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Research Article

Roles of anesthesia assistants within the code blue team at in-hospital cardiopulmonary arrests: A retrospective analysis

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Abstract

Introduction

Anesthesia assistants (AAs) are respiratory therapists or nurses who have additional sub-specialty training in the provision and maintenance of anesthesia. Their skill set includes advanced airway management, vascular access, and knowledge of vasoactive medications and resuscitative protocols. AAs function as non-physician members of the anesthesia team and can act as physician extenders to help offset the current shortage of anesthesiologists.

Methods

This study was a retrospective analysis of AA roles at code blue events at an adult academic teaching centre. Data was extracted from administrative data collection forms completed by AAs at adult code blue events between 2017 and 2022. The data elements that each form captured included time and location of event, presumed cause of the code, airway management details, vascular access provision, medication preparation or administration, human factors and cognitive supports provided to the team by the AAs.

Results

Administrative data collection forms from 320 code blue events were analyzed in this study. The most common primary causes of the code blue events were “arrest” (39%) and “respiratory failure” (26%). Regular floor beds (47%) and the intermediate care units (18%) were the most common locations of code blue events. Airway support was required in 77% of the codes, and in 50% of the cases requiring intubation, it was performed by the AAs. The first pass success rate for AA intubations was 83%, and overall success rate was 96%. In addition to airway management at codes, the AAs also reported providing numerous other valuable contributions to the team. The most reported supports provided to the team included cognitive support regarding resuscitation (49% of cases), intravenous access (19% of cases), and medication preparation or administration (9% of cases). Other roles included placement of arterial lines and drawing blood gases, obtaining interosseous vascular access, and assisting with patient transport to critical care units after resuscitation.

Conclusions

Our study characterizes the supporting roles that AAs can provide as members of the code blue team and demonstrates their contributions to management of critically ill patients. The AAs’ airway management, vascular access skillsets, and knowledge of vasoactive and resuscitative medications and protocols make them well-suited to the code blue team. In addition to assisting within the operating room team, AAs can also

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provide valuable support in non-operating room environments such as cardiopulmonary arrests.

INTRODUCTION

A "code blue" is an emergency situation where a patient is in cardiopulmonary arrest and requires immediate resuscitative efforts.[1] The estimated incidence of in-hospital cardiac arrests (IHCA) ranges from 6-9 events per 1000 admissions.[2-4] One older Canadian study from 1997-99 reported that 36.8% of IHCA patients were able to be resuscitated, yet only 11.3% were ultimately discharged home.[5] A more recent American study of over 155,252 IHCA from 656 hospitals reported that the overall survival to discharge has improved to 24.8%[6]; however, survival rates vary across centres and can be affected by the precipitant of the event (e.g., cardiac arrhythmias versus respiratory failure), location of the patient within the hospital, size of hospital, academic facility/status, whether the event was witnessed or unwitnessed, and time of occurrence.[4,5,7,8] Response times to arrests are critical; a one-minute delay in care can reduce survival rates by 10%.[9] Amongst the multiple steps in resuscitation (e.g., chest compressions, obtaining vascular access, medication administration, resuscitation, etc.), airway management is an important component of several time-sensitive elements crucial to code blue resuscitative efforts.[10]

Code blue teams are comprised of various healthcare professionals. Typically, the team includes physicians (including staff physicians, fellows and/or residents), respiratory therapists, nursing staff (which can include critical care trained nurses and other front-line nursing staff), paramedics, and may include porters or patient attendants and other allied health professionals (e.g., laboratory phlebotomists, pharmacists, EKG technicians).[11,12] However, currently, there are no internationally accepted standards for cardiac arrest team composition or distribution of tasks.[13] A previous qualitative analysis of top-performing hospitals for cardiac arrest management found that the top institutions included "*the participation of diverse disciplines of team members during IHCA*" and that there should be a "*focus on the core skills including chest compressions, airway management and intravenous access.*"[14]

A wide array of professionals are responsible for performing airway management during IHCAs. For example, in community hospitals, the registered respiratory therapist (RRT) or emergency room physicians may be the only members of the code blue team with airway management experience, particularly in after-hours scenarios. In some of the larger tertiary care centers, multiple other medical providers may be available to assist with airway management, including anesthesiologists, intensive care physicians, anesthesia residents or anesthesia assistants (AAs).

AAs are a subset of RRTs or registered nurses (RNs) who have undergone additional specialty training in anesthesia; they function as non-physician members of the anesthesia team who work under the delegation of anesthesiologists. Although the AA profession has existed since the 1970s,[15] it is considered a relatively new profession. In recent years, the role of the AA has expanded significantly, including many more clinical patient care responsibilities in addition to technical assistance and equipment setup.[16-18]

At our institution, AAs provide 24-hour support to the anesthesia and surgical teams in operating room and non-operating room anesthesia locations such as ophthalmology rooms, cardiac catheterization suite, pacemaker and electrophysiology suites, interventional radiology, and the computed tomography (CT) or magnetic resonance imaging (MRI) scanners. All the AAs employed at our center have prior training and certification as RRTs and typically perform 10 to 15 tracheal intubations or supraglottic airway insertions each month in the operating rooms as part of their normal day-to-day practice, which includes elective, urgent and emergent surgeries during weekday, overnight and weekend call shifts. They also routinely obtain peripheral intravenous (IV) access (with or without ultrasound guidance), prepare and administer vasoactive intravenous medications, place arterial lines, and draw arterial blood gases in the operating room setting.

The combination of airway management and vascular access skills, along with their intravenous medication and resuscitation knowledge, make AAs ideal members of the code blue team. Given the availability of AAs in our center and the skillset they offer, our institution provides a good context to empirically study the current and potential future role of AAs as members of the code blue team. Specifically, how AAs technical and clinical skills can be utilized, as well as their in-depth knowledge of emergency airway and ACLS protocols. Our center currently utilizes AAs as members within the institutional code blue team; however, to date, there is a paucity of research delineating the potential roles of an AA at a code blue and as a core member of the cardiac arrest response team. This study will describe the various roles and tasks AAs perform during code blue events at a Canadian adult academic teaching facility.

METHODS

Institutional Research Ethics Board review was waived for this retrospective review of quality improvement data (NSHA #1028158, May 20, 2022). Data for this study were collected using a standardized administrative data form completed by AAs after attending "code blue" events at our two adult tertiary care teaching facilities. The paper-based data forms were retrospectively completed by the AA who attended the code blue event, and the forms were submitted to the anesthesia management office by the end of the AA's shift. The two hospitals in our study admit both medical and surgical patients and perform all types of elective and emergency surgeries except for obstetrical and pediatric procedures. The total in-patient bed capacities for each site, including medical and surgical beds, are 259 at the Victoria General site and 482 at the Halifax Infirmary site. Mock "code blues" are intermittently conducted for quality assurance and training at our institution. To make these

mock codes realistic, they are conducted unannounced at random locations throughout the hospital; the code team are blinded to these codes occurring until they arrive on scene and high-fidelity manikins are employed for each scenario. We included these events for analysis as they would be representative of the true roles that AAs would provide at a code.

The AAs began covering the code blue service with 24-hour in-house call at the Victoria General site in 2013 and were added to a second site, the Halifax Infirmary, in 2021. Administrative code blue data collection forms completed between January 2017 and December 2022 were included for analysis in this study.

The code blue administrative data collection form (see **Supplementary Information**) was initially created by hospital administration to assess the roles and tasks AAs that were performing at code blue events. The form comprised a series of 25-line items with checkboxes and free text entries. Data elements captured included time, location and type of event, airway management details, medication administration by AAs, vascular access, Advanced Cardiac Life Support (ACLS) maneuvers, and human factors or communication issues during the code. Data from each form was retrospectively deidentified and compiled into an Excel spreadsheet (Microsoft Corporation, Redmond, WA, USA) for analysis. Descriptive statistics were calculated, including frequency and percentages for categorical variables and mean and standard deviation for continuous variables.

RESULTS

In total, 368 data collection sheets were collected between 2017 and 2022. Forty-eight forms were excluded from analysis as they were either duplicates where the original and faxed copies were sent to the AA manager's office or the form was missing patient identification labels (used to obtain the date and location when they were not otherwise entered). The remaining 320 forms were included in the final analysis. The number of data forms completed ranged from 38 to 83 forms per year. Five mock code events were included in our analysis, accounting for 5/320 (1.6%) events. The cohort was 32% female, 55% male and 12% unspecified, with a mean age of 63 years (SD=14; range=18-94 years). The time of event occurrence was reported in 309/320 data collection sheets, and 51.5% (n=158) of these events took place during the day (0700-1659 hours), while 48.5% (n=151) of these events took place at night (1700-0659 hours). The locations where code blue events occurred are shown in **Table 1**. The two most commonly specified types of code blue events were "cardiac arrest" 39% (n=124) and "respiratory failure" 26% (n=84). Other event types were also initiated as a "code blue" for unstable patients; these events included seizures, anaphylaxis, bleeding, arrhythmias, vagal or syncopal events, hypoglycemia, pre-arrest scenarios and mock training codes.

In 246 (77%) of the events, some form of airway intervention or support was required. Of the 246 cases requiring airway management, 140 (57%) were managed by the AA with supplemental oxygen, jaw thrust, bag-mask ventilation, oral/nasal pharyngeal airways, or supraglottic airway placement. Supraglottic airways were inserted by the AAs in 16/246 (6.5%) of cases. In five of those cases, the supraglottic airway was inserted as a temporizing device until the trachea could be definitively secured. Tracheal intubation was required in a total of 181/320 patients. The AAs performed laryngoscopy in 90/181 (49.7%) cases. The intubation method used and Cormack-Lehane glottic views[19] obtained by the AAs are shown in **Table 2**. In cases where the AA was the only person to attempt intubation, the first-pass success rate was 69/83 (83.1%), and the overall success rate was 80/83 (96.4%). There were three failed tracheal intubations involving the AAs; in one case, the Anesthesia resident was able to intubate the trachea on the second attempt, and in one case, the airway was rescued with placement of a supraglottic airway by the AA, which provided "adequate ventilation." The third case required a cricothyrotomy, which a critical care physician performed. In addition to directly performing airway management, AAs also reported providing cognitive support (e.g. decision-making support or guidance) for airway management to the code team in 131 of the 246 cases (53%) where airway management was required. The AAs also reported performing several other wide-ranging roles at code blue events, which included other non-airway related cognitive support, emergency medication preparation and administration, ACLS protocols (e.g. cognitive support related to ACLS algorithms and decision-making), vascular access, and patient transfer once stabilized (**Table 3**).

DISCUSSION

The primary aim of this research was to determine the success of including AAs as members of the code blue team to assist with a wide variety of technical, clinical and cognitive roles and responsibilities. Canada is facing a national crisis due to a shortage of anesthesia providers, with a widespread lack of anesthesiologists.[20,21] AAs are highly skilled, specialized healthcare professionals who can help act as physician extenders, especially in situations where an anesthesiologist may be liberated to attend to more critical patients or patient care areas. The current Canadian Anesthesiologists' Society guidelines recommend that facilities have formally trained AAs who work within the scope of local policies, regulatory agencies, and governmental regulations and are covered by the institution's liability insurance.[22] A previous national survey of the AA role reported on the expanding scope of the AA, including professional tasks both in and out of the perioperative setting.[16] A recent survey of academic institutions across Canada described the inter-provincial differences in the training, funding, roles, and licencing of AAs as part of the anesthesia care team.[18] In their report, they noted the need for more studies on the metrics of AAs in terms of patient safety and perioperative efficiency. Our paper is one of the first to describe out of operating room utilization of AA skills as members of the code blue team and demonstrate that AAs' resuscitative and critical care skills are readily transferrable to the code blue team.

Table 1. Locations of code blue events.

Location of Code Blue Event	Number of Cases n, (%)
Floor unit or regular ward bed	149 (46.6%)
Intermediate Care Unit (IMCU)	59 (18.4%)
Dialysis Unit	21 (6.6%)
Chemotherapy/Bone Marrow Transplant Unit	16 (5%)
IR/MRI/CT/ERCP/Hyperbaric chamber/ophthalmology sites	15 (4.7%)
Cardiac catheterization laboratory	9 (2.8%)
Non-ward locations (Clinics, Hallways, Public Washrooms, Pre-operative area)	8 (2.5%)
Cardiovascular Intensive care unit (CVICU)/Coronary Care Unit (CCU)	5 (1.6%)
Location not specified	38 (11.8%)

Abbreviations: IR = interventional radiology suite; MRI = magnetic resonance imager suite; CT = computed tomography suite; ERCP = Endoscopic retrograde cholangiopancreatography suite; IMCU = intermediate care unit. The different IMCUs within our hospitals contain medical or surgical patients who require closer monitoring than regular floor beds, but not full intensive care unit monitoring.

Table 2. Intubation method used and Cormack-Lehane airway grades obtained by AAs during tracheal intubation.

View Obtained	Direct Laryngoscopy (n=45) number (%)	Video Laryngoscopy (n=39) number (%)
Grade 1	33 (73%)	31 (80%)
Grade 2	8 (18%)	4 (10%)
Grade 3	4 (9%)	2 (5%)
Grade 4	0	2 (5%)

Note: There were 6/90 intubations performed by the AA where the airway grade was not specified.

Table 3. Roles and functions performed by anesthesia assistants at code blue events other than airway management (total n=320 events).

"Other" functions performed by Anesthesia Assistant	Number (%)
Cognitive support provided to other team members (Airway, ACLS, other)	157 (49%)
Peripheral Intravenous Line Insertion (IV)	61 (19%)
Medication administration or preparation (IV, topical, inhaled routes)	29 (9%)
Patient Transport (ICU, OR, IMCU)	24 (8%)
Intraosseous (IO) vascular access	17 (5%)
Arterial Blood Gas (drawn or analyzed in point of care machine)	17 (5%)
CPR / Chest Compressions performed	13 (4%)
Arterial line insertion	9 (3%)
Assist with central or arterial line preparation	8 (2%)
Cardioversion or Managed Defibrillator	3 (1%)

Abbreviations: ACLS= Advanced Cardiac Life Support; CPR= Cardiopulmonary Resuscitation; ICU = intensive care unit; OR = operating room; IMCU = intermediate care unit.
Note: The other functions performed were not mutually exclusive. At numerous code blue events the AA's performed more than one of the above tasks, in addition to assisting with airway management.

The role of the AA is expanding outside of the OR.[16] While it is more common for RRTs to be the members of the code blue team for airway management, the addition of AAs can supplement the airway management and further augment the resuscitation skills and knowledge of the code blue team. Previous studies have demonstrated significant variations in code blue team composition and availability for regular weekdays versus after-hours or weekend events.[23] At our center, the AAs have been cardiac arrest team members providing 24-hour on-site support for over a decade. This on-site, skilled support from an AA is critical, as our study found that nearly half of reported cardiac arrest pages happened outside of regular daytime hours.

Outcomes and survival of IHCA have been shown to depend on the composition and effectiveness of the response team, as well as the timeliness of the response.[23,24] One

centre in the United States demonstrated improved IHCA response times by paramedics hired to provide "rapid, round-the-clock" response to codes and assist with endotracheal intubation. They reported that paramedics were also familiar with defibrillation protocols and skilled at obtaining intravenous access.[25] Similarly, AAs with advanced airway training, resuscitation skills, and immediate availability could minimize delays in these situations. AAs may be more immediately available to respond to code blue calls when an anesthesiologist may be attending to other patient care obligations in the operating room.

There is no set protocol for who performs airway management during codes at our institution. Many different providers within our code blue team could perform airway management, including RRTs, Anesthesia resident physicians, ICU resident physicians, ICU attending physicians, and the AAs. Other factors affecting the choice of airway provider would include the presence or absence of difficult airway predictors, difficult airway history, who arrived first at the code and provider skill level. In our study, we observed that in approximately half of the codes definitive airway management was now being performed by the AAs. To date, no literature describes AAs' role in securing the airway during in-hospital cardiac arrests. However, paramedics have been reported to have an 80% first-attempt success rate for out-of-hospital cardiac arrests[26] and an overall intubation success rate of 87% during in-hospital CPR.[25] Other providers, such as emergency medicine residents, have a reported first-attempt success rate of 83%,[27] and first-pass success rates in the US for RRTs vary but have been reported around 90%.[28] Despite performing intubation in often chaotic and suboptimal conditions (e.g., limited time for comprehensive assessment of airway predictors, unstable hypoxemia/inability to pre-oxygenate, non-fasted patients, and poor patient positioning), our study showed that AAs had a comparable first-pass intubation success rate (83%), and an overall success rate of 96%, reinforcing the utility and safety of employing AAs within the code blue arrest team.

In addition to providing airway management and support, AAs were frequently reported to have assisted with cognitive support during resuscitation, peripheral IV access and medication administration. The AAs also reported assisting with other types of medical and surgical emergencies where a code blue had been initiated. These included anaphylaxis and unstable bleeding where their resuscitative skills were further utilized. These contributions are also noteworthy, as they demonstrate the multifaceted role of the AA on the code blue team.

LIMITATIONS

There were a few noted limitations to this study. The most significant was incomplete compliance with AA submission of the code blue forms after every event and each line item was not always applicable or completed within each form. Both issues resulted in missing data. As this was a retrospective study, we were not able to address the compliance issues in real time and were required to rely on what data was available to us. This is a known limitation of retrospective studies and could result in non-response bias.[29] Retrospective studies can also be prone to recall bias and confounding variables which may not have been measured at the time.[30]

We were unable to accurately report any specific data on IHCA outcomes as the administrative data sheet was not originally designed with the fidelity to capture the type of cardiac arrest (i.e., ventricular fibrillation or tachycardia, pulseless electrical activity, asystole or supraventricular tachycardias), return of spontaneous circulation (ROSC), maintenance of ROSC for over 20 minutes, survival at 24 hours or survival with discharge home. Thus, we cannot determine if AAs' presence had any effect on outcomes.

CONCLUSIONS

This study characterizes the valuable supporting roles that AAs can provide as members of the code blue team. Their airway, vascular access and resuscitative medication knowledge and skills derived from the anesthesia domain are readily transferrable to code blue scenarios outside of the operating room, further supporting their role as physician extenders within the healthcare system.

The results of this study have important implications for organizations that employ AAs, and that may be looking for further opportunities to utilize their skill sets. Similar to cardiac arrest teams, areas like ICUs, emergency departments and rapid response teams may also benefit from the advanced airway training, pharmacological knowledge and vascular access skillset of AAs in emergency or pre-cardiac arrest situations. Future research could focus on these types of out-of-OR teams, their current composition and whether AAs may be a beneficial addition.

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CONTRIBUTORS

All authors contributed to the conception or design of the work, the acquisition, analysis, or interpretation of the data. All authors were involved in the writing and preparation of the manuscript and have approved the final version.

COMPETING INTERESTS

All authors have completed the ICMJE form and declare no conflict of interest. Presented in part at the Canadian Anesthesiologists' Society Annual Meeting, Quebec, June 2023 and the Canadian Society of Respiratory Therapists Conference, Charlottetown, PEI, May 2023.

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ETHICAL APPROVAL

The institutional REB waived the requirement for review of this retrospective quality improvement study.

AI STATEMENT

No generative AI or AI assisted technology was used to generate this manuscript or its content.

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SUPPLEMENTARY MATERIALS

Supplementary Information. AA Code Blue Data Collection Form

Download: https://cjrt.ca/article/136463-roles-of-anesthesia-assistants-within-the-code-blue-team-at-in-hospital-cardiopulmonary-arrests-a-retrospective-analysis/attachment/279359.pdf