Brunei International Medical Journal

OFFICIAL PUBLICATION OF
THE MINISTRY OF HEALTH
AND
UNIVERSITI BRUNEI DARUSSALAM

Volume 17

8 December 2021 (4 Jamadilawal 1443H)

RATIONALE OF USING MECHANICAL COMPRESSION DEVICES FOR CARDIOPULMONARY RESUSCITATION DURING COVID-19 PANDEMIC.

Mohammad Noh LATIP

Emergency Department, Raja Isteri Pengiran Anak Saleha Hospital, Jalan Putera Muhtadee Billah, Bandar Seri Begawan, Brunei Darussalam BA1712.

ABSTRACT

In the event of a cardiopulmonary arrest, performing high quality chest compression during resuscitation is vital in improving patient outcome. Mechanical chest compression devices are widely used during cardiopulmonary resuscitation (CPR) with the aim of improving quality of chest compressions delivered. Benefits of using mechanical chest compression devices include delivering more consistent chest compressions as well as being able to deliver chest compressions safely when in a moving ambulance. However, with the use of mechanical CPR devices there is the risk of CPR pauses when having to adjust the device correctly on patients. There is also an increased risk of bone and soft tissue injuries to patients. During the COVID 19 pandemic, the American Heart Association (AHA) has introduced recommendations for the usage of mechanical CPR devices in order to reduce the number of healthcare workers involvement and exposure during CPR process. The AHA has also recommended that healthcare workers be properly trained to ensure chest compressions delivered are accurate, continuous, and also safe for both healthcare workers and patients.

Keywords: Advanced Cardiac Life Support, Cardiopulmonary Resuscitation, COVID-19, Emergency Medicine, Mechanical chest compression.

Brunei Int Med J. *2021;17:153-156*

ISSN 1560 5876 Print
ISSN 2079 3146 Online

Online version of the journal is available at www.bimjonline.com

Brunei International Medical Journal (BIMJ)
Official Publication of
The Ministry of Health
and
Universiti Brunei Darussalam

EDITORIAL BOARD

Editor-in-Chief
Ketan PANDE

Sub-Editors
Vui Heng CHONG
William Chee Fui CHONG

Editorial Board Members
Muhd Syafiq ABDULLAH
Alice Moi Ling YONG
Ahmad Yazid ABDUL WAHAB
Jackson Chee Seng TAN
Pemasiri Upali TELISINGHE
Pengiran Khairol Asmee PENGIRAN SABTU
Dayangku Siti Nur Ashikin PENGIRAN TENGAH

INTERNATIONAL EDITORIAL BOARD MEMBERS

Lawrence HO Khek Yu (Singapore)
Wilfred PEH (Singapore)
Surinderpal S BIRRING (United Kingdom)
John YAP (United Kingdom)
Nazar LUQMAN (Australia)
Jose F LAPENA (Philippines)
Chuen Neng LEE (Singapore)
Emily Felicia Jan Ee SHEN (Singapore)
Leslie GOH (United Kingdom)
Ian BICKLE (United Kingdom)
Christopher HAYWARD (Australia)

Advisor
Wilfred PEH (Singapore)

Past Editors-in-Chief
Nagamuttu RAVINDRANATHAN
Kenneth Yuh Yen KOK
Chong Vui Heng
William Chong Chee Fui

Proof reader
John WOLSTENHOLME (CfBT Brunei Darussalam)

ISSN 1560-5876 Print
ISSN 2079-3146 Online

Aim and Scope of Brunei International Medical Journal

The Brunei International Medical Journal (BIMJ) is a six monthly peer reviewed official publication of the Ministry of Health under the auspices of the Clinical Research Unit, Ministry of Health, Brunei Darussalam.

The BIMJ publishes articles ranging from original research papers, review articles, medical practice papers, special reports, audits, case reports, images of interest, education and technical/innovation papers, editorials, commentaries and letters to the Editor. Topics of interest include all subjects that relate to clinical practice and research in all branches of medicine, basic and clinical including topics related to allied health care fields. The BIMJ welcomes manuscripts from contributors, but usually solicits reviews articles and special reports. Proposals for review papers can be sent to the Managing Editor directly. Please refer to the contact information of the Editorial Office.

Instruction to authors

Manuscript submissions

All manuscripts should be sent to the Managing Editor, BIMJ, Ministry of Health, Brunei Darussalam; e-mail: editor-in-chief@bimjonline.com. Subsequent correspondence between the BIMJ and authors will, as far as possible via should be conducted via email quoting the reference number.

Conditions

Submission of an article for consideration for publication implies the transfer of the copyright from the authors to the BIMJ upon acceptance. The final decision of acceptance rests with the Editor-in-Chief. All accepted papers become the permanent property of the BIMJ and may not be published elsewhere without written permission from the BIMJ.

Ethics

Ethical considerations will be taken into account in the assessment of papers that have experimental investigations of human or animal subjects. Authors should state clearly in the Materials and Methods section of the manuscript that institutional review board has approved the project. Those investigators without such review boards should ensure that the principles outlined in the Declaration of Helsinki have been followed.

Manuscript categories

Original articles

These include controlled trials, interventional studies, studies of screening and diagnostic tests, outcome studies, cost-effectiveness analyses, and large-scale epidemiological studies. Manuscript should include the following; introduction, materials and methods, results and conclusion. The objective should be stated clearly in the introduction. The text should not exceed 2500 words and references not more than 30.

Review articles

These are, in general, invited papers, but unsolicited reviews, if of good quality, may be considered. Reviews are systematic critical assessments of literature and data sources pertaining to clinical topics, emphasising factors such as cause, diagnosis, prognosis, therapy, or prevention. Reviews should be made relevant to our local setting and preferably supported by local data. The text should not exceed 3000 words and references not more than 40.

Special Reports

This section usually consist of invited reports that have significant impact on healthcare practice and usually cover disease outbreaks, management guidelines or policy statement paper.

Audits

Audits of relevant topics generally follow the same format as original article and the text should not exceed 1,500 words and references not more than 20.

Case reports

Case reports should highlight interesting rare cases or provide good learning points. The text should not exceed 1000 words; the number of tables, figures, or both should not be more than two, and references should not be more than 15.

Education section

This section includes papers (i.e. how to interpret ECG or chest radiography) with particular aim of broadening knowledge or serve as revision materials. Papers will usually be invited but well written paper on relevant topics may be accepted. The text should not exceed 1500 words and should include not more than 15 figures illustration and references should not be more than 15.

Images of interest

These are papers presenting unique clinical encounters that are illustrated by photographs, radiographs, or other figures. Image of interest should include a brief description of the case and discussion with educational aspects. Alternatively, a mini quiz can be presented and answers will be posted in a different section of the publication. A maximum of

three relevant references should be included. Only images of high quality (at least 300dpi) will be acceptable.

Technical innovations
This section include papers looking at novel or new techniques that have been developed or introduced to the local setting. The text should not exceed 1000 words and should include not more than 10 figures illustration and references should not be more than 10.

Letters to the Editor
Letters discussing a recent article published in the BIMJ are welcome and should be sent to the Editorial Office by e-mail. The text should not exceed 250 words; have no more than one figure or table, and five references.

Criteria for manuscripts
Manuscripts submitted to the BIMJ should meet the following criteria: the content is original; the writing is clear; the study methods are appropriate; the data are valid; the conclusions are reasonable and supported by the data; the information is important; and the topic has general medical interest. Manuscripts will be accepted only if both their contents and style meet the standards required by the BIMJ.

Authorship information
Designate one corresponding author and provide a complete address, telephone and fax numbers, and e-mail address. The number of authors of each paper should not be more than twelve; a greater number requires justification. Authors may add a publishable footnote explaining order of authorship.

Group authorship
If authorship is attributed to a group (either solely or in addition to one or more individual authors), all members of the group must meet the full criteria and requirements for authorship described in the following paragraphs. One or more authors may take responsibility 'for' a group, in which case the other group members are not authors, but may be listed in an acknowledgement.

Authorship requirement
When the BIMJ accepts a paper for publication, authors will be asked to sign statements on (1) financial disclosure, (2) conflict of interest and (3) copyright transfer. The correspondence author may sign on behalf of co-authors.

Authorship criteria and responsibility
All authors must meet the following criteria: to have participated sufficiently in the work to take public responsibility for the content; to have made substantial contributions to the conception and design, and the analysis and interpretation of the data (where applicable); to have made substantial contributions to the writing or revision of the manuscript; and to have reviewed the final version of the submitted manuscript and approved it for publication. Authors will be asked to certify that their contribution represents valid work and that neither the manuscript nor one with substantially similar content under their authorship has been published or is being considered for publication elsewhere, except as described in an attachment. If requested, authors shall provide the data on which the manuscript is based for examination by the editors or their assignees.

Financial disclosure or conflict of interest
Any affiliation with or involvement in any organisation or entity with a direct financial interest in the subject matter or materials discussed in the manuscript should be disclosed in an attachment. Any financial or material support should be identified in the manuscript.

Copyright transfer
In consideration of the action of the BIMJ in reviewing and editing a submission, the author/s will transfer, assign, or otherwise convey all copyright ownership to the Clinical Research Unit, RIPAS Hospital, Ministry of Health in the event that such work is published by the BIMJ.

Acknowledgements
Only persons who have made substantial contributions but who do not fulfill the authorship criteria should be acknowledged.

Accepted manuscripts
Authors will be informed of acceptances and accepted manuscripts will be sent for copyediting. During copyediting, there may be some changes made to accommodate the style of journal format. Attempts will be made to ensure that the overall meaning of the texts are not altered. Authors will be informed by email of the estimated time of publication. Authors may be requested to provide raw data, especially those presented in graph such as bar charts or figures so that presentations can be constructed following the format and style of the journal. Proofs will be sent to authors to check for any mistakes made during copyediting. Authors are usually given 72 hours to return the proof. No response will be taken as no further corrections required. Corrections should be kept to a minimum. Otherwise, it may cause delay in publication.

Offprint
Contributors will not be given any offprint of their published articles. Contributors can obtain an electronic reprint from the journal website.

DISCLAIMER
All articles published, including editorials and letters, represent the opinion of the contributors and do not reflect the official view or policy of the Clinical Research Unit, the Ministry of Health or the institutions with which the contributors are affiliated to unless this is clearly stated. The appearance of advertisement does not necessarily constitute endorsement by the Clinical Research Unit or Ministry of Health, Brunei Darussalam. Furthermore, the publisher cannot accept responsibility for the correctness or accuracy of the advertisers' text and/or claim or any opinion expressed.

RATIONALE OF USING MECHANICAL COMPRESSION DEVICES FOR CARDIOPULMONARY RESUSCITATION DURING COVID-19 PANDEMIC.

Mohammad Noh LATIP

Emergency Department, Raja Isteri Pengiran Anak Saleha Hospital, Jalan Putera Muhtadee Billah, Bandar Seri Begawan, Brunei Darussalam BA1712.

ABSTRACT

In the event of a cardiopulmonary arrest, performing high quality chest compression during resuscitation is vital in improving patient outcome. Mechanical chest compression devices are widely used during cardiopulmonary resuscitation (CPR) with the aim of improving quality of chest compressions delivered. Benefits of using mechanical chest compression devices include delivering more consistent chest compressions as well as being able to deliver chest compressions safely when in a moving ambulance. However, with the use of mechanical CPR devices there is the risk of CPR pauses when having to adjust the device correctly on patients. There is also an increased risk of bone and soft tissue injuries to patients. During the COVID 19 pandemic, the American Heart Association (AHA) has introduced recommendations for the usage of mechanical CPR devices in order to reduce the number of healthcare workers involvement and exposure during CPR process. The AHA has also recommended that healthcare workers be properly trained to ensure chest compressions delivered are accurate, continuous, and also safe for both healthcare workers and patients.

Keywords: Advanced Cardiac Life Support, Cardiopulmonary Resuscitation, COVID-19, Emergency Medicine, Mechanical chest compression.

INTRODUCTION

In the event of a cardiac arrest resuscitation, performing high quality chest compression is vital to improve patient outcome.[1] One of the main difficulties in executing good cardiopulmonary resuscitation (CPR) is maintaining high-quality chest compressions during an in-patient or out-of-hospital cardiac arrest.[2] One intervention currently being practiced in real life resuscitation is utilizing "mechanical chest compression" where a device is used instead of *human effort* with the aim of improving quality of chest compressions.[3]

It is important to understand the mechanics of these devices in relation to the anatomy and physiology of cardiopulmonary resuscitation. There are a few devices available with different mechanisms which can be categorized into load distributing band or piston device instrument. Load distributing band devices also known as "Autopulse" uses a band covered across the patient's chest while performing

Correspondence: Dr Mohammad Noh Hj Latip, Emergency Department, Raja Isteri Pengiran Anak Saleha Hospital, Jalan Putera Muhtadee Billah, Bandar Seri Begawan, Brunei Darussalam BA1712. Telephone: 8815333; Email: mdnoh145@gmail.com

chest compressions with the rate of 80 beats per minute and 20% depth of chest height.[4] Piston device instruments such as "LUCAS" (Lund University Cardiac Arrest System) uses a backplate and piston device which anteriorly encircles the patient's chest and delivers chest compressions of 102 beats per minute with depth of around 5.3cm.[5] This paper aims to understand the benefits and challenges of using these devices during cardiopulmonary resuscitation by reviewing the appropriate guidelines and evidence-based outcomes available.

BENEFITS OF MECHANICAL CPR

Despite frequent training, humans are always challenged with exhaustion during on-going CPR where after a point we cannot reliably sustain the correct depth and appropriate rate of compressions.[6] Therefore, the main advantage of using mechanical devices is that it can provide consistent, quality chest compressions throughout the CPR course.[6] The involvement of multiple healthcare personnel in doing manual CPR cycles has also been shown to cause an increase in interruptions to the chest compressions at up to 57% within the entire arrest time.[7] Hence another benefit of utilizing mechanical CPR is that there are fewer pauses between arrest cycles.[7-9]

Another important factor needing to be taken into consideration is the safety of healthcare providers while performing CPR.[8] Healthcare personnel performing CPR are unrestrained in a moving ambulance which exposes them to a higher risk of injuries so using a mechanical CPR device allows ambulance crew to stay restrained and safe.[8] This is in accordance to the 2015 Advance Cardiac Life Support Guideline which states that mechanical devices are useful in the setting where it is difficult or dangerous to perform chest compression and this includes a moving ambulance or flying helicopter.[10-11]

CHALLENGES OF MECHANICAL CPR

Relying upon mechanical devices does have its set-backs and this includes the problem of having time "hands off chest" while the device is being mounted onto the patient. [12] Studies have shown it can take-up to an average of 39 seconds to do this, even when being done by trained personnel.[12] There are also issues with CPR pauses which includes time taken to remove the device off the patient and time taken when having to adjust the devices correctly.[13] The median "no-flow time" found during these interruptions when delivering mechanical CPR can be up to 52 seconds.[13]

There are also concerns regarding the safety of patient's physical anatomy against the force exerted by mechanical compression. [14] A prospective multicentre trial study done by Smekal et al., has shown that during autopsy, 91.4% of patients who underwent mechanical compressions suffered from at least one organ injury.[14] Other studies have also reported mechanical CPR as causing an increased risk of rib fractures, sternal fractures, vertebral fractures as well as visceral injuries such as pulmonary oedema. [14-15]

EVIDENCE-BASED OUTCOMES

Multiple studies have shown conflicting evidence regarding the outcome of using mechanical CPR devices. [17-18] In 2013, Westfall et al., did a large meta-analysis which included 3 randomized controlled trials with a total of 6538 subjects, and results showed cardiac arrest patients resuscitated with mechanical CPR had higher rates of return of spontaneous circulation compared to patients who had manual CPR performed.[17] However, a Cochrane review performed by Crooks et al., in 2013 which included 6 trials with 1166 patients concluded that there was no superiority of using mechanical compression over manual

CPR in terms of patient outcome.[18] The latter study goes in accordance with the American Heart Association guideline in 2015 which emphasized that manual chest compressions remain the standard of care while mechanical devices can still be a reasonable alternative to be used by trained personnel before the COVID 19 pandemic.[19]

COST EFFECTIVENESS

On an administrative level, an important factor to consider prior to introducing and standardising the use of mechanical CPR is to review the cost-effectiveness of using expensive mechanical devices in comparison to cheaper manual CPR during resuscitation.[16] A study carried out by Marti et al., in 2017 suggested that LUCAS devices represent "poor money value" when compared with manual CPR technique as patients with mechanical CPR suffered poorer health outcomes and received higher health and social care cost.[16]

USAGE OF MECHANICAL CPR DEVICES DURING COVID-19 PANDEMIC

The infectious disease safety of healthcare providers during CPR are taken more seriously during the COVID-19 pandemic.[20] In 2020, AHA produced an interim guidance in reducing risk of COVID-19 transmission during the active CPR process.[20] The guidelines include the use of proper personal protective equipment during CPR and also recommended to reduce the number of healthcare workers involves in CPR.[20] Mechanical chest compression devices were recommended to be used during active CPR procedures as it can significantly reduce the number of healthcare workers involvement and exposure during CPR process.[20] Recent study in 2021 by Abishek et al showed that mechanical CPR has the potential to reduce number of healthcare workers involves in CPR while still have similar clinical outcome with manual CPR during the current on going COVID-19 pandemic.[21]

CONCLUSION

Mechanical compression practices are an innovative creation that has been widely accepted as part of our day to day emergency care support devices that can potentially bring more benefit for years to come. During the challenging COVID-19 pandemic times, mechanical CPR provides extra benefits in reducing the number of healthcare workers involves in performing CPR. However, continuous efforts to improve the usage of these devices must always be a priority in order to improve patient outcome, not only in terms of return of spontaneous circulation but also for better neurological recovery and minimising physical harm. For emergency care providers, it is important to understand the mechanics of these devices as well as knowing their benefits and challenges. Furthermore, healthcare workers should have proper training to ensure chest compressions delivered are accurate, continuous, and also safe for both healthcare workers and patients.

CONFLICTS OF INTEREST

There was no financial support for this article and there were no other potential conflicts of interests by any party.

REFERENCES

1: Wik L, Kramer-Johansen J, Myklebust H, et al. Quality of Cardiopulmonary Resuscitation During Out-of-Hospital Cardiac Arrest. JAMA. 2005;293:299–304. [Accessed on 2021 November 30].

2: Abella BS, Alvarado JP, Myklebust H, et al. Quality of Cardiopulmonary Resuscitation During In-Hospital Cardiac Arrest. JAMA. 2005;293:305–310. [Accessed on 2021 November 30].

3: Ong MEH, Ornato JP, Edwards DP, et al. Use of an Automated, Load-Distributing Band Chest Compression Device for Out-of-Hospital Cardiac Arrest Resuscitation. JAMA. 2006;295:2629–2637. [Accessed on 2021 November 30].

4: Duchateau FX, Gueye P, Curac S, et al. Effect of the AutoPulse automated band chest compression device on hemodynamics in out-of-hospital cardiac arrest resuscitation. Intensive Care Med. 2010;36:1256-1260. [Accessed on 2021 November 30].

5: Smekal D, Johansson J, Huzevka T, Rubertsson S. A pilot study of mechanical chest compressions with the LUCAS™ device in cardiopulmonary resuscitation. Resuscitation. 2011;82:702-706. [Accessed on 2021 November 30].

6: Ochoa FJ, Ramalle-Gómara E, Lisa V, Saralegui I. The effect of rescuer fatigue on the quality of chest compressions. Resuscitation. 1998;37:149-152.

7: Steen S, Liao Q, Pierre L, Paskevicius A, Sjöberg T. The critical importance of minimal delay between chest compressions and subsequent defibrillation: a haemodynamic explanation. Resuscitation. 2003;58(3):249-258.

8: Becker LR, Zaloshnja E, Levick N, Li G, Miller TR. Relative risk of injury and death in ambulances and other emergency vehicles. Accid Anal Prev. 2003;35:941-948.

9: Axelsson C, Karlsson T, Axelsson AB, Herlitz J. Mechanical active compression-decompression cardiopulmonary resuscitation (ACD-CPR) versus manual CPR according to pressure of end tidal carbon dioxide (P(ET)CO2) during CPR in out-of-hospital cardiac arrest (OHCA). Resuscitation. 2009;80:1099-1103.

10: William P, Rao P, Kanakadandi UB, Asencio A, Kern KB. Mechanical Cardiopulmonary Resuscitation In and On the Way to the Cardiac Catheterization Laboratory. Circ J. 2016;80:1292-1299. [Accessed on 2021 November 30].

11: Venturini JM, Retzer E, Estrada JR, et al. Mechanical chest compressions improve rate of return of spontaneous circulation and allow for initiation of percutaneous circulatory support during cardiac arrest in the cardiac catheterization laboratory. Resuscitation. 2017;115:56-60.

12: Estock JL, Curinga HK, Li A, Grieve LB, Brackney CR. Comparison of chest compression interruption times across 2 automated devices: a randomized, crossover simulation study. Am J Emerg Med. 2016;34:57-62.

13: Ong ME, Annathurai A, Shahidah A, et al. Cardiopulmonary resuscitation interruptions with use of a load-distributing band device during emergency department cardiac arrest. Ann Emerg Med. 2010;56:233-241. [Accessed on 2021 November 30].

14: Smekal D, Lindgren E, Sandler H, Johansson J, Rubertsson S. CPR-related injuries after manual or mechanical chest compressions with the LUCAS™ device: a multicentre study of victims after unsuccessful resuscitation. Resuscitation. 2014;85:1708-1712.

15: Pinto DC, Haden-Pinneri K, Love JC. Manual and automated cardiopulmonary resuscitation (CPR): a comparison of associated injury patterns. J Forensic Sci. 2013;58:904-909.

16: Marti J, Hulme C, Ferreira Z, et al. The cost-effectiveness of a mechanical compression device in out-of-hospital cardiac arrest. Resuscitation. 2017;117:1-7. [Accessed on 2021 November 30].

17: Westfall M, Krantz S, Mullin C, Kaufman C. Mechanical versus manual chest compressions in out-of-hospital cardiac arrest: a meta-analysis. Crit Care Med. 2013;41:1782-1789.

18: Wang PL, Brooks SC. Mechanical versus manual chest compressions for cardiac arrest. Cochrane Database Syst Rev. 2018;8:CD007260. [Accessed on 2021 November 30].

19: Link, Mark S et al. "Part 7: Adult Advanced Cardiovascular Life Support: 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care." Circulation 2015;132 Suppl 2: S444-64. [Accessed on 2021 November 30].

20: Goodloe, Jeffrey M et al. "Interim Guidance for Emergency Medical Services Management of Out-of-Hospital Cardiac Arrest During the COVID-19 Pandemic." Circulation. Cardiovascular quality and outcomes 2021;14: e007666. [Accessed on 2021 November 30].

21: Bhardwaj A, Alwakeel M, Wang X, Duggal A, Gaieski DF, Fadel FA. Effectiveness of mechanical cardiopulmonary resuscitation for patients with COVID-19 and in hospital cardiac arrest. Resuscitation. 2021;162:268-270. [Accessed on 2021 November 30].