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Intraoperative Cardiac Arrest: An Algorithm to Address the Synchronous Underlying Pathology

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ABSTRACT

Intra-operative cardiac arrest (IOCA) is a rare yet feared complication. It has been reported with diverse range: from 0.8/10,000 cases to 21/100,000 cases. [1,2,3]

The immediate mortality and subsequent 30 days mortality are paramount, from 62% to 75%, respectively. [1,2] Patients that had incurred an operation due to trauma had an even worse prognosis, in some studies. [4] Elective cases, where the arrest was addressed with a resuscitation algorithm, unobstructed communication, and teamwork between the surgery and anesthesia teams, fared the most favorable outcomes. [5] Some literature has even reported that the use of CPR, when necessary, was a poorer prognostic indicator. [6] Often successful resuscitation and rescue of the patient from IOCA is performed before the surgeon has had the opportunity to address the pathology that originally scheduled the patient for an operation. There is not an established algorithm of how or when to take the patient back to the operating room to address the underlying pathology. We propose an algorithm where a successfully resuscitated patient, without sustaining a myocardial infarction (MI), can be appropriately worked up, managed, undergo prophylactic cardiac protection, and return to the operating room for a successful operation.

CASE PRESENTATION

We present a 53 y/o female that presented to her primary care physician with intermittent dull abdominal pain. She was subsequently referred to a gastroenterologist. She underwent a screening colonoscopy and was found to have a near obstructive mass in the transverse colon. The patient was referred to surgery for further evaluation. Her past medical history was pertinent for hypertension that was well controlled with medication. Upon consultation with the surgeon, a plan for a laparoscopic segmental colon resection was outlined. Informed consent was obtained.

After successful induction of anesthesia, the patient underwent insertion of a 5 millimeter (mm) port. The abdomen was insufflated to 15 atmospheres (atm) of pressure. A second 5 mm port was introduced into the abdominal cavity under direct visualization. The first port site was inspected and looked excellent. We commenced with our mobilization of the intra abdominal contents for exposure. All vital signs were stable and there was negligible blood loss.

Approximately 5 minutes into the dissection, anesthesia announced that the patient was becoming bradycardic. The patient went into asystole. Chest compressions were started and the abdominal cavity was decompressed. Epinephrine and Atropine were administered. CPR continued and the patient regained a pulse within a minute. The case was aborted and the patient was awakened and taken to the post anesthesia care unit, PACU. She was in stable condition. She was extubated in the PACU.

The patient was taken urgently to the cardiac catheterization lab, where she underwent strenuous interrogation of her coronary vasculature. There were not any marked abnormalities found.

The following day (hospital day #2) she underwent implantation of a temporary permanent pacemaker (PPM). She tolerated the procedure well.

On hospital day #3, she underwent a laparoscopic segmental colon resection without any incidents. She recovered well, was discharged home on post operative day four. Upon her six week follow up, she is doing well and has resumed all pre-operative activities.

RESULT AND PROPOSED ALGORITHM

Intra-operative cardiac arrest (IOCA) is the most feared complication during surgery. The acuity of surgery coupled with cardiac arrest create a stressful environment on the patient and the surgical team. Continual communication between the anesthesiology team and surgical team is paramount in handling this catastrophe. The patient in our case had malignant pathology that could not be postponed. It is the intent of the authors of this manuscript to propose a plan to address patients following IOCA that have a malignant process: Figure 1.

Following the successful resuscitation of a patient, the patient should be monitored and evaluated for extubation. A cardiac catheterization should be undertaken to interrogate the coronary vasculature. If the coronaries are found to have limited to absent disease, without an infarction, we recommend placement of a temporary PPM. Surgery can be undertaken the following day. The temporary PPM is removed prior to the patient leaving the hospital.

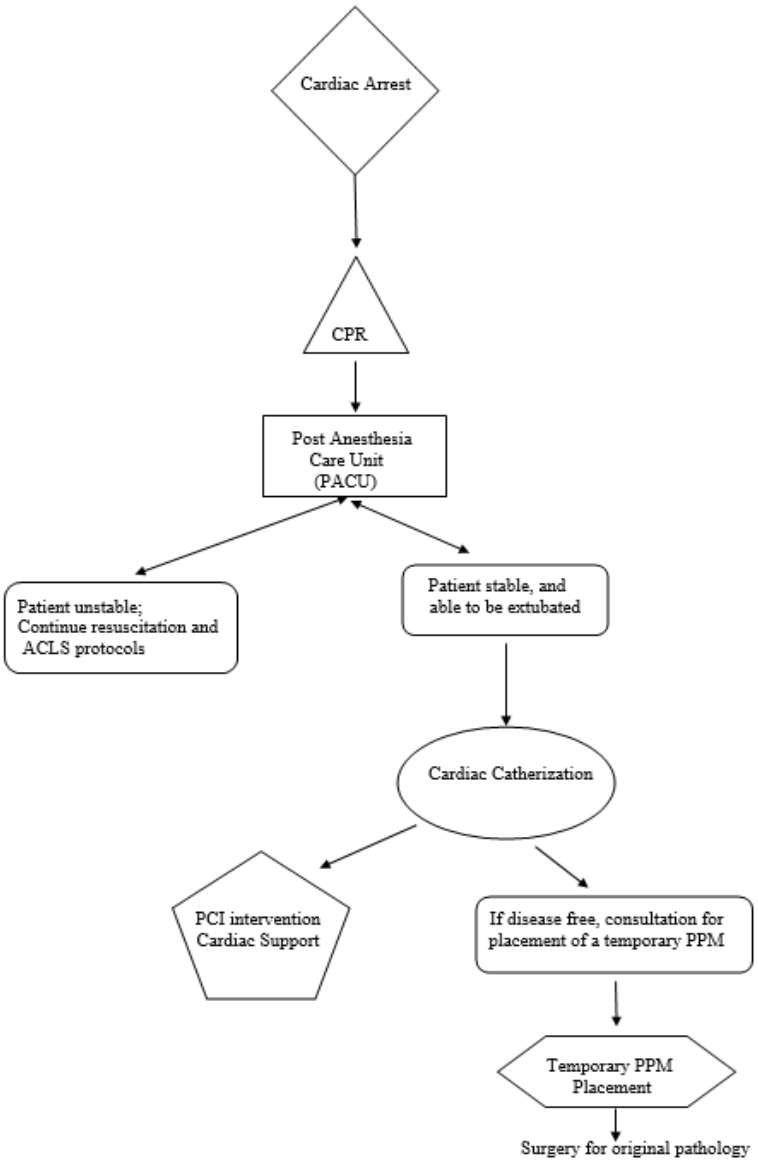

Figure 1: *Houston Methodist Sugar Land IOCA Flow Diagram*: Flow diagram depicting an algorithm of IOCA to potential definitive surgery.

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DISCUSSION

Intra-operative cardiac arrest is a potentially devastating complication. Although the reported rates vary, the incidence is reported to be decreasing worldwide. [7,8, 9] Data from Brazil, pooling 4 studies that amassed 204,000 patients, showed the incidence decrease from 39/10,000 to 13/10,000. Furthermore, the mortality also decreased over that time period from 48.3% to 30.8% [7]. There are multiple reported causes of IOCA. These range from weakening cardiac conditions, metabolic abnormalities, hypovolemia, local anesthetic systemic toxicity, trauma, and malignant hyperthermia to name a few. [5] There are some obscure reasons for IOCA, such as Kounis syndrome, whereby the arrest is triggered from mast cell activation. [10] An example would be the administration of cephalosporin causing a marked allergic reaction to the patient and leading to an allergic acute coronary syndrome.[10] While the immediate cause of the arrest is often not identified, the ACLS protocol is immediately initiated. Supporting the patient and restoring circulation and maintaining an airway are paramount in patient survival and safety. Operating rooms that have the surgical team and anesthesia team in synchronous partnerships fare better in successfully resuscitating and rescuing the patient. [3,4,11]

The immediate recognition of bradycardia and subsequent asystole allowed quick action in our patient. While the anesthesia team was administering medications and ensuring the airway was continually secure, the surgical team was simultaneously performing CPR and decompressing the abdominal air from the laparoscopic insufflation. These concerted efforts led to the patient being immediately resuscitated and successfully rescued.

The advances in technology and medicine have also contributed to better outcomes from IOCA. The aging and sicker population do pose challenges for the surgeon and anesthesiologist in the operating room. Patients with congestive heart failure, circulation disorders, vascular disease, end-stage renal disease had a 15.44 fold increase in risk-adjusted in-hospital mortality, with an even higher IOCA mortality. [12] Interestingly, with the onset of COVID, the incidence of cardiac arrests was higher in COVID patients, however the data for IOCA in COVID patients needs further evaluation and analysis. [13] Transplant patients fared poor outcomes when faced with an intr-operative arrest. [14] Data from 7 academic centers showed IOCA higher with BMI > 40, MELD > 40, and incidence of post perfusion syndrome. The 30 day and 1 year mortality, post liver transplant, was 43.9% and 52% respectively. [14]

Once our patient was successfully resuscitated, she still had her underlying pathology, a near obstructive, cancerous mass, that had to be addressed. It was important to evaluate her cardiopulmonary status prior to continuing with the operation. The cardiology team immediately consulted upon the patient and she was taken to the catheterization lab. Her coronaries were found to have minimal disease so an acute myocardial infarction was ruled out. Her airway and circulation post recovery were excellent and stable. The patient's vitals signs had maintained their baseline well after insufflation of the abdominal cavity, thus a vasovagal event was unlikely the etiology of her arrest. A decision was made to implant a temporary PPM, to ensure that she could safely undergo a major abdominal operation with general anesthesia.

Multiple research and reports recommend postponing an elective surgery after a myocardial infarction. [15] The risk of peri-operative mortality following an acute MI is markedly increased

in the first 30 days with a continual increase of morbidity and mortality for the first six months. Cardiac catheterization is paramount to ensure the cause of IOCA is not an MI, and allows the surgeon to follow the algorithm proposed in this paper.

The medical teams consisting of surgery, anesthesia, interventional cardiology and electrophysiology all worked in conjunction to ensure the safety and well being of the patient. The communication was constant and the interventions were expedient. The careful yet efficacious timings of the management allowed the patient to undergo a successful operation and address her cancerous tumor. As IOCA continues to be a dreaded complication, the implementation of this algorithm facilitates an approach and pathway that can result in a successful outcome.

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