Exploring Barriers to Consistent Chest Compressions in CPR

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Abstract
A crucial factor in determining a patient's survival during cardiac arrest is providing excellent cardiopulmonary resuscitation (CPR). Nevertheless, it might be difficult to administer adequate chest compressions consistently, especially when tired. In developed nations, cardiac arrest is one of the main causes of death. The principles of closed chest compression, first defined in 1960, are followed in cardiopulmonary resuscitation (CPR) recommendations. The goal of mechanical CPR equipment is to enhance the quality of chest compressions, which takes into account better resuscitation results. Because performing successful chest compressions is frequently variable, fatigue-prone, and practically difficult, this study sought to explore barriers to administering cardiopulmonary resuscitation in medical settings and explain good quality chest compressions.

Keywords*:* barriers, CPR, clinical, cardiopulmonary resuscitation.

Introduction

Effective cardiopulmonary resuscitation (CPR) is a critical factor in determining a patient's chance of survival in cardiac arrest. Nevertheless, doing efficient chest compressions is practically difficult, prone to fatigue, and frequently inconsistent. A vital link in the cardiac arrest survival chain is providing effective chest compressions. In clinical practice, prolonged delivery of high-quality cardiopulmonary resuscitation (CPR) is rarely accomplished, despite its critical relevance [1].

International recommendations emphasize the significance of high-quality chest compressions, which are characterized by minimal interruptions and a depth of 5-7 cm at a rate of 100-120 compressions per minute, enabling the chest to fully recoil in between. Both in-hospital and out-of-hospital settings present challenges in providing high-quality manual chest compressions, despite consistent observational data demonstrating a link between CPR quality and patient success. Particular obstacles include weariness on the part of the caregiver, the need to exert physical force to loosen up the patient's thoracic cage, and compressible underneath surfaces like mattresses that might cause shallow chest compressions. In an investigation involving 9136 OHCA patients, for instance, only 45% of them got the recommended guideline chest compression depth [1].

A vital component of cardiopulmonary resuscitation (CPR) is chest compressions. They maintain circulation during cardiac arrest, and the likelihood of a successful return of spontaneous circulation (ROSC) and survival is increased by providing high-quality chest compressions with minimal interruption [2].

One of the main causes of mortality in developed nations is cardiac arrest. Guidelines for cardiopulmonary resuscitation (CPR) adhere to the closed chest compression theory as initially presented in 1960. The goal of mechanical CPR equipment is to enhance the quality of chest compressions, hence improving the results of resuscitation efforts.

Humanity has been trying to "re-animate" dead people for thousands of years. In 1960, manual closed- chest cardiac massage—a major advancement in cardiopulmonary resuscitation (CPR)—was introduced. More modern innovations include devices that use load-distributing bands, inflatable vests, or pistons to manually and automatically compress the chest. Can mechanical chest compression devices that are automated outperform human performance and once again revolutionize CPR? [3].

Aim of study

The goal of this study was to examine barriers to the use of cardiopulmonary resuscitation in medical settings and provide an explanation for high-quality chest compressions, which are difficult to perform consistently, fatigue-prone, and practically problematic.

Literature review

Effective CPR is essential to the success of resuscitation. It has been noted that when performing manual CPR, rescuers become more and more exhausted and that compressions stop frequently. Fatigue and disruptions both reduce blood flow, which is necessary for sufficient heart and brain perfusion and the restoration of spontaneous circulation (ROSC), as well as positive neurological outcomes. It has been demonstrated that high-quality chest compressions with little breaks increase survival rates when compared to poorly executed chest compressions [4].

Mechanical CPR systems were developed in response to problems with manual CPR, with the goal of enhancing CPR quality—a critical factor in survival. According to application studies, the use of mechanical CPR devices can enhance hemodynamic conditions and arterial carbon dioxide levels, both of which are markers of improved tissue perfusion and improve cerebral and coronary blood flow. Moreover, the most important factors influencing survival after resuscitation have been reported to be brain and coronary perfusion. Better results might be anticipated from these devices if automated mechanical CPR is predicated on the idea that it offers a sustained quality of chest compressions [4].

Incidence of cardiac arrest

A sizable percentage of adult Americans suffer from cardiac arrest. Ten percent of victims of out-of-hospital cardiac arrests (OHCAs) in the US survive to be discharged from the hospital, out of over 300,000 cases annually. 20% of the more than 200,000 individuals who experience an in-hospital cardiac arrest (IHCA) each year go on to survive. The survival rate from IHCA and OHCA has slightly improved during the past ten years. Prompt resuscitation efforts and shocks, enhanced CPR performance, and better post-resuscitation care (including rapid angiographic reperfusion) may all be responsible for this advancement [5].

Still, there's a lot of space for development. Even after taking the severity of the illness and facility layout into consideration, patient outcomes in comparisons among health-care institutions are very diverse. This research implies that care practices have an impact on results, with CPR quality playing a major role. High-quality CPR is considered to be the cornerstone of resuscitation by the Institute of Medicine, the American Heart Association (AHA), and the International Liaison Committee on Resuscitation [5].

CPR Physiology

Restoring blood flow and perfusion to important organs is the aim of CPR. The thoracic pump and cardiac pump ideas are the two most likely explanations for how chest compressions cause blood flow. In the past, the heart pump idea was thought to be the dominant mechanism. Every time the chest is compressed, the heart is squeezed because of its position between the sternum and the spine. Due to the limitation of retrograde flow by valves, the heart may contract intrinsically or extrinsically, resulting in a stroke volume. The mechanical connection of the heart and sternum is essential to this mechanism.The ventricles shrink, the aortic valve opens to permit forward flow, and the mitral valve closes to restrict retrograde flow, according to echocardiography performed on both human and animal subjects during chest compression [6].

Conventional CPR physiologyThe Compression Phase

The hands-only method of performing standard (S)-CPR is conventional. Every time the chest is compressed, the heart is compressed between the sternum and the spine, increasing intrathoracic pressure. The pressures in the right atrium and the aorta rise with each compression; the pressures in the right atrium are occasionally greater than those in the left atrium. The existence of one-way valves within the heart and pressure differentials between the thorax and nonthoracic regions force blood forward from the non-beating heart into the brain, coronary arteries, and the rest of the body. The impact of elevated intrathoracic pressure on intracranial pressure (ICP) during the compression phase has attracted fresh attention in the last ten years. ICP rises during this phase, increasing the body's resistance to brain perfusion. Changes in intrathoracic pressure transduced through the paravertebral venous/epidural plexus and spinal fluid to the intracranial compartment are thought to be the secondary cause of the spikes and falls in ICP during CPR [7].

Every positive pressure breathing raises the ICP. Figure (1) (0° supine tracings) illustrates the rise in ICP and the concurrent fall in the computed cerebral perfusion pressure (CerPP). With each compression, the right atrial, right ventricular, and pulmonary artery pressures rise simultaneously. The difference between the right-sided and aortic pressures is typically used to compute the coronary artery perfusion pressure during CPR. Coronary perfusion pressures are therefore restricted by high right-sided pressures during S-CPR. The authors hypothesize that a contributing factor in the poor patient outcomes associated with certain CPR techniques, such as S-CPR, is the lack of focus on comprehending the interplay between variations in right-side cardiac pressures, intracranial pressure, and the cerebral and coronary perfusion pressures that follow [7].

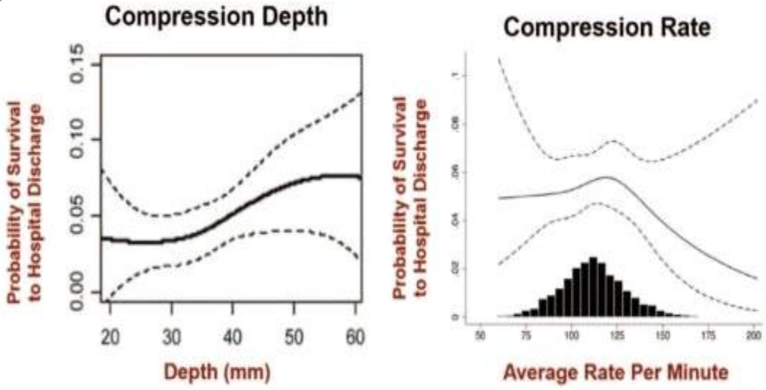

Figure (1) Relationship between chest compression depth and rate and the probability of survival to hospital discharge [7].

The Chest Decompression Phase

The decompression, or chest recoil, phase of CPR involves a complicated physiology: It's just been more clearly known recently how important it is during CPR. The heart is replenished during the decompression phase following its emptying from the prior chest compression. When performing S-CPR, when passive chest wall recoil is the sole force capable of drawing blood back into the right side of the heart, this refilling process is particularly ineffective. Patients who have broken ribs or other conditions that affect chest recoil may experience a much more pronounced effect from this. Not only does the decompression phase improve the venous return to the heart, but it also lowers ICP.ICP falls after each recoil of the chest wall due to the same pressure transmission mechanisms that raise ICP during the compression phase. Figure (1) depicts this (0° supine tracings). When performing CPR, these variations in ICP during the compression and decompression phases aid in determining the degree of cerebralperfusion [8].

Tools to Improve the Quality of CPRReal-time Feedback

Numerous studies have shown little adherence to the suggested targets and significant heterogeneity in the quality of CPR in clinical practice, despite the evidence supporting these crucial elements of high-quality CPR and strong published guidelines. The discrepancy between guidelines and practice is multifaceted: after training, rescuers may not retain all of their knowledge; resuscitation is a complex situation involving multiple time- sensitive tasks; and fatigue among rescuers is common, often occurring as soon as one minuteafter beginning CPR [9].

Compression rates are often outside the recommended range when CPR measurements are examined. There are a lot of pauses, and according to some studies, only half of the code is compressed. In 50% of cases, the compression depth is not able to reach the target. Chest recoil is unintentionally hindered by rescuers during the decompression stage. Patients frequently have twice the recommended breathing rate, resulting in hyperventilation [10].

Mechanical Chest Compression

In light of the significance of continuous, high- quality compressions, mechanical devices present an appealing alternative to human rescuers who are prone to error. These devices (such as the LUCAS device from Jolife AB, a division of Physio Control, Inc.) ensure active chest decompression and provide continuous mechanical compressions at a predetermined depth and pace. Animal physiologic studies indicate that cerebral blood flow is higher when compression is mechanical as opposed to manual. Nevertheless, further research on patients has not shown that using these mechanical compression devices improves results [11].

Timely Vascular Access

While there remains debate on the appropriateness of IV pharmacologic therapy for patients experiencing cardiac arrest, antiarrhythmics and vasoconstrictors continue to be essential components of advanced cardiovascular life support. In order to provide medications, perform fluid resuscitation, infuse blood products, and draw blood for laboratory testing, vascular access must be secured.

Vascular access is attempted, compromising compressions and wasting valuable time. With a 43% success rate on the first try, rescuers need an average of 3.6 to 5.8 minutes to insert a peripheral IV catheter. Comparably, central venous catheters have a 60% success rate and sometimes take longer than 10 minutes. An excellent substitute for central and peripheral venous catheters is intraosseous (IO) access. Through the extremely vascular medullary plexus, the IO route guarantees access to systemic circulation and is not compressible [12].

drug supplied this way has pharmacokinetics and absorption comparable to that of drug given peripherally. Insertion can be completed quickly (from 20 s to about 2 min), has a greater success rate (> 80%), and requires less training than a central venous catheter. Additionally, endotracheal, sublingual, and intramuscular routes—all of which have erratic absorption—are less dependable for drug delivery than IO access. One can gain access to the internal organs through the tibia, humerus, or sternum. The time to peak drug blood concentration achieved by the sternal route is similar to that of a central venous catheter [13].

Barriers during performing cardiopulmonary resuscitation

Lack of knowledge and training

It has not yet been examined how CPR psychomotor skills relate to self-efficacy or willingness to administer CPR. Given the correlation between bystander CPR and survival following an OHCA, it's critical to determine whether those who are willing to provide CPR possess the necessary psychomotor abilities. Examining a relationship between psychomotor skills and self-efficacy may help in creating instructional plans that enhance abilities. To improve their CPR skills, laypeople should all participate in an instructor- led CPR training program that offers either delayed or real-time feedback. To guarantee that skills are retained, training sessions should incorporate a variety of validated skill-specific training methodologies, ideally with music that is well-liked and feedback. Every three to six months, refresher training should be conducted with an emphasis on skills and self-confidence rather than knowledge; however, further validation is required for this schedule [14].

Fear and panic

When lay responders arrive at a cardiac arrest scene, they may experience extreme terror that keeps them from dialing 9-1-1 or even from starting CPR. Lay responders frequently report that it is difficult to maintain composure while doing what is required for the patient. Twenty percent of lay responders who were questioned and who conducted CPR in the Public Access Defibrillation Trial reported feeling anxious or stressed [15].

Fear of hurting someone or doing CPR incorrectly was found to be a major obstacle in several evaluations including a wide variety of individuals. Numerous research also revealed it to be the most prevalent barrier. This could be due to a lack of confidence in one's abilities, which increases the likelihood that someone with some capabilities will take action. Even with experienced medical professionals, self- efficacy—the conviction that one can carry out a plan of action to handle a potential circumstance—has been demonstrated to be correlated with the execution of vital life- saving abilities [15].

Failure to Recognize Cardiac Arrest

Patients experiencing an in-hospital cardiac arrest who had their triggering factors identified by the emergency technician (ET) had better 1-hour survival and hospital discharge rates. Patients presenting with a non- shockable rhythm and non-cardiac etiology benefited most from the survival advantage. The worst outcome for hospitalized individuals experiencing a serious disease is in-hospital cardiac arrest (IHCA). Should the in-hospital emergency team (ET) identify the triggeringcauses of arrest, this could have critical implications for the patient's survival [16].

Concerns about hurting the sufferer when administering CPR and using an AED are another commonly mentioned obstacle. It is important to emphasize that performing CPR and using an AED can double or triple a victim's chances of survival, that using an AED can increase survival by 50% to 70%, and that major injuries are unlikely to result from performing CPR and using an AED. Patients experiencing sudden cardiac arrest may suffer permanent brain damage if these procedures aredelayed [17].

Numerous educational programs have impacted this age group's awareness and understanding, especially those targeted toward the younger generation (e.g., the first aid course). Physical characteristics, information accessibility, and acceptance of new information could all be important variables. It is common knowledge that older adults are far less likely to utilize an AED and do CPR. Public health interventions must address the attitudinal views of the elderly in order to encourage a higher percentage of them to administer CPR and utilize an AED on a victim of cardiac arrest [17].

Interruptions during CPR

Patients should get continuous life support for around one-third of their time, yet unnecessary CPR interruptions happen often. The primary feature of needless disruptions is secondary medical actions that could be viewed as significant. The fact that every team member concentrates on the same side work during most needless pauses suggests that the resuscitation team's task distribution is inadequate. The results highlight the value of team training, placing a special focus on task distribution and situational awareness [18].

Crowded or Restricted Space

A patient in need of CPR might not be supine or might be resting on an unsteady surface. Guidelines for how to perform CPR in these kinds of scenarios are lacking, most likely because they are uncommon and don't happen very often. In operating rooms (ORs), these are the scenarios in which patients experience cardiac arrest while undergoing surgery, lying prone or laterally, and under general anesthetic. The best course of action is to turn the patient supine and start CPR, but because of different patient-fixing devices and the exposed surgical field, this alternative might occasionally be challenging to implement. An further disincentive is the possibility of wasting valuable time while attempting to shift the patient supine [19].

Effectively performing CPR in a limited space or on a patient transport trolley in the traditional manner can be difficult when a patient experiences cardiac arrest in confined places like airplanes, submarines, CT/MRI suites, or intrahospital transfers [19].

Conclusion

The results of this investigation showed that a number of variables influence how well CPR works. Many of these elements, including the CPR team's tardiness, their lack of training, and their subpar and outdated equipment, are avoidable or reduceable. In the interim, it is especially crucial to focus on empowering the resuscitation team's nurses and to provide the facilities and equipment they require. Future research should consider obstacles to successful CPR from the viewpoint of other members of the resuscitation team.

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