"Stayin' Alive": A Novel Mental Metronome to Maintain Compression Rates in Simulated Cardiac Arrests

ABSTRACT

Study Objectives: A novel and yet untested memory aid has anecdotally been proposed for aiding practitioners in complying with American Heart Association (AHA) CPR compression rate guidelines (at least 100 compressions per minute). This study investigates how subjects using this memory aid adhered to current CPR guidelines in the short and long term.

Methods: A prospective observational study was conducted with medical providers certified in 2005 AHA guideline CPR. Subjects were randomly paired and alternated administering CPR compressions on a mannequin during a standardized cardiac arrest scenario. While performing compressions subjects listened to a digital recording of The Bee Gees song "Stayin' Alive", and were asked to time compressions to the musical beat. After at least five weeks, the participants were retested without directly listening to the recorded music. Attitudinal views were gathered using a post-session questionnaire.

Results: Fifteen subjects (mean age 29.3 years, 66.7% resident physicians and 80% male) were enrolled. The mean compression rate during the primary assessment (with music) was 109.1 and during the secondary assessment (without music) was 113.2. Mean CPR compression rates did not vary by training level, CPR experience, or time to secondary assessment. Subjects felt utilizing the music improved their ability to provide CPR and felt more confident in performing CPR.
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Conclusions: Medical providers trained to use a novel musical memory aid effectively maintained AHA guideline CPR compression rates initially and in long term follow-up. Subjects felt the aid improved their technical abilities and confidence in providing CPR.
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INTRODUCTION

Properly performed bystander cardiopulmonary resuscitation (CPR) doubles, and may triple, a patient’s chance of survival from sudden cardiac arrest.\(^1,2\) However, several studies have documented the lack of quality CPR among highly trained healthcare professionals.\(^3-7\) Current training techniques, primarily the American Heart Association’s (AHA) Basic Life Support (BLS) and Advanced Cardiac Life Support (ACLS) classes, have not translated into consistent clinical practice, as studies have shown that even after ACLS training, graduates do not reliably perform CPR in accordance with the guidelines.\(^3-7\)

AHA CPR guidelines emphasized the importance of quality basic CPR, especially chest compressions, in improving outcomes.\(^1,8\) Current 2010 AHA guidelines call for a rate of at least 100 compressions per minute.\(^1\) Yet multiple studies show this rate is often unmet or not sustained during CPR.\(^3-7\) Recently, a novel yet untested memory aid has been proposed for aiding practitioners in complying with AHA compression rate guidelines.\(^9,10\) It has been suggested that familiar songs from popular music with beat counts of 100 per minute could be used as mental metronomes during performance of chest compressions. We hypothesized that such a musical memory aid would help to optimize the rate of chest compressions during simulated CPR scenarios. In addition, we believe that learners would retain AHA CPR rate adherence during subsequent testing, even when the music was not directly present.

METHODS
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This was a prospective observational pilot study conducted at a Midwestern tertiary academic medical center. Institutional review board approval was sought and received prior to initiating the study. The study population included resident physicians of all postgraduate training years from Emergency, Internal, and Family Medicine programs, as well as third and fourth year medical students, and subjects were enrolled from October 2008 to March 2009. Subjects were offered enrollment into the mental metronome pilot study as part of a larger study of CPR performance using human patient simulator technology. Subjects were recruited from the medical school and residency programs using flyers, email notices and direct appeal during conference times. Participants were required to have received previous training and certification in the AHA’s ACLS program after the 2005 guidelines were introduced. All participants were consented, but blinded to the specific purpose of the study (they were told they would be participating in an educational study regarding CPR training). Enrolled participants were matched into two-member teams according to level of training and specialty. In the event an enrolled participant didn't not have another participant for a team (second member did not show or a subject without a partner), an investigator served as the second member of the team.

Immediately prior to the first assessment, participants viewed an AHA training video, which detailed CPR standards for the 2005 AHA CPR guidelines. Each participant team then performed the BLS component of a standardized cardiac arrest ACLS scenario using a traditional CPR mannequin. The subjects alternated administering chest compressions and ventilating during the scenario, with each subject performing two cycles of CPR. The subject performing chest compressions did so with the use of a musical memory aid. The musical memory aid was a
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digital recording of The Bee Gees “Stayin’ Alive” (Saturday Night Fever, The Original Movie Soundtrack; Polygram International Music, 1977), and subjects were asked to time CPR compressions to the beat of the music. Prior to study initiation, the tempo of the song was verified at 103 beats per minute (BPM) using MixMeister BPM Analyzer (MixMeister Technology, LLC). The resuscitation scenarios were video recorded. Compression rates for each subject were recorded by an investigator during each scenario using a hand-held tally counter and later reviewed and corroborated by an additional investigator using video review and a hand-held tally counter. Following the scenario, each team was given feedback on their performance of compressions and ventilations with respect to the AHA guidelines, as well as the importance of minimizing interruptions.

A minimum of 5 weeks after enrollment, the same teams were reassessed using the same ACLS scenario. During this second assessment, the song “Stayin’ Alive” was not played, but subjects were encouraged to mentally utilize the aid. The same initial variables were recorded. At the end of the second scenario, the participants were surveyed for feedback on the educational aspect of the project using an investigator-derived instrument, similar to that used for evaluation of ACLS courses. This instrument consisted of several questions, with responses rated on a Likert scale from 1-10, to determine if the participants felt the training was beneficial. Additional data was collected from the participants at this time, including demographic information and prior CPR experiences.

Collected data were analyzed using SPSS v14.0 (SPSS Inc., Chicago, IL). Descriptive statistics were used to summarize demographic data. The primary outcome measured was the
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rate of chest compressions. Compressions were recorded for each round of CPR performed and averaged, for a mean session CPR compression rate. Differences between mean compression rates, CPR experience (stratified as having performed CPR on a human in the past 6 months or not), subject medical training level (stratified as resident physician vs. medical student) and time to secondary assessment (stratified as <70 days or >70 days) were assessed using the student T-test, and statistical significance was defined as p<0.05.

RESULTS

Fifteen subjects were enrolled in the trial (average age 29.3 years, 80% male, and 66.7% resident physicians). Resident physicians represented multiple specialties (internal medicine 3, internal medicine/pediatrics 3, neurology 1, family practice 1, emergency medicine 1, and diagnostic radiology 1). Resident physicians were of different training years (post-graduation year one (PGY-1): 2 subjects; PGY-2: 3 subjects; PGY-3: 5 subjects) as were enrolled medical students (second year medical students: 3 subjects; third year medical students 2 subjects). No subjects had prior experience as emergency medicine technicians (EMTs) or paramedics and none were ACLS instructors. Subjects had performed CPR an average of 6.6 times in the prior 6 months. Secondary assessment of subjects occurred on average 73.3 days after initial testing (range 41 to 111 days).

The mean CPR compression rate during the primary assessment (with music present) was 109.1 compressions per minute and the mean CPR compression rate during the secondary assessment (no music present) was 113.2 compressions per minute (an increase of 4.1 compressions per minute between primary and secondary assessments (95% CI 1.45 – 6.7)). All
subjects performed a mean CPR compression rate at least 100 compressions per minute for both
the primary assessment (range 101.3 to 139.8) and the secondary assessment (range 102 to
144.3). No differences were noted for the combined mean primary and secondary CPR
compression rates between resident physicians and medical students (111.3 vs. 110.9; p=0.91),
human CPR experience in the past 6 months (CPR experience 111.7 vs. no CPR experience
110.7; p=0.82), or for secondary assessment length (<70 days 108.5 vs. >70 days 115.1; p=0.16).

Subjects felt using the music improved their ability to provide CPR in accordance with
AHA guidelines (mean score 7.6 [1 strongly disagree – 10 strongly agree]; 95% CI 7.1 – 8.2).
Subjects also felt more confident in performing CPR on a patient using the musical memory aid
(mean score 7.1, 95% CI 6.3 – 7.93).

DISCUSSION

Our results show that subjects using the musical memory aid performed chest compressions at
rates that met current CPR guidelines. During the initial assessment subjects effectively
maintained adequate compression rates while directly listening to the musical aid. Upon
secondary assessment several weeks later, subjects were not directly provided the music but were
encouraged to use the memory of the music as a mental metronome to perform chest
compressions at the correct rate. All subjects using this mental musical memory aid several
weeks later were able to maintain adequate rates of chest compressions. Furthermore, subjects
felt that utilizing the musical aid improved their ability to perform CPR in accordance with AHA
guidelines, and also to perform CPR on an actual patient.
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This study is important for several reasons. Foremost, despite the emphasis on high quality CPR, studies have shown that healthcare providers often fail to meet current guidelines.\textsuperscript{3-7} Abella et al performed a prospective observational study of in-patient cardiac arrests and found CPR compression rates to be < 90 compressions per minute during 28% of the resuscitation time.\textsuperscript{4} Additionally, Abella et al in another study investigating chest compressions found that compression rates were < 80 compressions per minute during 58% of the resuscitation time.\textsuperscript{7} These findings have subsequently generated research into ways improve adherence to published CPR compression rate guidelines.

Recent literature has explored using real time audiovisual feedback to improve the quality of CPR. Real-time feedback in one study was shown to improve in-hospital CPR quality by reducing the variability of CPR, conforming more to the guideline recommendations.\textsuperscript{11} Several commercial systems have been studied, most notably defibrillators that provide real-time feedback on multiple variables including chest compression rate and depth. These have likewise been shown to improve adherence to published guidelines.\textsuperscript{11, 12} The use of metronomes has also been examined. Kern conducted a prospective randomized study of professional rescuers using metronome assisted CPR and showed a statistically significant improvement in CPR performance compared to controls.\textsuperscript{13}

Our study is the first we are aware of that demonstrates an effective modality to adhere to CPR guidelines utilizing a simple and widely-known mental metronome. These results have obvious applications to CPR performance and education, both among healthcare professionals and laypersons. Principally, this technique is easily implemented into current CPR
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training and education, with minimal cost or setup. CPR students can be exposed and taught the memory aid with very little instruction time or instructor training. Secondly, it requires no additional technology during resuscitation, which is advantageous in the community setting. Many previously studied mental metronomes utilize pulsing lights or sounds incorporated into defibrillators or devices that are placed onto the cardiac arrest victims. While these devices are effective, they are costly and may not always be present in the prehospital setting, particularly for bystanders initiating CPR. Perhaps most important is that the song "Stayin Alive" by the Bee Gees is widely popular and easily memorable. The song also lends itself well to capturing the public interest regarding positive outcomes for bystander initiated CPR. With new emphasis on compression-only CPR, it is now even more important that compressions are performed in the most effective manner; correct rate is the first component.14, 15

The 2010 AHA CPR guidelines recommend performing CPR compressions at least 100 per minute.1 All subjects in this pilot study were able to comply with this recommendation, with some subjects having a maximum mean compression rate of 144 compressions per minute upon follow-up testing. This is faster than the mental metronome tempo and could lead to eventual rescuer fatigue, although still meeting the 2010 AHA mandate. While and upper limit for CPR compressions has not been established, a compression rate <100 compressions per minute have shown improved patient outcomes, and therefore this was used as a primary outcome measure.1, 8

LIMITATIONS

Our results must be interpreted in light of several important limitations. This study represents a pilot effort, with a limited number of subjects enrolled. The subjects were resident physicians
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and senior medical students that had previous experience with CPR, and results could differ with different populations. Most importantly, while subjects were able to maintain adequate CPR compression rates on secondary testing, no control group was utilized, and therefore other confounding variables could have contributed to the results. This study does not demonstrate improvement in CPR compression rates with the mental metronome; rather, it demonstrates only adherence, as no baseline control group was utilized. Future studies utilizing a randomized control group should be conducted to determine if the mental metronome improves CPR compression rate adherence.

This study also only evaluated the correct rate of CPR and did not assess for the proper hand placement, inadequate or excessive compression depth, or body positioning, all of which contribute to how effective chest compressions are delivered in a clinical setting. Although the song provides consistent rhythm, individual subject’s compression rates may have varied during the scenarios (i.e. fast then slow, etc), as the analyzed compression rates were based upon mean rates. In our study, subjects were reminded to utilize the mental metronome upon follow-up, but were not allowed to listen to the music. However, without the reminder, subjects may not have independently remembered to use the song tempo and the results could have varied. Finally, the study was conducted in a laboratory setting using a mannequin, and the results generated may not be applicable to “real world” scenarios with bystanders performing CPR on human subjects.

CONCLUSIONS

Medical providers were able to maintain established AHA guideline CPR compression rates utilizing a novel musical memory aid both initially and in long-term follow-up. Subjects felt the
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aid improved their technical ability and confidence in providing CPR. This novel mental metronome is a cost-effective and easily implementable addition to basic CPR teaching that may help trainees more consistently perform an appropriate chest compression rate. While the results of this pilot study are encouraging, further study with larger and more diverse subject groups is required for validation.
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REFERENCES


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