Emergency Medicine

Association of Pharmacist Presence on Compliance with Advanced Cardiac Life Support Guidelines During In-Hospital Cardiac Arrest

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BACKGROUND: The pharmacist has many potential roles as part of the resuscitation team during cardiopulmonary arrest. Limited published research has evaluated the practice of advanced cardiac life support (ACLS) during in-hospital arrest. Recent reviews indicate that an audit of in-hospital resuscitation practices should be performed to guide future resuscitation training programs for hospital personnel.

OBJECTIVE: To assess compliance with ACLS guidelines during in-hospital cardiopulmonary arrest in a community teaching hospital and evaluate the association of compliance with the presence of a pharmacist on the resuscitation team.

METHODS: A retrospective analysis of the records of 74 consecutive in-hospital arrests occurring between January 1, 2003, and June 30, 2004, was conducted to evaluate compliance with American Heart Association ACLS guidelines.

RESULTS: A total of 74 arrests were evaluated. Noncompliance was noted in 58.1% of all documented arrests; of the 650 treatment interventions identified, 10.6% were noncompliant with ACLS guidelines. The reasons cited for noncompliance included an incorrect medication dosage (20.3%), prolonged period of time between sequential interventions (26.1%), omission of an indicated treatment (17.4%), deviation from recommended treatment guidelines (26.1%), and incorrect energy for defibrillation (10.1%). A pharmacist was present at 36.5% of documented arrests. Compliance with ACLS treatment guidelines was more likely during resuscitations in which a pharmacist was present (59.3% vs 31.9%; p = 0.03).

CONCLUSIONS: Noncompliance with resuscitation guidelines was common during in-hospital resuscitation. The presence of a pharmacist on the resuscitation team was associated with improved compliance with treatment guidelines. Despite institutional requirements for pharmacist participation during resuscitation efforts, participation rates remain low. Further evaluation of the role of the pharmacist on the resuscitation team and the impact of the pharmacist on resuscitation practices should be considered.

KEY WORDS: advanced cardiac life support guidelines, pharmacist intervention.

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Cardiovascular disease remains the leading cause of death in the US, with sudden cardiac death comprising more than one-half of all related deaths.[1] The survival rates from cardiac arrhythmias that result in sudden cardiac death can be increased by enacting prompt medical care.[2] The "chain of survival" approach to care includes early recognition of warning signs, activation of emergency response personnel, cardiopulmonary resuscitation (CPR), defibrillation, airway management, and administration of intravenous medications. This treatment strategy is essential to the delivery of advanced cardiac life support (ACLS).[2-4] Healthcare providers use this treatment sequence, along with ACLS treatment guidelines, to attempt resuscitation of the patient in cardiac arrest.

The pharmacist has many potential roles on the resuscitation team, including providing recommendations for drug therapy, preparation of medications for administration, and documentation of drug administration.[5] Research has demonstrated that pharmacist participation on the resuscitation team improves hospital mortality rates.[6,7] Despite this knowledge, surveys

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have demonstrated that the pharmacist is a participant on the resuscitation team in only one-third of medical centers.[5,8] Several barriers to pharmacist participation on the resuscitation team have been determined and include inadequate staffing within the pharmacy department, a lack of advanced resuscitation training for pharmacists, and a lack of perception of the pharmacist's role on the resuscitation team.

The majority of research currently available has examined the practice of ACLS in the out-of-hospital setting. Few studies have examined compliance with ACLS guidelines during in-hospital cardiopulmonary arrest. To ensure that the collection of data is consistent among recording and reporting healthcare entities, guidelines for reviewing, reporting, and conducting research on in-hospital resuscitation have been developed.[9,10]

The purpose of this study was to evaluate the compliance of clinicians involved in resuscitation practice with the ACLS guidelines during in-hospital arrest and to evaluate the association of compliance with the presence of a pharmacist on the resuscitation team.

Methods

SETTING

This evaluation was conducted in a 350-bed community teaching hospital. At the time of this evaluation, institutional policy designated a predefined team of healthcare providers to respond to all arrests that occurred within the institution. The team was comprised of an attending physician, registered nurses, respiratory therapists, a pharmacist, a cardiology technician, and a security officer. In addition, one team member was responsible for documenting all aspects of the arrest on a prespecified form. The responsibilities of the pharmacist included drug therapy recommendations, drug procurement, and drug preparation for administration. Institutional policy mandated that all physician, nurse, and respiratory therapy members of the team maintain current certification in ACLS; ACLS certification of pharmacists was not mandatory.

IDENTIFICATION AND COLLECTION OF DATA

A retrospective analysis of the ACLS resuscitation practices of consecutive in-hospital cardiopulmonary arrests occurring from January 1, 2003, to June 30, 2004, was conducted. All arrest records were identified from the institution's CPR committee, which had compiled a database of all cardiopulmonary arrests that occurred in the institution, indexed by date. The arrest record was included for evaluation if the patient was 18 years of age or older, the onset of the arrest occurred while the patient was admitted to the hospital, and the documented arrest type was included in the ACLS treatment guidelines. All arrests of respiratory or cardiac origin, including ventricular fibrillation, pulseless ventricular tachycardia, bradycardia, pulseless electrical activity, and asystole were included. The research proposal and protocol were approved by the Institutional Review Board and the Human Subjects Research Committee of the medical center.

The arrest record was obtained from the patient's permanent medical record and reviewed for demographic information, including patient age, sex, location at time of arrest, type of arrest, and arrest outcome. The date and time of the arrest, the duration of the arrest (from the recorded time of onset of arrest to post-arrest status), and the electrocardiograph (ECG) rhythm were recorded based on documentation available on the arrest record. If the patient had more than one identified ECG rhythm during a single arrest event, each ECG rhythm was evaluated. The practice specialty of the physician code-team leader and the presence (or absence) of a pharmacist were also recorded.

EVALUATION OF INTERVENTIONS

All recorded treatments and interventions were evaluated, including artificial airway management, defibrillation or transcutaneous pacing, and administration of medications. All records were evaluated using the then-current 2000 American Heart Association ACLS guidelines.[3] The provided intervention was compared with the recommended intervention for the corresponding ACLS treatment algorithm. The sequential order of provided interventions and the timing (in minutes) of each intervention provided were evaluated, starting from the time of onset of the arrest and the time lapse between sequential interventions. Treatment decisions or interventions that occurred outside of the direct treatment of the cardiopulmonary arrest were not evaluated (eg, sedation and pain control).

Noncompliant interventions were subsequently classified into categories that included omission of an indicated treatment or intervention, incorrect dosage of medication, incorrect energy level for cardioversion, a delay in the time to the provided intervention, and a deviation in the sequence of treatment interventions. Each noncompliant intervention was classified and recorded into the corresponding category. Multiple occurrences of the same noncompliant intervention during a single arrest were recorded a single time. A delay in providing a treatment intervention was recorded from the onset of arrest; for advanced airway management, this time was defined as greater than 5 minutes; for defibrillation, greater than 8 minutes; and for subsequent administration of medication, greater than 5 minutes in excess of the recommended interval. A deviation was recorded if the administration of an intervention did not follow the specific sequence or interval in which interventions are recommended (eg, administration of epinephrine prior to defibrillation or a repeated dose of

epinephrine after 1 min in the treatment of ventricular fibrillation) or if interventions were provided that were not recommended for the treatment of the arrest. A noncompliant deviation from the practice guidelines was recorded as a single noncompliant event. Subsequent analysis of the resuscitation following a noncompliant intervention was performed as though the previous intervention had been compliant.

STATISTICAL ANALYSIS

Descriptive statistics were used to describe demographic characteristics, interventions, and treatments administered during cardiopulmonary arrest, and the reasons cited for noncompliance. The presence of a pharmacist and the occurrence of noncompliance were compared using a χ^2 2 × 2 contingency table. Statistical significance was defined as a p value less than or equal to 0.05.

Results

Eighty-six cardiopulmonary arrest records were identified; of these, 12 were excluded from evaluation, 4 due to absence of the arrest record and 8 because the onset of arrest occurred prior to the patient's arrival at the medical center. Demographic characteristics and the outcomes of arrest are summarized in Table 1. The median duration of the documented arrests was 15 minutes (range 0–212). Clinical variables identified for the arrest records, including the recorded ECG rhythms, physician team leader practice specialty, and pharmacist's presence, are summarized in Table 2.

Table 1. Demographic Characteristics[a]

Characteristic	Pharmacist Present	No Pharmacist Present	Overall Population
Age, y (range)[b]	66 (26–88)	72 (31–94)	71 (26–94)
Sex, n (%)			
female	14 (36.8)	24 (63.2)	38 (51.4)
male	13 (36.1)	23 (63.9)	36 (48.6)
Location at time of arrest, n (%)			
intensive care unit	15 (38.5)	24 (61.5)	39 (52.7)
ward	12 (34.3)	23 (65.7)	35 (47.3)
Time of arrest, n (%)[c]			
first shift	8 (27.6)	21 (72.4)	29 (39.2)
second shift	9 (39.1)	14 (60.9)	23 (31.1)
third shift	10 (45.5)	12 (54.5)	22 (29.7)
Arrest outcome, n (%)			
return of spontaneous circulation	18 (36)	32 (64)	50 (67.6)
death	9 (37.5)	15 (62.5)	24 (32.4)
Survival to discharge rate, n (%)	6 (21.4)	22 (78.6)	28 (37.8)

[a]N = 74.
[b]Median.
[c]First shift defined as time of day 0700–1459, second shift as 1500–2259, and third shift as 2300–0659.

From the 74 arrest records, 650 treatment interventions were documented and subsequently evaluated. A total of 581 (89.4%) interventions were compliant with treatment guidelines, and 69 (10.6%) interventions were noncompliant. The distribution of noncompliant interventions is summarized in Table 3. Noncompliance occurred in 43 (58.1%) of the arrest records evaluated. Compliance with ACLS treatment guidelines was more likely during resuscitations in which a pharmacist was present (59.3% vs 31.9%; p = 0.03).

A total of 46 noncompliant medication interventions were identified. Noncompliance was recorded involving the administration of epinephrine, atropine, lidocaine, and amiodarone. The distribution of noncompliant drug interventions is summarized in Table 4. Noncompliance occurred less frequently when a pharmacist was present at the resuscitation (32.6% vs 67.4%).

Discussion

In this evaluation, noncompliance with ACLS guidelines was common, occurring in more than half of all resuscitations and nearly 10% of all interventions. This rate of noncompliance is lower than that reported in similar evaluations of in-hospital resuscitation, which has been reported in the range of 10% to greater than 60%.[11-15] An ACLS-certified critical care physician directed 91.9% of all arrests evaluated in our study, which could have resulted in lower rates of noncompliance than seen in prior research.[12] Despite this rate of noncompliance, the survival of patients to hospital discharge was relatively high (38%) compared with the very dismal rate of survival reported in the resuscitation literature (10–20%).[16] The high survival rate shown in our study may be reflective of the high incidence of ECG rhythms responsive to defibrillation (pulseless ventricular tachycardia and ventricular fibrillation), which are associated with higher successful resuscitation rates in the hospital setting.

It is likely that a number of factors contribute to the high rate of noncompliance observed in this and other studies. In reviewing the literature on noncompliance with treatment guidelines, medical knowledge, technical skills, and human factors all appear to affect guideline compliance.[17,18] Although several studies have concluded that ACLS-certified physicians tend to be more compliant with treatment guidelines, evaluation of their performance suggests that frequent practice sessions should be encouraged for maximum retention of knowledge and skills.[11-13,19] This is supported by the findings of our study, as a relatively high rate of noncompliance was noted despite the institutional requirement that all

physician members of the cardiac arrest team maintain current certification in ACLS.

Several studies have also demonstrated deficiencies in the technical skills of trained medical professionals, particularly in the delivery of chest compressions during CPR and use of the defibrillator.[11,12,14,15,20] This topic is specifically addressed by the revised 2005 ACLS guidelines.[4] However, unless resuscitation team members are thoroughly trained and practices are frequently reviewed, these deficiencies are likely to continue. Finally, human factors that have been specifically associated with performance in ACLS practices include a lack of leadership behavior and a lack of task distribution among the resuscitation team.[17] Additional factors, such as lack of awareness, familiarity, or agreement with treatment guidelines, and expectation of poor outcome may also contribute to noncompliance with treatment guidelines.[18]

The American Heart Association first established guidelines for ACLS in 1974.[3] Since that time, several revisions to the guidelines have been made as new evidence-based practices have evolved, with the most recent guidelines being published in 2005.[4] When conducting evaluations of compliance with treatment guidelines, it is important to consider evolving evidence in the literature that may influence current medical practice. In our study, analysis of the data did not reveal noncompliant interventions that would have been classified as compliant using evolving data. In fact, quite the opposite was true, in that noncompliant interventions seemed to be reflective of treatment guidelines and interventions that have been updated in previous guidelines as opposed to evolving evidence (eg, high-dose epinephrine). In addition, there are many potential interventions to be considered during the resuscitation of a patient that are not direct recommendations within the ACLS guidelines but are essential to the resuscitation effort (eg, treatment of hyperkalemia, rapid sequence intubation). These interventions were not evaluated in our study but are additional interventions that can impact the success of the resuscitation effort.

We noted that discrepancies in medication administration were common and included incorrect doses, delays in providing subsequent drug therapy, and omission of indicated drugs. Routine pharmacist participation on the resuscitation team may be one way to improve compliance. As noted in this evaluation, twice as many noncompliant in-

Table 2. Clinical Characteristics[a]

Characteristic	n	%
Respiratory arrest[b]	9	12.2
Cardiac arrest ECG rhythm (n = 99)[c]		
VF/VT	50	50.5
PEA	11	11.1
asystole	27	27.3
bradycardia	11	11.1
Physician practice specialty		
critical/intensive care	68	91.9
internal medicine	3	4.1
family medicine	2	2.7
general surgery	1	1.4
Pharmacist present		
yes	27	36.5
no	47	63.5

ECG = electrocardiogram; PEA = pulseless electrical activity; VF = ventricular fibrillation; VT = pulseless ventricular tachycardia.
[a]N = 74.
[b]Primary presenting arrest type.
[c]Reflects all ECG rhythms recorded; possible for one patient to have more than one ECG rhythm recorded during a single arrest.

Table 3. Distribution of All Noncompliant Interventions[a]

Noncompliant Intervention	n	%
Error in dose	21	30.4
incorrect defibrillation energy	7	10.1
incorrect drug dose	14	20.3
Delay in intervention	18	26.1
Omission of indicated treatment	12	17.4
Deviation from treatment guideline	18	26.1

[a]n = 69.

Table 4. Distribution of Noncompliant Drug Treatment

Drug	Pharmacist Present, n (%)	No Pharmacist Present, n (%)	Total Noncompliant Interventions, n (%)
Incorrect dose			
amiodarone	2 (50)	2 (50)	4 (28.6)
atropine	0 (0)	2 (100)	2 (14.3)
epinephrine	1 (16.7)	5 (83.3)	6 (42.9)
lidocaine	0 (0)	2 (100)	2 (14.3)
total	3 (21.4)	11 (78.6)	14 (100)
Omission			
amiodarone	0 (0)	0 (0)	0 (0)
atropine	1 (25)	3 (75)	4 (50)
epinephrine	0 (0)	4 (100)	4 (50)
lidocaine	0 (0)	0 (0)	0 (0)
total	1 (12.5)	7 (87.5)	8 (100)
Delay			
amiodarone	0 (0)	0 (0)	0 (0)
atropine	2 (50)	2 (50)	4 (36.4)
epinephrine	4 (57.1)	3 (42.9)	7 (63.6)
lidocaine	0 (0)	0 (0)	0 (0)
total	6 (54.5)	5 (45.5)	11 (100)
Deviation			
amiodarone	0 (0)	0 (0)	0 (0)
atropine	0 (0)	2 (100)	2 (15.4)
epinephrine	4 (40)	6 (60)	10 (76.9)
lidocaine	1 (100)	0 (0)	1 (7.7)
total	5 (38.5)	8 (61.5)	13 (100)
All interventions	15 (32.6)	31 (67.4)	46 (100)

terventions occurred when a pharmacist was not a member of the resuscitation team. In addition to the roles that the pharmacist may offer directly when on the resuscitation team, the pharmacist can be involved in the distribution of medications to be provided to the team during the arrest. This could be facilitated by providing commonly used drugs, such as epinephrine and atropine, as prefilled syringes with the recommended treatment dose in each syringe. For example, epinephrine is available as both a prefilled syringe and a multiple-dose vial. The pharmacist could influence the compliant use of epinephrine during resuscitation by ensuring that only the prefilled syringe is provided to the team.

Evaluations of resuscitation practices suggest that the pharmacist may have a highly valuable role on the resuscitation team. Previous research has demonstrated that pharmacist participation on the CPR team improves hospital mortality rates.[6,7] Despite this knowledge, surveys have demonstrated that the pharmacist is a participant on the resuscitation team in only one-third of medical centers.[5,8] Although pharmacists are recognized members of the resuscitation team expected to respond to all in-hospital cardiac arrests at our institution, a pharmacist attended only one-third of all arrests that occurred during the study period. The retrospective nature of this evaluation did not allow for a determination of the reasons for the lack of pharmacist presence during all of the recorded resuscitations. However, based on previous studies, barriers to the inclusion of the pharmacist may include inadequate staffing within the pharmacy department, a lack of advanced resuscitation training for pharmacists, and a lack of perception of the pharmacist's role on the resuscitation team.[5,8]

Limitations

The major limitations of this study are that it is a retrospective review and is subject to the accuracy of the record keeping at the time of the arrest. Retrospective evaluation does not allow for determination of variables that could influence a treatment decision that diverges from recommended treatment guidelines. It is also important to recognize that this evaluation was not designed to fully account for variables that may influence compliance with treatment guidelines outside of the mere presence of a pharmacist at the resuscitation. Although pharmacist presence during the resuscitation was recorded, the actual level of participation of the pharmacist was unable to be determined. Finally, although the modes of noncompliance noted in this study were consistent with findings of previous research, the generalizability of the compliance patterns may be limited. For example, noncompliant use of drugs that we identified reflects the type of arrest recorded, which may vary among healthcare institutions.

Conclusions

The reasons for noncompliance with ACLS treatment guidelines are diverse, with no single mode comprising the majority of noncompliant interventions. The presence of a pharmacist on the resuscitation team was associated with improved compliance with treatment guidelines. Further evaluations of the relationship between guideline compliance and outcomes from resuscitation practices during in-hospital arrest are desirable. Despite institutional requirements for pharmacist participation during CPR efforts, participation rates remain low. Barriers to pharmacists' participation on the resuscitation team should be identified and addressed. In addition, a prospective evaluation of the impact of a pharmacist's participation on the resuscitation team and the barriers to such participation would be beneficial for defining the impact of pharmacist intervention on resuscitation practices.

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Asociación entre Presencia del Farmacéutico y Cumplimiento con las Guías para el Cuidado Cardíaco Avanzado Durante Paro Cardíaco Ocurrido Dentro del Hospital

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EXTRACTO

TRASFONDO: El farmacéutico tiene muchos roles potenciales en el equipo de resucitación durante un paro cardiopulmonar. La investigación publicada que evalúa la práctica de cuidado cardíaco avanzado durante un paro ocurrido dentro del hospital es limitada. Revisiones recientes indican que debe llevarse a cabo una auditoría de las prácticas de resucitación dentro del hospital, para guiar programas futuros de adiestramiento en resucitación para el personal del hospital.

OBJETIVO: Determinar el cumplimiento con las Guías para el Cuidado Cardíaco Avanzado durante paro cardíaco ocurrido dentro del hospital en un hospital de enseñanza de la comunidad y evaluar la asociación del cumplimiento con la presencia de un farmacéutico en el equipo de resucitación.

MÉTODOS: Se condujo un análisis retrospectivo de los expedientes de paro de 74 paros consecutivos ocurridos dentro del hospital entre el 1 de enero de 2003 y el 30 de junio de 2004, para evaluar el cumplimiento con las Guías para el Cuidado Cardíaco Avanzado de la Asociación Americana del Corazón.

RESULTADOS: Un total de 74 paros fueron evaluados. Se notó incumplimiento en 58.1% de todos los paros documentados. De las 650 intervenciones de tratamiento identificadas, 10.6% no cumplieron con las Guías para el Cuidado Cardíaco Avanzado. Las razones citadas para el incumplimiento incluyeron: dosificación incorrecta del medicamento (20.3%), periodo de tiempo prolongado entre intervenciones secuenciales (26.1%), omisión de un tratamiento indicado (17.4%), desviación de las guías de tratamiento recomendadas (26.1%), y energía para defribilación incorrecta (10.1%). Un farmacéutico estuvo presente en 36.5% de los paros documentados. El cumplimiento con las Guías para el Cuidado Cardíaco Avanzado fue más frecuente en resucitaciones durante las cuales un farmacéutico estuvo presente (59.3% contra 31.9%; p = 0.03).

CONCLUSIONES: El incumplimiento con las guías de resucitación fue común durante resucitaciones ocurridas dentro del hospital. La presencia de un farmacéutico en el equipo de resucitación fue asociada con mejor cumplimiento con las guías de tratamiento. A pesar de requerimientos institucionales de participación de un farmacéutico en los esfuerzos de resucitación, las tasas de participación se mantienen bajas. Debe considerarse evaluación ulterior del rol del farmacéutico en el equipo de resucitación y su impacto en las prácticas de resucitación.

Traducido por Ana E Vélez

La Présence du Pharmacien sur les Équipes de Réanimation Cardiaque Permet une Meilleure Observance aux Algorithmes de Traitement

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RÉSUMÉ

OBJECTIF: Le pharmacien détient plusieurs rôles potentiels au sein de l'équipe intra-hospitalière de réanimation cardio-respiratoire (RCR). Peu d'études font état de la pratique des techniques avancées de RCR et il a été suggéré que des audits sur ces pratiques puissent être effectués pour guider les programmes futurs de formation destinés au personnel hospitalier. Le but de cette étude est de documenter l'observance du personnel hospitalier aux lignes directrices sur les techniques avancées de RCR émises par la Fondation américaine des maladies du cœur.

MÉTHODOLOGIE: Cette étude rétrospective de dossiers-patients a été effectuée entre le 1er janvier 2003 et le 30 juin 2004 et a permis l'analyse détaillée de 74 patients consécutifs ayant eu un arrêt cardiorespiratoire.

RÉSULTATS: L'ensemble des 74 cas identifiés a été analysé. La non-observance aux algorithmes de traitement a été notée dans 58.1% des cas documentés d'arrêts cardiaques. Des 650 interventions thérapeutiques identifiées, près de 11% n'étaient pas conformes aux algorithmes de traitement. Les raisons évoquées pour une telle non-observance incluaient notamment, une posologie inadéquate (20.3%), une période prolongée dans la séquence recommandée des différentes interventions (26.1%), l'omission d'un traitement recommandé (17.4%), la déviation des lignes directrices (26.1%), et un niveau inadéquat d'énergie utilisée lors d'une défibrillation (10.1%). Un pharmacien était présent dans 36.5% des arrêts cardio-respiratoires documentés. L'observance aux algorithmes de traitement de la Fondation semblait être meilleure lors de la présence d'un pharmacien (59.3% vs 31.9%; p = 0.03).

CONCLUSIONS: La non-observance aux algorithmes de traitement lors d'une ressuscitation cardiaque est courante. La présence d'un pharmacien sur les équipes de réanimation semble être associée à une meilleure observance des lignes directrices. Malgré les exigences institutionnelles de la participation d'un pharmacien à de telles équipes, le taux de participation demeure faible. Une considération particulière devrait être portée quant au rôle du pharmacien sur les équipes de réanimation cardio-respiratoire et l'impact d'une telle présence sur la nature des interventions pratiquées.

Traduit par Sylvie Robert