# ANESTHETIC CONSIDERATIONS AND MANAGEMENT OF A PATIENT WITH UNSUSPECTED CARCINOID CRISIS DURING HEPATIC TUMOR RESECTION

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## Abstract

Anesthetic management for massive blood loss in liver surgery concomitant with hemodynamic instability secondary to carcinoid crisis can be challenging in the perioperative setting. Hypotension, diarrhea, facial flushing, bronchospasm, and tricuspid and pulmonic valvular diseases are the common manifestations of carcinoid syndrome. This report illustrates the importance of early recognition and treatment for signs and symptoms of carcinoid syndrome not only in the preoperative setting but also in the intraoperative phase to prevent undue cardiovascular collapse.

**Keywords:** Octreotide, carcinoid crisis, neuroendocrine hepatic tumor, hypotension.

## Introduction

Carcinoid tumor is a rare form of neuroendocrine cancer that is derived from enterochromaffin cells. Approximately 74% of carcinoid tumors originate from the gastrointestinal tract, most commonly from the small bowel (29%) and appendix (19%), and 25% from the lungs[1]. The annual incidence is reported to be 0.28 per 100,000 population[2]. The tumor secretes serotonin, histamine, bradykinins, and vasoactive intestinal peptides that produce vessel permeability, hypotension, flushing, diarrhea, and wheezing when released into the systemic circulation from liver metastases or extrahepatic carcinoid tumor during surgical manipulation[3].

## Case Report

A 64-year-old male (83 kg, 185 cm) with past medical history of hyperlipidemia and left hepatic tumor, presented with bronchitis, diarrhea, and flushing for 9 months. A liver biopsy confirmed intermediate grade neuroendocrine tumor of unknown primary neoplasm. The patient underwent hepatic artery embolization and received monthly somatostatin depot for symptomatic relieve before he was evaluated for surgical intervention.

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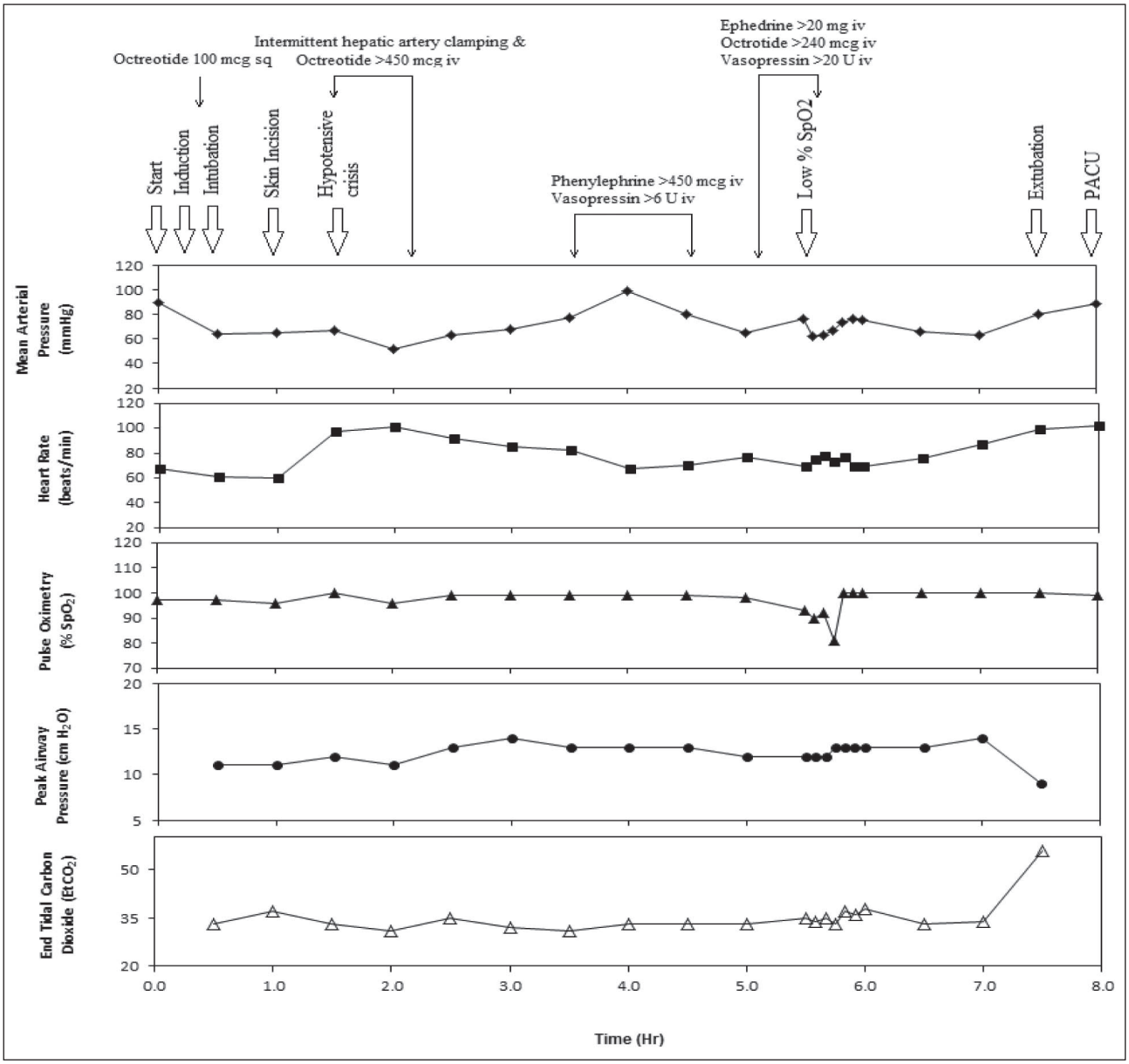
On the day of surgery, the patient appeared well-nourished with stable vital signs (BP=114/69 mmHg, P=79 beats/min, RR=18 breaths/min, $SpO_2$=98%, and T=37 ºC). Electrocardiogram and chest radiography revealed sinus rhythm and no metastatic lesions, respectively. Computerized tomography of the chest, abdomen, and pelvis was unremarkable. Laboratory values were the following: Na=140 mEq/L, K=4.1 mEq/L, Cl=102 mEq/L, $CO_2$=25 mEq/L, BUN=21 mg/dL, Cr=1.1 mg/dL, Glu=71 mg/dL, Hct=43.5%, PLT=143 × $10^9$/L, PTT=28.7 sec, and PT=13.8 sec. Two large bore peripheral intravenous catheters (14- and 16-gauge) and a radial arterial line were inserted. He was pretreated with levoalbuterol for mild bronchitis and midazolam for anxiety. Patient tolerated induction and intubation without hemodynamic swings. Octreotide 100 mcg was injected subcutaneously after intubation. Ciprofloxacin and metronidazole were administered for his penicillin drug allergy.

Arterial pressure fell abruptly to 43/26 mmHg 30 minutes after skin incision (Figure 1). Manipulation of the tumor was stopped as fluid and intravenous

*Fig. 1*
*Intraoperative hemodynamic measurements*



octreotide (>450 mcg) were immediately administered to temporize the sudden drop in blood pressure and intermittent clamping of the hepatic artery to prevent the release of hepatic carcinoid mediators. No facial flushing or wheezing was noticed. Blood pressure was maintained with phenylephrine, ephedrine, and vasopressin boluses for refractory hypotension[4].

After 4 hours of surgery, the oxygen saturation dropped gradually to 81% on the pulse oximeter. Because of concerns for pneumothorax from inadvertent diaphragmatic injury or venous air embolism[5], the inspiratory oxygen concentration was increased from 50% to 100%. Ascultation of breath sounds were clear and pulmonary compliance on bag ventilation was adequate. Peak airway pressure and end-tidal carbon dioxide were unchanged. An arterial blood gas showed $PaCO_2$=39 mmHg and $PaO_2$=459 mmHg. Hypoperfusion secondary to blood loss could be a possibility that accounted for the low oxygen saturation, but it steadily improved as 2 units of packed red blood cells were transfused and more vasopressors given. Estimated blood loss and urine output were 1-L and 1.8-L, respectively. A total of 2.5-L of 5% albumin and 5-L of crystalloid were infused. Patient was successfully extubated in stable condition with a post-transfusion hematocrit of 31%.

## Discussion

Currently the drug of choice for treatment of carcinoid syndrome is octreotide, a somatostatin analog that inhibits the release of vasoactive mediators[6,7]. The optimal dose for octreotide administered subcutaneously is 100 mcg before induction, or 25 mcg to 100 mcg intravenous boluses during surgery to achieve a desired effect[8]. Other adjunct but obsolete therapies include antagonists that block specific histamine ($H_1$ and $H_2$)[3] and serotonin ($5\text{-}HT_2$)[9,10] receptors, or bradykinin[11] production. The effectiveness of these medications for preventing carcinoid crisis is inconclusive as studies have disputed their efficacy.

Indirect adrenergic agonist (e.g., ephedrine) that causes catecholamine release is typically contraindicated because they worsen the mediator cascade. However, their role is unclear in preventing hypotension since ephedrine has been used in the intraoperative setting after octreotide therapy has failed[12]. On the other hand, direct adrenergic agonist (e.g., phenylephrine) and vasopressin, which acts on the $V_1$ receptor, increase blood pressure by vasoconstriction of blood vessels are not involved in catecholamine release. Therefore, both are useful drugs to prevent carcinoid hypotension.

While much emphasis is placed on the pharmacological strategies that target the pathophysiology of carcinoid syndrome, it underscores the perioperative considerations and its anesthetic implications. The key points in the management for this case include: (1) a complete preoperative assessment and optimization of electrolyte imbalance (e.g., hypokalemic hyperchloremic metabolic acidosis) from diarrhea before surgery[13]; (2) avoidance of medications that trigger allergic reactions or histamine release; (3) minimization of stress response that can release catecholamines during induction, intubation, and surgery[14]; (4) placement of an arterial line for monitoring rapid changes in blood pressure and blood draws for electrolytes, and large bore intravenous catheters, or even a central line, for infusion of blood and fluids; (5) availability of vasopressors and blood products in anticipation for hemodynamic instability and potential blood loss; and (6) good communication between the surgical and anesthesia team in case of emergency.

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