

The use of FloTrac/Vigileo™ Device for Hemodynamic Monitoring During Resection of Carcinoid Liver Metastases

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Citation

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Abstract

Carcinoid syndrome is a rare disease characterized by the release of vasoactive amines resulting in haemodynamic instability. This clinical entity presents unique challenges in the intra operative monitoring and anaesthetic management. We present a case of liver resection of metastatic carcinoid tumour while using the FloTrac/Vigileo™ device for haemodynamic monitoring. Data derived by this device was consistent with that from the pulmonary artery catheter (PAC) opening the possibility for this device to be used in place of the PAC for similar cases in the future.

CASE REPORT

A 51-year-old woman (165 cm, 73 kg) presented for elective right lobe of liver resection for the control of symptoms of carcinoid syndrome secondary to hepatic metastases from an intestinal carcinoid tumor. Her symptoms included severe nausea, diarrhea, flushing, palpitations and palmar erythema despite being on high dose octreotide (50 mg/week). A CT scan revealed multiple metastatic lesions present mainly in the right lobe of liver and the diagnosis was confirmed with Indium 111 Octreotide scan.

Her past medical history is otherwise unremarkable apart from surgery for resection of terminal ileum for carcinoid tumor 8 years previously. Her regular medications apart from octreotide included citalopram and methylphenidate. She was sensitive to morphine, which gave her hives. On examination her heart rate was 62 beats per minute and her blood pressure was 110/40 mmHg, the cardiovascular and respiratory system examinations were unremarkable. There were no abnormalities detected on the pre-operative ECG and chest x-ray, her hemoglobin was 14.4 g/dl and serum creatinine was 64 mg/dl. Pre-operative echocardiography showed no evidence of valvular heart disease.

After explanation of the anaesthetic technique, consent was obtained and the patient was premedicated with 2 mg of lorazepam and 100 mcg of subcutaneous octreotide. After institution of routine anaesthesia monitoring and placement of a 16G peripheral intravenous cannula, an arterial cannula (20G/1.88in Angiocath™, Becton Dickinson Infusion

Therapy Systems Inc. Sandy, UT, USA) was sited in the left radial artery. An epidural catheter was sited in the T7-T8 vertebral interspace for intra and postoperative analgesia. Anaesthesia was induced with midazolam 2mg, fentanyl 250mcg and propofol 150 mg. Anaesthesia was maintained with 0.8 – 1.0 MAC of desflurane and a remifentanyl infusion (0.25 mcg/kg/min). After induction, an octreotide infusion was started at 40 mcg/hr and continued throughout the case. Phenylephrine (40 mcg aliquots) was used to maintain a systolic blood pressure between 90 and 110 mm Hg to reflect the baseline values. A pulmonary artery floatation catheter (PAC) (Edwards Life sciences, Irvine, CA, USA) and arterial pressure derived continuous cardiac output measurement (APCO) using the FloTrac/Vigileo™ device (Edwards Life sciences, Irvine, CA, USA, software version V01.10, PIC V1.0) was used to guide fluid and hemodynamic management.

One episode of severe hypotension occurred at the start of liver dissection where systolic blood pressure decreased to 60 mm Hg and cardiac index (CI) decreased to 1.5 L/min/m². This was unresponsive to a crystalloid fluid bolus of 250 mls and a total of 200 mcg of phenylephrine. The hypotension was corrected with an IV bolus of octreotide (30 mcg) and this restored the CI to over 2 L/min/m². The haemodynamic data derived from the PAC and the FloTrac/Vigileo™ device is summarized in Table 1. The total procedure time was 3.5 hours and there were no further episodes of haemodynamic instability. Right hemi-hepatectomy was performed with an estimated blood loss of 600 mls and the patient received 3

liters of normal saline intraoperatively. Granisetron 1 mg was used as prophylaxis for post-operative nausea and vomiting and the patient was reversed with neostigmine 2.5 mg and glycopyrolate 0.4 mg at the conclusion of surgery. The surgical team was able to debulk 75-80% of the lesions by removing about 60% of the liver. The patient had an uneventful recovery and was discharged home after 4 days with minimal symptoms of carcinoid syndrome.

Figure 1

Table 1. Comparison of Haemodynamic variables between PAC and FLOTRAC

Time (min)	Cardiac Output (l.min ⁻¹)		Cardiac Index (l.min ⁻¹)		Stroke volume (mL)	
	PAC	FLOTRAC	PAC	FLOTRAC	PAC	FLOTRAC
0	4.0	3.9	2.2	2.1	63	61
30	4.7	4.9	2.6	2.7	74	74
60	5.7	5.4	3.1	3.1	80	78
90	4.3	4.5	2.4	2.5	74	76
120	5.0	5.2	2.8	2.8	74	76
150	4.4	4.8	2.4	2.7	72	73
180	4.9	5.4	2.7	3.0	76	70

PAC: Pulmonary artery catheter; FLOTRAC: FloTrac/Vigileo™ device;

l.min⁻¹: Liters per minute; mL: milliliters.

DISCUSSION

Carcinoid tumours are rare neuroendocrine tumors that primarily occur in the gastrointestinal tract. These tumours can metastasize to other organs, including the liver, bone, ovaries and the central nervous system. These tumours may release various vasoactive amines and peptides such as serotonin, histamine, substance P, prostaglandins, kallikrein and bradykinins leading to the development of the carcinoid syndrome. Severe flushing, diarrhea, abdominal cramping, and bronchospasm characterize this syndrome and, occasionally presents as life threatening right-sided heart failure [1]

The long acting somatostatin analogue octreotide is effective in providing symptom relief in patients with carcinoid syndrome [2]. Patients with metastatic disease to the liver that is refractory to medical treatment may require surgery, radiofrequency ablation or hepatic artery embolization for the control of symptoms.

In the peri-operative period patient anxiety, the stress response and tumour manipulation may all induce release of vasoactive substances, sometimes in large amounts, leading to severe haemodynamic instability and carcinoid crisis. The

main challenge in the peri-operative management of patients with carcinoid syndrome centers on mitigating the release of these vasoactive substances and the control of haemodynamic parameters.

Octreotide given as a pre-medication and intra-operative infusion has been described in many case reports to prevent the release of mediators and help control haemodynamic instability occurring peri-operatively [3-5]. Low dose remifentanyl infusion whilst avoiding hypotension, has the advantages of good suppression of sympathetic response related to intubation, tumour manipulation and pain and has been previously used in this setting [6] and provided a stable anesthetic in this case.

The use of invasive arterial blood pressure monitoring and central venous pressure monitoring is routine in most centers for liver resection surgery. The use of the FloTrac/Vigileo™ device with the ability to monitor continuous stroke volume and cardiac output has not previously been described in the management of such cases. The FloTrac/Vigileo™ device uses an analysis of the arterial pressure waveform from a standard radial artery catheter and specific demographic data to derive a continuous monitor of cardiac stroke volume. The derived haemodynamic data in patients with abnormal vasodilatation has been inconsistent when compared to PAC derived data [7]. We compared these two methods under conditions of pathological vasoactivity in this case as the use of the FloTrac/Vigileo™ device did not need any additional invasive monitoring above the routine placement of an arterial catheter. In this patient the haemodynamic data derived from the FloTrac/Vigileo™ device was consistent with data from the pulmonary artery catheter (Table 1).

We found good agreement between FloTrac/Vigileo™ and PAC over a wide range of haemodynamic parameters under dynamic circumstances in a patient with carcinoid syndrome undergoing hepatic resection. Our experience in this case suggests that using of FloTrac/Vigileo™ device is feasible in patients over a wide range of rapidly changing haemodynamic variables. Further studies will be required to confirm whether FloTrac/Vigileo™ may obviate the necessity for pulmonary artery catheters for these cases.

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