Critical Rounds Newsletter
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Dear Doctor,

Greetings from Micro Labs Limited. We are happy to bring you **"Critical Rounds Newsletter"** which contain latest and interesting news in the field of Critical Care.

This issue contains:

1. Incidence and risk factors of arterial catheter failure

2. Relationship Between Hyperoxia during Cardiopulmonary Bypass and Postoperative Delirium in the Pediatric Cardiac ICU

3. Determination of the characteristics and prognostic importance of Acute Kidney Injury among an out-of-hospital cardiac arrest patients

4. Case report on an uncommon cause of acute chest pain

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Looking forward to your valuable feedback

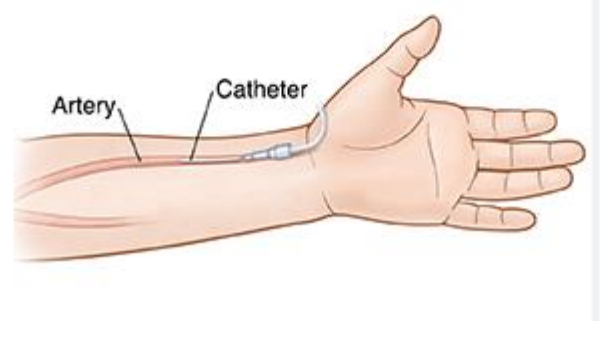
Best Regards,
Medical Team, Micro Labs Limited

Incidence and risk factors of arterial catheter failure

Introduction

Arterial catheterization is a common procedure in critical care and anaesthesia departments around the world.[1] Peripheral arterial catheters (PAC) are usually placed into the radial and femoral arteries, but may also be utilized in the axillary, brachial, and dorsalis pedis arteries. Further, PAC placement was typically used during severe illness or during perioperative and postoperative periods. In the PICU, PACs allow for continuous blood pressure monitoring and regular blood collection. Although arterial cannulation is crucial for clinical purposes, it can be difficult to insert and may lead to problems such infection, skin necrosis, obstruction, and thrombosis.[2] Such complications in the intensive care unit (ICU) can cause significant patient morbidity and higher healthcare costs.[1] So, the purpose of this study was to investigate the incidence and risk factors of AC failure.

Ultrasound-guided insertion significantly lowered AC failure and occlusion rates.



Arterial catheter

Methods:

This was a secondary analysis of a multicenter randomized controlled study, comprised of adult critical care unit patients with an AC. The primary outcome was all-cause AC failure, defined as the termination of catheter function before completing essential therapy. Secondary outcomes included catheter-associated bloodstream infections (CABSI), suspected CABSI, occlusion, thrombosis, unintentional removal, discomfort, and line fracture. AC failure risk factors were analyzed using Cox proportional hazards and competing-risk models.

Results

Out of 664 patients, 173 (26%) experienced AC failure (incidence rate [IR]: 37/1000 catheter days) (Table 1). The most common failure type was suspected CABSI (11%, IR 15.3/1000 catheter days), followed by occlusion (8%, IR 11.9) and unintentional removal (4%, IR 5.5/1000 catheter days). CABSI was observed in 16 (2%) patients. Ultrasound-assisted insertion reduced all-cause failure and occlusion (adjusted hazard ratio [HR] 0.43, 95% CI 0.25, 0.76; sub-HR 0.11, 95% CI 0.03, 0.43). Older age was linked to lower rates of AC failure (HR 0.63, 95% CI 0.44 to 0.89; HR 0.36, 95% CI 0.20, 0.64; referent 15-59 years). Females had a higher occlusion rate (adjusted sub-HR 2.53, 95% CI 1.49, 4.29), while diabetic individuals had a lower rate (SHR 0.15, 95% CI 0.04-0.63). Suspected CABSI was related with an abnormal insertion site appearance (SHR 2.71, 95% CI 1.48–4.99).

Discussion

In this adult ICU population, accidental early removal of ACs was common (1 in 4 cases). ACs were typically removed due to infections, occlusion, and accidental removal. Ultrasound-guided insertion has been shown to significantly reduce AC failure and occlusion, supporting its increasing use.[1] Contrarily, a previous study found that using ultrasound during AC insertion reduced the risk of all-cause failure, infection, and occlusion.[3]

Reason	Arterial catheters (N = 664), *n* (%)	IR (95% CI)
All cause failure[b]	173 (26)	36.8 (31.7 to 42.7)
Suspected CABSI	69 (10)	14.7 (11.6 to 18.6)
Occlusion	55 (8)	11.7 (9.0 to 15.2)
Accidental removal	25 (4)	5.3 (3.6 to 7.9)
Proven CABSI	16 (2)	3.4 (2.1 to 5.6)
Fractured	4 (< 1)	0.9 (0.3 to 2.3)
Painful	3 (< 1)	0.6 (0.2 to 2.0)
Thrombus	1 (< 1)	0.2 (0.0 to 1.5)

IR: incidence rate; CI: confidence interval; CABSI: catheter associated bloodstream infection

[a] Each device could have more than one complication; [b]Fractured, painful, occlusion, accidental removal, thrombus, suspected CABSI, CABSI

Table 1: Failure Incidence (173 failures out of 664 catheters)[a]

Conclusion

This study found that younger age was connected with greater risk of occlusion, whereas female patients have a much higher risk. But diabetes patients have a lower risk. AC failure is common, although ultrasound-guided insertion has a reduced failure rate.

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Relationship Between Hyperoxia during Cardiopulmonary Bypass and Postoperative Delirium in the Pediatric Cardiac ICU

Introduction

Cardiopulmonary bypass (CPB) is commonly utilized in cardiac surgery, however its risks have received more attention. Postoperative delirium (POD) is a common clinical consequence, affecting 3.1%-52% of patients. It can result in a prolonged hospital stay, higher social burden, and impaired recovery and quality of life. During cardiac surgery with cardiopulmonary bypass, detached atherosclerotic plaque and air trapping in the CPB circuit can create emboli, resulting in cerebral embolism and increased risk of postoperative delirium.[1] The risk factors for delirium include young age, prolonged use of cardiopulmonary bypass (CPB), deep sedation and comatose states, cumulative sedative exposure (especially benzodiazepines), immobilization, developmental delay, severe disease, and need for mechanical ventilation (MV). According to recent findings, hyperoxia was associated with poorer outcomes in critically ill children.[2] So, this study was conducted to determine whether a higher incidence of postoperative delirium was linked to hyperoxia on CPB in pediatric patients.

According to an exploratory investigation, delirium risk may be significantly influenced by nutritional status (z score for weight).

Methods

This was a secondary analysis of a prospectively collected cohort of patients (0 days to 18 years) admitted post-CPB in the pediatric cardiac ICU, with confirmed delirium evaluation scores using the Preschool/Pediatric Confusion Evaluation Method for the ICU, and included in the Precision Medicine in Pediatric Cardiology Cohort.

Results

Among 148 patients who underwent cardiac surgery, 35 (24%) experienced delirium within the first 72 hours. Throughout their ICU stay, 45 (30.4%) patients screened positive for delirium. Only two people died while in the hospital, one of them was delusional. Hyperoxia on CPB did not correlate with postoperative delirium across all definitions of hyperoxia, including hyperoxic area under the curve over 5 predetermined Pao2 levels. The following results were reported: 150 mm Hg (odds ratio [95% CI]: 1.176 [0.605–2.286], $p = 0.633$); 175 mm Hg (OR 1.177 [95% CI, 0.668–2.075], $p = 0.572$); 200 mm Hg (OR 1.235 [95% CI, 0.752–2.026], $p = 0.405$); 250 mm Hg (OR 1.204 [95% CI, 0.859–1.688], $p = 0.281$); 300 mm Hg (OR 1.178 [95% CI, [0.918–1.511], $p = 0.199$). An exploratory study found only a difference in the z score for weight between patients with and without delirium within 72 hours (mean [sd]: 0.09 [1.41] vs. -0.48 [1.82], $p < 0.05$). Among 45 patients (30%) who developed delirium during their ICU stay, MV days, severity of disease (Pediatric Index of Mortality 3 Score), CPB time, and z score for weight were significantly linked with delirium ($p < 0.05$) (Table 1).

Demographic Characteristics	Overall ($n = 148$)	Delirium Absent ($n = 103$)	Delirium Present ($n = 45$)	p
Sex, female (%)	63(42.6)	46 (44.7)	17 (37.8)	0.550
Age (mo) (median [IQR])	7.0 (4.0, 50.3)	10.0 (4.0, 64.0)	6.0 (4.0, 20.0)	0.087
Race (%)				
Asian	3 (2.0)	2 (1.9)	1 (2.2)	0.936
Asian Indian	1 (0.7)	1 (1.0)	0 (0)	
Black	11 (7.4)	9 (8.7)	2 (4.4)	
Hispanic	4 (2.7)	3 (2.9)	1 (2.2)	
White	129 (87.2)	88 (85.4)	41 (91.1)	
Pediatric Index of Mortality 3 Score (median [IQR])	0.01 (0.01, 0.01)	0.01 (0.01, 0.01)	0.01 (0.01, 0.02)	**0.008**
STAT Score 1 (%)	38 (25.7)	28 (27.2)	10 (22.2)	0.780
STAT Score 2 (%)	48 (32.4)	30 (29.1)	18 (40.0)	
STAT Score 3 (%)	39 (26.4)	29 (28.2)	10 (22.2)	
STAT Score 4 (%)	13 (8.8)	9 (8.7)	4 (8.9)	
STAT Score 5 (%)	10 (6.8)	7 (6.8)	3 (6.7)	
z score for Weight (mean [SD])	−0.04 (1.53)	0.14 (1.37)	−0.47 (1.80)	**0.024**
Cardiopulmonary bypass time (median [IQR])	132.5 (90.0,198.25)	126.0 (89.5, 180.5)	154.0 (111.0, 225.0)	**0.022**
Cross-clamp time (median [IQR])	54.0 (25.0, 89.8)	50.0 (24.0, 90.5)	68.0 (35.0, 84.0)	0.275
Mechanical ventilation use in first 72 hr (%)	115 (77.7)	74 (71.8)	41 (91.1)	**0.010**
Dexmedetomidine use in first 72 hr (%)	146 (98.6)	101 (98.1)	45 (100)	1.0
Opioid use in first 72 hr (%)	66 (44.6)	38 (36.9)	28 (62.2)	**0.008**
Benzodiazepine use in first 72 hr (%)	7 (4.7)	3 (2.9)	4 (8.9)	0.200
ICU LOS (median [IQR])	4.0 (2.0, 7.0)	3.0 (1.0, 5.0)	6.0 (2.0, 13.0)	**< 0.001**
Hospital LOS (median [IQR])	8.0 (5.0, 15.0)	7.0 (4.0, 12.0)	11.0 (6.0, 28.0)	**0.002**

IQR = interquartile range, LOS = length of stay, STAT Score = the Society of Thoracic Surgeons-European Association for Cario-Thoracic Surgery score, designed to predict the risk of mortality based on congenital heart surgery procedure.
Comparison of demographic data and variables of interest between those who were never delirious versus those who experienced delirium at any point during their ICU stay. Bold indicates $p < 0.05$, considered statistically significant.

Table 1: Risk Factors for ICU Delirium

Discussion

Hyperoxia was not connected to postoperative delirium (within 72 hours of CPB). According to an exploratory investigation, delirium risk may be significantly influenced by nutritional status (z score for weight).[2] Previous study found that the duration of surgery, postoperative mechanical ventilation, and postoperative CCU stay were risk factors for POD.[3]

Conclusion

Postoperative delirium occurred in 24% of pediatric patients within 72 hours of CPB. Hyperoxia, characterized in various ways, was not linked to delirium. Exploratory study suggested that nutritional status (z score for weight) might play a major role in delirium risk. More research was needed to distinguish between risk factors for postoperative and ICU delirium.

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Determination of the characteristics and prognostic importance of Acute Kidney Injury among an out-of-hospital cardiac arrest patients

Introduction

Acute kidney injury (AKI) patients, with or without continuous kidney replacement therapy (CKRT), showed lower 1-year survival than non-AKI patients.

Acute kidney injury (AKI) is a major clinical renal syndrome with high incidence and mortality, caused by a variety of factors including ischemia, nephrotoxic medications, oxidative stress, inflammation, and urinary tract blockage. Epidemiological studies indicated that the incidence of acute kidney injury (AKI) among general inpatients was 5%, whereas severe patients have a mortality rate of over 50%.[1] Around 40% of patients resuscitated from out-of-hospital cardiac arrest (OHCA) experience AKI, which was linked to poor short- and long-term survival. In addition, patients with pre-existing kidney impairment prior to an OHCA incident have a higher 90-day death rate. Post-resuscitation care can prevent additional renal deterioration and improve outcomes.[2] So, this study aimed to identify AKI characteristics based on the Kidney Disease Improving Global Outcomes (KDIGO) classification, as well as the prognostic significance of AKI severity in a defined OHCA population enrolled in the Blood Pressure and Oxygenation Targets After OHCA trial.

Methods

This was a sub-study of a randomized trial that included 789 comatose adult OHCA patients with a presumed cardiac etiology and prolonged return of spontaneous circulation (ROSC). The study comprised 759 patients with no prior dialysis-dependent renal illness who survived at least 48 hours. AKI was classified according to the kidney disease: improving global outcome (KDIGO) classification, and patients were categorized into three groups according to the degree of AKI development and the requirement for continuous kidney replacement therapy (CKRT): no AKI, AKI no CKRT, and AKI CKRT. The primary outcome was overall survival within 365 days after OHCA in the AKI group. Adjusted Cox proportional hazard models were used to compare overall survival within 365 days among the three groups.

Results

This study included 759 patients and according to the KDIGO definition, 254 patients (33.5%) developed AKI, with 77 requiring CKRT and 177 not required for CKRT. AKI CKRT patients experienced longer time-to-ROSC and greater metabolic disturbances upon hospital admission. The severity of kidney impairment reduced overall survival after OHCA within 365 days. According to an adjusted Cox regression analysis, AKI was significantly linked to a lower overall survival rate up to 365 days, with similar hazard ratios compared to no AKI (HR 1.75, 95% CI 1.13–2.70 vs. HR 1.76, 95% CI 1.30–2.39) (Table 1). According to Kaplan-Meier survival estimates, patients with no AKI had a 74% overall survival rate 365 days after hospital admission, 55% with AKI and no CKRT, and 43% with AKI CKRT.

Covariate	All-cause mortality		
	HR	95% CI	*p* value
Unadjusted model			
AKI no CKRT (*v* no AKI)	1.99	1.51 to 2.63	***<0.001***
AKI CKRT (*v* no AKI)	3.10	2.20 to 4.36	***<0.001***
Adjusted model			
AKI no CKRT (*v* no AKI)	1.76	1.30 to 2.39	***<0.001***
AKI CKRT (*v* no AKI)	1.75	1.13 to 2.70	***0.012***
Age (per year)	1.03	1.02 to 1.04	***<0.001***
Sex (female *v* male)	1.61	1.17 to 2.20	***0.030***
eGFR upon admission (per ml/min/1.73 m^2)	1.00	0.99 to 1.01	*0.71*
Diabetes mellitus (yes *v* no)	1.01	0.71 to 1.43	*0.95*
Heart failure (yes *v* no)	1.33	0.94 to 1.87	*0.10*
Shockable rhythm (yes *v* no)	0.49	0.34 to 0.70	***<0.001***
Witnessed arrest (yes *v* no)	0.79	0.55 to 1.13	*0.20*
Bystander CPR (yes *v* no)	0.49	0.35 to 0.68	***<0.001***
Time-to-ROSC (per minute)	1.02	1.02 to 1.03	***<0.001***
Percutaneous coronary intervention (yes vs no)	0.96	0.73 to 1.27	*0.78*

Cox regression analysis evaluating risk of death within 365 days according to No AKI, AKI no CKRT, and AKI CKRT. Bold italic values indicate highligth statistical significance

AKI, acute kidney injury; *CI*, confidence interval; *CKRT*, continuous kidney replacement therapy; *CPR*, cardio-pulmonary resuscitation; *eGFR*, estimated glomerular filtration rate; *HR*, hazard ratio; *ROSC*, return of spontaneous circulation

Table 1. Cox regression analysis

Discussion

Patients with AKI, with or without CKRT, showed lower 1-year overall survival compared to those without AKI. After adjusting for peri-arrest characteristics, AKI remained a significant risk factor for lower overall survival, regardless of CKRT commencement. In this study, 30% of patients who had AKI received CKRT treatment. Also, it was found that patients who were resuscitated after OHCA and developed AKI, regardless of CKRT commencement, had lower 1-year overall survival rates than non-AKI patients.[2] A previous study found that AKI complicates care for 40% of cardiac arrest survivors and was linked with significantly higher short- and long-term mortality.[3]

Conclusion

Individuals with AKI, regardless of when CKRT was started, had a lower one-year overall survival rate than non-AKI patients among comatose patients who had been resuscitated after OHCA. This association remained statistically significant even after accounting for additional peri-arrest risk variables.

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Case report on an uncommon cause of acute chest pain

Introduction

Chest pain is the second most prevalent medical complaint among adults. The emergency department's primary purpose is to assess if a patient's acute chest pain is life-threatening.[1] Differentiating between grade 1 acute myocardial infarction (AMI) and other types of myocardial injury is critical for patients with elevated troponin levels. Cardiac Magnetic Resonance Imaging (CMRI) is an effective tool for identifying individuals with chest pain in the emergency ward.[2] In this case, a 40-50 year-old male reported to the emergency ward with chest pain and it radiated to his upper abdomen and left flank.

The patient with acute chest pain was diagnosed with esophageal rupture, and surgical repair of esophageal prosthesis was done for clinical improvement.

Case Presentation

A 40-50 year-old male admitted with the complaints of chest pain and radiated to his upper abdomen and left flank. He had personal history of anxiety and currently taking diazepam and duloxetine. The patient had no history of gastrointestinal disorders or allergies. His symptoms started suddenly after vomiting and he complained of acute pain. He also experienced nausea, diaphoresis, and no signs of severe acute respiratory syndrome. Upon admission, the patient's physical examination revealed pale and sweaty skin, a blood pressure of 112/73 mmHg, a heart rate of 135 beats per minute, a respiratory rate of 25 breaths per minute, a temperature of 36.2 °C, and an oxygen saturation of 98%. During the initial clinical examination, the patient appeared pale and sweaty, with complaints in the retrosternal and left lumbar regions. The patient's initial blood gas showed a metabolic acidosis with a significant anion gap (pH 7.37, pCO2 29 mmHg, pO2 102 mmHg, bicarbonate 16.8 mmol/L, saturation 98.7%, anion gap 14 mEq/L, lactate 1.4 mmol/L). The initial chest X-ray revealed no acute abnormalities and no pneumothorax or pneumomediastinum, and the 12-lead electrocardiogram indicates a normal sinus rhythm. The patient's laboratory results showed mild leukocytosis (14 10^3/uL) and a C-reactive protein level below 1 mg/L. His renal and electrolyte profiles were normal, with a creatinine level of 1.5 mg/dL. There were no aberrant levels of cardiac biomarkers, pancreatic lipase and amylase, or D-dimer. A CT scan revealed a left pneumothorax, anterior pneumomediastinum, and unclear esophageal wall with pneumomediastinum just above the gastro-esophageal junction, indicating esophageal rupture (Figures 1 and 2). General surgeon’s consultation done, and considering the history of the

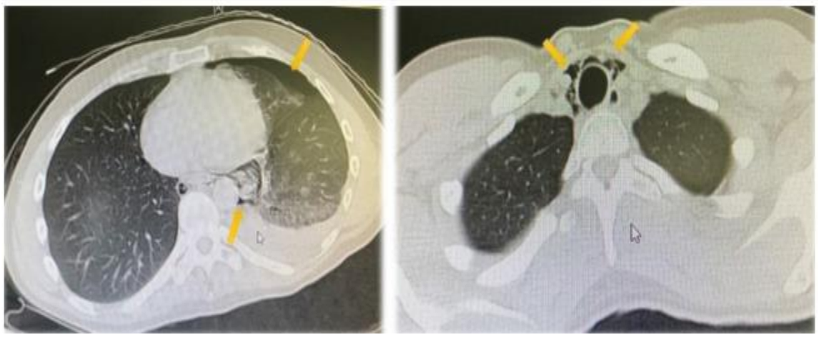

Figure 1: Axial image of CT chest showing left pneumothorax and pneumomediastinum (yellow arrows).

current sickness, two sets of blood cultures were taken. Fluconazole, piperacillin/tazobactam, and other broad-spectrum antibiotics, together with prokinetics and analgesics, were started. After being diagnosed with esophageal rupture, the patient was transferred to a referral center for surgical repair. An esophageal prosthesis was placed, leading to clinical improvement. He discharged home on the 12th postoperative day. After one month of follow-up, the patient was healthy with no impairments.

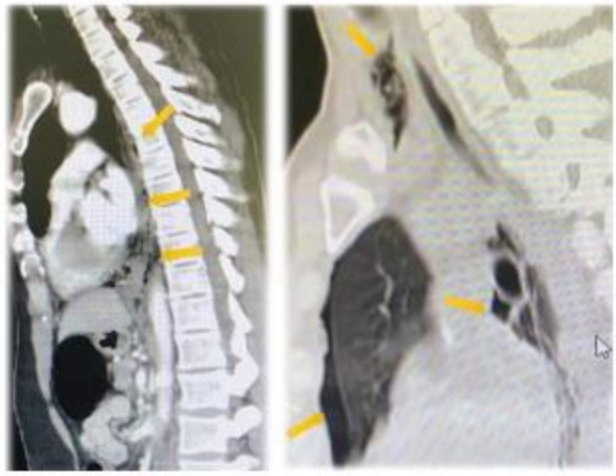

Figure 2: Sagittal scan of CT chest reveals extra-luminal free air in the mediastinum (yellow arrows) and a left-sided pneumothorax.

Discussion

Excruciating retrosternal chest pain can result from an intrathoracic esophageal perforation caused by severe vomiting. Physical exam findings may include abnormal vitals (diaphoresis, tachycardia, tachypnea, fever), reduced breath sounds on the perforated side, mediastinal emphysema, and Hamman's sign (mediastinal "crackling" with every heartbeat) in the left lateral decubitus position. Laboratory testing can rule out more prevalent illnesses in the differential diagnosis, such as pancreatitis, myocardial infarction, and aortic aneurysm dissection, but they don't really help in the diagnosis.[1] Imaging was crucial for identifying Boerhaave Syndrome. Chest radiography may reveal pleural effusion (left more often than right), pneumothorax, a normal radiograph may show pneumomediastinum, pneumoperitoneum, or subcutaneous air, but it cannot rule out esophageal rupture.[3]

Conclusion

The patient was diagnosed with esophageal rupture, and surgical repair with an esophageal prosthesis led to clinical improvement. A high level of suspicion is necessary for fast diagnosis and timely imaging to guide subsequent interventions.

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