted from the texts above.
Picture received from:<http://www.abbottpointofcare.com/Patient-Care-Settings/Hospital/Critical-Care.aspx>

Adrenaline in Prehospital Cardiac Arrest

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BACKGROUND

In the realm of prehospital cardiac arrest, adrenaline has been a mainstay of treatment for decades. Its administration is included in management protocols in emergency medical services throughout the world because of the drugs potent α and β adrenergic stimulating properties that cause peripheral vasoconstriction and positive inotropic and chronotropic activity in the heart (Neumar et al., 2010). The American Medical Association's most recent guidelines still recommend a dosage schedule of 1mg every three to five minutes for both shockable and non-shockable rhythms (Neumar et al., 2010). However, the literature is lacking in evidence surrounding the effectiveness of adrenaline on mortality rates in out-of-hospital cardiac arrest patients.

OBJECTIVES

There are a number of aims that hope to be achieved, based around assessing the literature regarding various aspects of patient outcomes after adrenaline administration during cardiac arrest:

- Prehospital return of spontaneous circulation (ROSC)
- Patient mortality
- Neurological outcomes in cardiac arrest survivors

METHODS

A search of the literature was performed, with databases including PubMed and The Cochrane Library. Articles were chosen based on their coverage of the objectives. More recent articles were preferred (2005 onwards), but given the limited amount of research completed regarding this topic, using a timeframe that was too narrow would have greatly reduced the evidence available for analysis. Ideally, randomised controlled trials were sought, but many of the studies investigating these objectives were observational studies, often to prevent ethical dilemmas that arise in denying some subjects a potentially beneficial medication. For the same reason, study design was not taken into account during the research phase. Rather, study design and limitations was discussed in the findings so as to allow for a more complete assessment of the validity and relevance of the current literature surrounding the use of adrenaline in cardiac arrest. This method of research produced three articles addressing the outlined objectives.

Table 2: Cerebral Performance Category (CPC)

CPC	Description
1	Good cerebral performance: conscious, alert, able to work, might have mild neurologic or psychological deficit.
2	Moderate cerebral disability: conscious, sufficient cerebral function for independent activities of daily life.
3	Severe cerebral disability: conscious, dependent on others for daily support because of impaired brain function.
4	Coma or vegetative state: any degree of coma without the presence of all brain death criteria.
5	Brain death: apnea, areflexia, EEG silence

Ref: (US FDA, 2014)

FINDINGS

After analysing and bringing together the results from the three chosen articles, the overall conclusions around the impact of adrenaline on gaining ROSC, patient mortality and neurological function were similar. By examining the results of each study in isolation, as well as their respective study design and limitations, a better conclusion could be drawn on the collective viewpoint of the literature.

Jacobs and Finn et al conducted the first randomised controlled trial (RCT) comparing clinical outcomes for patients who received adrenaline versus a placebo during cardiac arrest. It was a double-blind placebo controlled study, conducted in Western Australia between 2006 and 2009. According to their results, adrenaline significantly increases that rate at which prehospital ROSC is obtained compared to placebo, at 23.5% and 8.4% respectively (Table 1) (Jacobs et al., 2011), with this pattern reflected in hospital admission rates of 25.4% and 13% respectively. However, in their secondary outcomes of survival to discharge, there was not a significant difference between those who received adrenaline and those that did not. In addition, neurological outcomes in those who survived to discharge – measured as per the Cerebral Performance Category (CPC) (Table 2) – did not exhibit a significant difference (Table 1) (Jacobs et al., 2011). Despite this study providing some prominent results, there were some design problems with the study. While all paramedics were governed by Australian Resuscitation Guidelines and did not administer any other resuscitation drugs during the trial, the study itself was underpowered to detect significant outcomes. The trial was initially calculated to require 2213 individuals per treatment group, which was originally obtainable because several other ambulance services were intending to participate. However, these other services withdrew from the trial, and since participation was voluntary, only 44% of paramedics took part (Jacobs et al., 2011). Consequently, less than 300 individuals were placed in each treatment group, significantly fewer than the number required to give the study a power of at least 80%. As such, the study provided some significant results as the first conducted RCT investigating adrenaline administration during cardiac arrest, but had some major methodological issues.

An observational study undertaken in Japan in 2005-2008 (Atikawedparit et al., 2014) looked at near-identical outcomes as in Western Australia with similar results, all at $p < 0.0001$. In the group who received adrenaline versus those who did not receive adrenaline, the rate at which prehospital ROSC was achieved was 18.3% and 10.5% respectively (Hagihara et al., 2012) (Table 1). At one month post-arrest, survival rates between groups were 5.1% and 7% respectively (Hagihara et al., 2012). In terms of neurological outcomes, 1.3% of patients in the adrenaline group had a CPC score of 1 or 2, while 3.1% of those who did not receive adrenaline achieved this neurological outcome (Hagihara et al., 2012) (Table 1). As such, the results from this study suggest that adrenaline administration during cardiac arrest improves the chance of obtaining ROSC, but had unfavourable outcomes when considering one-month mortality and neurological status.

This study had advantages in that because it was observational, it had a large participation rate, with 13401 individuals in each treatment group (Hagihara et al., 2012) and a power of 94.1%. However, this study had a number of limitations. In the Japanese EMS system, EMS personnel only became permitted to administer adrenaline part way through the study, before which consultation with a physician was required (Hagihara et al., 2012). Physician presence in ambulances was highly variable, and automated external defibrillators had only been introduced prehospitally a few years prior to the study, meaning the Japanese EMS system was still relatively inexperienced in modern cardiac arrest management. In addition, clinicians were not blinded and in-hospital treatment was not recorded, adding potential confounders to the results.

Table 1: Summary of Results from Chosen Studies

Author	Patient Outcome								
	Prehospital ROSC (%)			1-Month Survival / Survival to Discharge (%)			CPC Score 1 or 2 (%)		
	Adrenaline	No Adrenaline	P-Value	Adrenaline	No Adrenaline	P-Value	Adrenaline	No Adrenaline	P-Value
Jacobs et al	23.5	8.4	<0.001	4.0	1.9	NS	81.8	100	NS
Hagihara et al	18.3	10.5	<0.001	5.1	7.0	<0.001	1.3	3.1	<0.001
Goto et al	22.8	27.7	<0.0001	15.4	27.0	<0.0001	7.0	18.6	<0.0001
S et al	18.7	3	<0.0001	3.9	2.2	<0.0001	0.59	0.62	NS

Ref: (Jacobs et al., 2011)(Hagihara et al., 2012) (Goto et al., 2013)

The third article chosen to review with regards to the major objective was another observational study also in Japan, but during the 2009-2010 period (Atikawedparit et al., 2014). Their results were segregated into those for shockable and non-shockable rhythms. For shockable rhythms, ROSC rates were lower in the adrenaline group and than for those who did not receive adrenaline, at 22.8% and 27.7% respectively (Goto & Maeda, 2013) (Table 1). One-month survival rates were 15.4% and 27% respectively, and the rate of achieving CPC 1 or 2 in the adrenaline group versus the no-adrenaline group was 7% and 18.6%. All of these results were at a high level of significance, with $p < 0.0001$ (Goto & Maeda, 2013). In non-shockable cardiac arrests, prehospital ROSC achievement was 18.7% in the adrenaline group and 3% for those who did not receive adrenaline (Table 1). Similarly, one-month survival was higher in the adrenaline group, at 3.9% and 2.2% respectively, $p < 0.0001$ (Goto & Maeda, 2013). While these results were also at a high level of significance, there was not a significant correlation found in terms of neurological outcomes (Table 1). Again, a number of limitations were present with this study. Patients were not randomised, and adrenaline was only indicated (as per FDMA guidelines) for non-shockable rhythms that were refractory to compressions or non-shockable rhythms that became so after defibrillation of a shockable rhythm (Goto & Maeda, 2013). These criteria may have biased the adrenaline patients to worse outcomes. In addition, there was no analysis done regarding the number of doses and their associated outcomes, and in-hospital management was not followed up. However, despite these methodological issues, the study raises a few key points in that perhaps the effectiveness of adrenaline should be assessed in terms of the presenting rhythm. This study found that adrenaline was beneficial in shockable rhythms but not non-shockable rhythms. Different pathologies may respond differently to the adrenergic properties of adrenaline and this warrants further investigation.

CONCLUSIONS

Across the three studies discussed, there was a similar trend exhibited in the results. Generally, adrenaline increased that rates at which prehospital ROSC was achieved, but was associated with equal or decreased rates of good neurological outcomes and one-month survival. The exception was in Goto and Maeda's observational study that exhibited increased one-month survival rates when adrenaline was administered to patients presenting with a non-shockable rhythm. All studies had limitations and methodological problems that prevent the integration of these results into Advanced Cardiovascular Life Support (ACLS) Guidelines. This review of recent studies regarding this topic has allowed for a number of recommendations to be formed for consideration during the planning and execution of future trials:

- Utilising double-blind, placebo-controlled randomised controlled trials will minimise selection bias and inconsistent drug administration
- Recording and analysing the additional relationship between the number of doses administered, in-hospital treatment and patient outcomes
- Conduct study in a location where clinician skill levels are capable of performing current ACLS guidelines
- Use multi-centre approach to ensure participant numbers are high enough to give the study an appropriate level of power

Although strong and consistent evidence of the effects of adrenaline on patient outcomes after cardiac arrest is not currently available, the literature has provided a basis for future research. Implementation of these recommendations forthcoming studies will assist in establishing a reliable platform on which to base future cardiac arrest management guidelines.

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What do we know about crowdsourcing the Chain of Survival using mobile phones?

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Objective: To review the available research on the use of mobile phones to support the chain of survival by dispatching laypersons to out-of-hospital cardiac arrests.

Background: The chain of survival has been central to out-of-hospital cardiac arrest (OHCA) management since the early 1990s (1). Several solutions for ‘crowdsourcing’ the chain of survival (ie, dispatching laypersons to cardiac arrests) have used mobile phone messaging and apps, some of which have seen rapid public uptake (2). However, their role in the chain of survival has only recently been researched.

Methods: MeSH-compatible search terms were identified, and a search performed using CINAHL, Embase, Pubmed, Science Direct, ProQuest and Google Scholar. 96 articles relating to the use of mobile phones in out-of-hospital cardiac arrest were identified. In the included articles, 9 studied the use of mobile phones to dispatch laypersons to cardiac arrests while 2 others studied AED-mapping apps. 1 was excluded as a duplicate, and 5 articles were only available as abstracts. Results relating to the chain of survival were then tabulated and compared against the goals of early access, early CPR, and early defibrillation.

Results: The included articles studied crowdsourcing solutions that were administered by the local emergency medical services (EMS), using either text message dispatch or a smartphone app. No articles compared these two solutions directly. No articles included solutions that operate without EMS involvement (eg, Good SAM).

No articles reported a primary outcome of patient survival or neurological status. 89 other findings were reported, of which 10 were reported by more than one article.

Step	Outcome	Result
Early Access/Early Recognition	User Profession	PulsePoint: Firefighters (30%), Paramedics (21%), EMT (16%), Nurse (4.4%), MD (0.83%) (3) AED-Alert: “One-third” involved with police, fire or medicine (4)
	Dispatch time (only measuring data input time by EMS)	Motegi: 37 seconds (range 21-60) (5)
	Total dispatch time (incl. data input and geolocation)	Mobile Life Saver: 87 seconds (SD±45sec; simulation) (6) Bucharest ¹ : “A few seconds” (7)
	Proportion of laypersons responding to alerts	PulsePoint: 23% (n=157) (3) AED-Alert: 28.2% (n=579) (4)
	Time reduction to arrival (compared to EMS)	Motegi: 127 seconds (simulation, rural setting; trial arm actual response time: 6 min

¹ Where the name of the service is unavailable, its location is given instead.

		21 sec) (5) Mobile Life Saver: 140 seconds (simulation, urban setting) (6)
Early CPR	Time from dispatch to CPR commencement	Bucharest: “1-3 minutes” (7)
	Frequency of CPR commencement by layperson-responders when indicated	PulsePoint: 80% (n=8) (3) AED-Alert: 49.3% (n=37) (4) Mobile Life Saver: 30% (n=6) (6)
	Total number of patients who received early CPR	AED-Alert: n=11 (4)
Early Defibrillation	Frequency of AED connection in ≤ 6 minutes (from time of emergency call)	TM-Alert: 16.5% (n=29) (8)
	Frequency of early defibrillation	AED-Alert: n=7 (“early defibrillation”) (4) TM-Alert: 10.5% (n=8) (“first shock in ≤ 6 minutes”) (8)
	Time reduction to first shock (compared to EMS)	TM-Alert: 2 min 39 sec (8)

Discussion: No trials have attempted to assess the effect of ‘crowdsourced’ CPR on patient mortality, return of spontaneous circulation, or haemodynamic parameters, which are the preferred outcomes for smaller trials of cardiac arrest interventions (9). The included papers reported a very wide range of outcomes to do with processes, such as the response times and travel distances, user actions and demographics.

The evidence suggested that the studied solutions were an effective part of the chain of survival. Merchant et al found that AED mapping could be crowdsourced cheaply and accurately (10), while the responder apps were found to significantly reduce response time, time to CPR and time to defibrillation. One simulation found that only response distance was reduced, without reducing response time. Only two papers assessed adverse effects: one paper reported none (6), while another found that 2% (n=12) of laypersons required follow-up care (4).

Comparison between solutions is difficult. On the available evidence, it is not possible to assess the relative merits of text messages sent to users’ mobile phones versus in-app notifications using smartphones, or to compare dispatch processes initiated by the local EMS versus those initiated directly by bystanders.

Conclusion: Mobile phones are likely to be useful for crowdsourcing the chain of survival to reduce the time to access, cardiopulmonary resuscitation and defibrillation. There is no evidence for the superiority of any particular dispatch method or strategy.

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Socioeconomic Status and its effect
on pregnancy and childbirth:
paramedic considerations in the
prehospital setting

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ABSTRACT

This article aims to identify the role of socioeconomic status in determining poor health outcomes in pregnancy and childbirth. It brings to light the limitations and complications that a person in a low socioeconomic society may face and the effect that this possibly has on the health of the mother and child. The literature has been reviewed in relation to three key areas, namely: social and emotional matters, lifestyle factors and financial issues. Particular focus has been put on understanding these issues from a paramedic perspective and how this can assist in both treating and educating the patient in the pre-hospital environment. While there has been sufficient research into the individual areas of socioeconomic status affecting pregnancy, this article has drawn these topics together to create an overview of a subject which is complex and multifaceted.

KEY WORDS

pregnancy; low socioeconomic status; paramedics; drug and alcohol abuse; financial issues; stress and support; poor health outcomes; birth defects

INTRODUCTION

Low socioeconomic status (SES) has long been associated with poor health outcomes in the developed world when compared against high SES in the same vicinities. This is an important consideration for paramedics in comprehending their environment and understanding cause and effect. It is relevant therefore to explore the health discrepancies between low SES and high SES communities from the same regions and how this affects specific issues in the community. This article will explore the relationship between SES and poor health outcomes in pregnancy and childbirth focusing specifically on the prehospital aspect. Socioeconomic disadvantage and its effect on health is a multifaceted issue however this article will attempt to focus on three of the key aspects of low SES communities: social and emotional matters, lifestyle choices and financial issues. It will identify the negative impact on both the mother and baby and outline considerations which paramedics must keep in mind when attending pregnancy and childbirth related jobs in low SES communities.

SOCIAL AND EMOTIONAL ISSUES

Stress and Lack of Support

Females in low SES societies are already under increased stress and this is exacerbated by the extra stressors of pregnancy. The extra stress that low SES people are put under can be attributed to financial troubles, fear for safety and lack of support just to name a few. (1) In addition, during pregnancy there is extra pressure put on the mother as there is increased financial struggle due to the inability to work as well as the anticipation of not coping when the baby arrives. (1) It has also been shown that people in low SES societies have a lower ability to cope with stress possibly due to lack of education and life experience. (2)

Support

Support is proven to have a positive impact on pregnancy whether it be from the father of the child, grandparents, friends or a community nurse.(3) It has been shown that greater paternal involvement and support during pregnancy results in lower anxiety levels in pregnant women.(4) Due to the often unsafe and unstable surroundings which a low SES female is faced with, they may find it hard to put their trust in

someone during such a vulnerable time.(5) Females in low SES communities often have smaller social groups and strain on such friendships is increased during pregnancy, especially if the expectant mother is relying heavily on social support rather than family.(1) Functional family relationships are helpful in providing help and support to the expectant mother however they are rare in low SES societies.(3)

Stress

Stress during pregnancy can be linked to poor health outcomes such as anxiety and depression (6)(7) and is believed to be connected with the foetus via the corticosteroid pathway.(8) Extra stressors put on expectant mothers during a time when they are already susceptible to mental illness can have an extremely negative impact.(5) Paramedics should understand that lower SES females are likely to be depressed, anxious or facing other mental illnesses.(6) In extreme cases, preterm birth can also result from stress during pregnancy.(3) Paramedics must consider the increased risk of preterm labour and birth when attending cases that are in low SES communities.(9) Preterm birth is the birth of a child prior to 37 weeks gestation and depending on the gestational age of the baby, different outcomes can occur.(10) There is a higher neonatal morbidity and mortality in lower SES groups which can be linked to higher rates of preterm birth.(8) It is important to get a good history from the patient and to evaluate the risk of a preterm birth, understanding the complications that are associated.

LIFESTYLE CHOICES

Smoking

It is no secret that there is a higher prevalence of smoking in lower SES societies than high SES ones.(11) Due to the increasing evidence linking smoking and adverse health outcomes, the effect of smoking on health and morbidity is a well-researched topic. However the relationship between smoking during pregnancy and harmful consequences for both the baby and mother are not as widely researched. In 2002/2003, 18 percent of pregnant females smoked during pregnancy. (12) High smoking rates in low SES communities can be attributed to lack of education (12) and peer pressure.(5) Not only are low SES females more likely to smoke, they are also less likely to seek help from doctors to quit.(11) Low SES females are often unaware of pregnancy until late into the first trimester and may only begin to cease or reduce smoking habits when pregnancy is confirmed.(12)

Even a small number of cigarettes consumed during conception and pregnancy can be detrimental (13) and can increase the risk of preterm birth, a low birth-weight, placenta previa and placental abruption.(12) Females who smoke during pregnancy have a 30% higher chance of giving birth prematurely.(14) In addition, smoking during pregnancy increases the risk of sudden infant death syndrome.(14) It has also been linked to but not proven with enough supporting evidence that smoking during pregnancy causes cleft palate, reduced respiratory function in the newborn and cognition difficulties in childhood.(14) In the prehospital environment, paramedics must recognise the increased risk of these conditions when attending a patient in a low SES society. While it does not change the treatment or interventions, it is still important to be able to identify these issues early and take the appropriate action.

Recreational drug and alcohol abuse

Recreational drug and alcohol abuse is common in low SES communities. Alcohol and drug use during pregnancy is linked to poor health outcomes for both the mother and the baby.(15) In 2002/2003, 4.3 percent of pregnant females used illicit drugs and 4.1 percent took part in binge alcohol consumption.(12) Due to poor education, low self-esteem, lack of contraceptive agents such as the contraceptive pill and reduced rate of abortions, females in the 15-25 year old age bracket in low SES societies are more likely to fall pregnant and continue to use illicit drugs and alcohol.(12) As with smoking, those who use drugs and alcohol are not likely to tell their doctors as there is stigma surrounding this topic.(11) Given the range of

social drugs on the market, it is impossible to understand the effect that each drug can have and their short and long term effects on pregnancy and childbirth.(14) Paramedics are therefore required to be flexible and open to a range of possibilities and able to act accordingly.

Alcohol

Alcohol abuse before falling pregnant can cause health deficits in the mother such as pancreatitis, cardiomyopathy, coagulopathy and malnutrition just to name a few.(15) This already creates an unhealthy environment for a foetus to grow, regardless of alcohol consumption levels during pregnancy.(15) This, however, is not the main concern related to alcohol abuse and pregnancy. Ethanol easily crosses the placental barrier and this means that alcohol consumption by the mother directly affects the growing foetus during pregnancy.(15) If alcohol is consumed during pregnancy, the newborn may suffer from foetal alcohol syndrome (FAS).(14) This syndrome has a number of symptoms including but not limited to mental handicap, musculoskeletal, cardiovascular and genitourinary abnormalities.(15) Binge drinking during pregnancy can account for 18 percent of neonatal mortalities.(15) Some other foetal health concerns include microcephaly and other growth defects.(12)

Narcotics

Narcotic use can have an indirect (poor maternal health) and direct (transplacental opioid transfer) effect on the foetus.(15) It has been linked to perinatal mortality, preterm delivery and preterm rupture of membranes.(12) Unlike smoking and alcohol, it is not recommended that opiates are completely ceased during pregnancy as this can result in withdrawal symptoms that can be detrimental to the baby.(14)(15) Rather than completely stopping opiate consumption during pregnancy, it is recommended that methadone be substituted.(14) For this reason, it is important for expectant mothers to seek medical help rather than trying to quit on their own.(15) If the pregnant female reaches the stages of labour and needs opioid substitutes (methadone) in labour, it is important that paramedics take them to an appropriate facility. It is also important for paramedics to understand the signs of withdrawal and how this can affect both the mother and the unborn child. Babies can be born with respiratory depression due to the transplacental effect of maternal narcotic consumption (14) and this may have to be managed in the prehospital environment. Severe withdrawal symptoms of the newborn are commonly seen within the first 24-72 hours of birth and can include tremors, seizures and respiratory distress just to name a few.(14) While most symptoms present within this period, it is also possible for the effects to occur 10-36 days post birth.(14) These are all things that paramedics must consider when attending cases in low SES communities which are associated with pregnancy, childbirth and infants.

CNS Stimulants

Other drugs such as central nervous system (CNS) stimulants (cocaine, amphetamines) can also directly and indirectly affect the foetus. These drugs are more associated with long-term effects such as cognition and behavioural deficits however can still increase the risk of spontaneous abortion, placental abruption and growth restrictions.(12) It has been found that the indirect effect of cocaine abuse is a result of the mother's vasoconstriction and therefore reduced uteroplacental blood flow.(15) Indirect effects of CNS stimulants are most likely the cause of adverse health outcomes for the baby as these drugs cause hypertension, arrhythmias and myocardial ischaemia in the expectant mother.(15) The use of anaesthetics should be done so with caution in cocaine addicted patients as it may cause complications.(15)

Poor diet

Lifestyle choices such as poor diet stem from childhood and are continued throughout a person's life, including pregnancy.(5). An adequate diet and healthy lifestyle is paramount in creating the basis for a healthy baby.(16) People in low SES communities often consume diets that are low in key nutrients and

high in saturated fat.(5) Poor diets have been associated with poor foetal growth, preterm delivery and an increased risk of chronic diseases later in life.(16) They also can increase the risk of gestational diabetes and pre-eclampsia in the expectant mother.(16) While not in the forefront of causes of ambulance call-outs during pregnancy, they are still things that a paramedic must take into account when treating a low SES pregnant patient.

FINANCIAL ISSUES

Cost of medical assistance and antenatal care

Those who have low socioeconomic status are financially unstable and this can be linked to poor health outcomes in pregnancy and everyday life. While there is little research on the specific effect of limited money and pregnancy outcomes, it is well known that medical costs are quite significant in any setting. General practitioner (GP) visits, ante-natal care, birthing classes and private hospitals can cost a substantial amount of money, especially if you take things such as travel to and from appointments and missing work into consideration. Studies have shown that there is a relationship between attending antenatal care classes and a reduced incidence of preterm birth.(17) However that relationship is proportional to the number of classes attended.(17) In addition, rates of oral contraceptives such as the contraceptive pill are lower in low SES communities due to their cost.(18) This results in more unwanted pregnancies, less abortions and a higher rate of pelvic inflammatory disease which in turn increases the rate of ectopic pregnancies. (18)

Environmental factors

Low SES communities are situated in areas of high pollutant exposure due to the lower cost of living in these areas.(19) Air pollutants which can be found in and around the home as well as at work can increase the risk of a small birth weight or preterm birth at high concentrations.(20) Other pollutants such as lead and mercury can be found in batteries, pottery glazes and paints and can also lead to poor health outcome.(21) There are few studies that look at the direct link between low SES and high incidence of pollutant toxicity and its association with pregnancy.

CONCLUSION

This article has only scratched the surface of socioeconomic status and its effect on pregnancy and childbirth. It has, however, brought to light the major issues that low SES females face which result in poor health outcomes during pregnancy and childbirth. While there are certain areas surrounding this topic which need to be further studied, overall the topic has been well researched in the community. Paramedics are at the forefront of both pre-hospital health care and patient education on how they can reduce poor health outcomes especially during pregnancy and childbirth. While it is not an issue that will be quickly resolved, it is important for paramedics to understand their role in improving patient outcomes.

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