Drastic Times, Drastic Measures: A Case Report on Massive Transfusion*

Lorena Margarita B. Osorio, MD[1]

ABSTRACT

Massive intraoperative bloodloss requires expectant measures, efficient coordination amongproviders, and timely feedback to optimize outcomes. In the Philippines, case reports on massive blood loss and transfusion are lacking. This report describes a 67-year-old female who underwent elective adrenalectomy, nephrectomy, and hepaticresection, with a total intraoperative blood loss of 20 liters in a 13-hour surgery. Efficient conduct of the institution's massive transfusion protocol, multiple press or support, electrolyte and glucose correction, and anticipatory management of associated complications of hypovolemia and transfusion were important elements to successful management. The patient tolerated the surgery and was discharged well after 12 days. In theabsence of more sophisticated monitoring and management options in a low-resource setting, maximizing available means and anticipatory interventions is key.

Keywords: massive transfusion, hemorrhage, coagulopathy

INTRODUCTION

In the face of extensive and life-threatening hemorrhage, massive transfusion aims to maintain oxygen supply and circulating volume as well as to minimize complications of dilutional coagulopathy and hypovolemia, all while source control is being carried out. While massive transfusion may be arbitrarily defined, it is traditionally the transfusion of 10 or more units of whole blood (WB) or red blood cells (RBC) in 24 hours, the transfusion of more than 4 RBCs in1 hour with the anticipation of continued need for blood product support, or the replacement of greater than 50% of total blood volume by blood products within 3 hours[1] .A massive transfusion protocol (MTP) serves to delegate tasks and streamline workflow once it is activated, predefine ratios of different blood products for transfusion, and set subjective and objective goals to continue or hold transfusion.

In the index hospital, MTP is triggered following (1) Assessment of Blood Consumption (ABC) score ≥2, (2) persistent hemodynamic instability, or (3) active bleeding requiring surgery orangioembolization[2]. The first round of blood products made available within 15 minutes

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***UP-PGH Medical Center**

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of activating MTP consists of 4 units packed RBC (type O), 4 units plasma (type AB or A with low anti-B), and 4 units platelet concentrate. Type and match tailors blood product provisions for succeeding rounds. Transfusion is held once bleeding is controlled via clinical assessment and once specific laboratory parameters are met. a series of three short inflations to reach an inspiratory pressure of 40-55cmH206. The last method known was using a volume-controlled ventilation with a low tidal volume computed at 5ml/kg, PEEP of 30 cmH2O and inspiratory plateau pressure of 15cmH2O above PEEP for two minutes immediately after desufflation[7]. Different studies showed the maximal airway pressure needed in order to open the lungs. However, there are limited studies on its role to hemodynamics especially to patients undergoing abdominal laparoscopic procedures.[3]

This study aims to determine the effectiveness of Recruitment maneuver in terms of oxygenation status, hemodynamic stability and post operative pain of patients undergoing laparoscopic cholecystectomy.

CASE DESCRIPTION

A 67-year-old female, categorized under the American Society of Anesthesiologists Physical Status Classification 3 for malignancy, metabolic syndrome, and pulmonary tuberculosis, presented for elective excision of are troperitoneal mass, probably renal versus adrenal cancer.

The mass had been increasing in size for the past 2 months, accompanied by a 10-kilogram weight loss, right flank pain, and postprandial vomiting. The patient is also a known hypertensive for the past 25 years with poor compliance to medications. She was also previously diagnosed with impaired fasting glucose and dyslipidemia. From another wise unremarkable physical examination is a finding of a large, firm, palpable mass occupying the right hemi abdomen. Bloodtests showed mild anemia at 106 g/L (normal range 120-160 g/L). Chest x-ray showed suspicious densities on bilateral upper lung lobes; chest CT showed calcified granulomata for which pulmonary tuberculosis was suspected. Abdominal CT showed a circumscribed mass in the right upper abdomen measuring 16 x 14.5 x 16.5 cm, accompanied by caudal displacement of normal renal parenchyma, compression of the liver, anteromedial displacement of the inferior vena cava, and antero caudal displacement of the hepatic flexure.

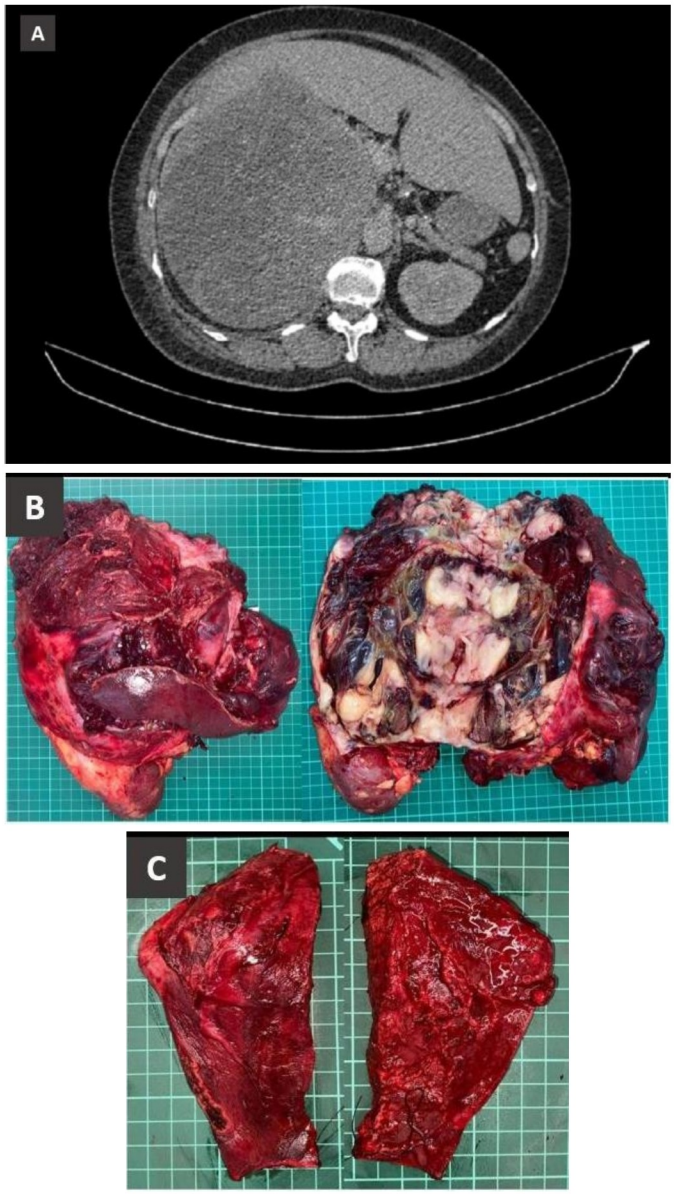

Figure 1. A) Cross-sectional CT of the circumscribed renal mass, **B)** Adrenal en bloc nephrectomy en bloc non anatomic hepaticresection, **C)** liver segment.

Preoperatively, bilateral quadrates lumborum block was done. ASA standard monitors, arterial and central venous access were inserted, and forced air warming was employed. Intubation was done via standard sequence, using the following intravenous medications: fentanyl 100 mcg, propofol120 mg, and atracurium 40 mg. This was followed by placing the patient on right soft flank position. General anesthesia was initially maintained with sevoflurane and neuromuscular blockade with atracurium boluses. A loading dose of tranexamic acid was given at 10mg/kg, then an infusion was run at 2 mg/kg/hour intraoperatively. Packed red blood cells (RBC), frozen fresh plasma (FFP), and platelet concentrate (PC) were transfused starting 2 hours into the surgery. Norepinephrine and epinephrine infusion were also started subsequently, following decreasing blood pressure trends.

Four hours into the operation, anesthetic management was shifted to total intravenous anesthesia due to hemodynamic instability. This was done using intermittent midazolam and fentanyl boluses. At this time, blood loss was at 3,700mL and still rising. Vital signs were as follows: blood pressure 90/50, heart rate 80s-90s, oxygen saturation 100%, and computed pulse pressure variation at 22.At this time, all the blood products prepared for the surgery, namely 10 units each of RBC, FFP, and PC, were already given.

MTP was triggered after all 30 units of blood products were exhausted, 5 hours into the surgery. A total of 3 rounds were called, with the first and second rounds consisting of 4-4-4 (RBC-FFP-PC), and the third round consisting of 4-4-0 due to unavailability of platelet concentrate at the time. MTP was terminated 3 hours after activation. Point-of-care testing was done at multiple points during the procedure to evaluate adequacy of transfusion and correct other derangements, with results as detailed below:

Table1. Laboratory parameters taking before, at various points during, and after surgery.

	Baseline	*1100H*	*1354H*	*1515H*	*1641H*	*1700H*	*1746H*	*1827H*	*2000H*	*2058H*	*Postop*
pH	-	7.415	7.333	7.150	7.149	7.303	7.158	7.26	7.146	7.197	7.244
pO2	-	254.5	242.9	246.9	320	318.0	257.1	284	248	224.6	260.9
pCO2	-	39.3	42.0	54.3	43.3	38.5	36.3	43.2	49.8	52.8	50.8
HCO3	-	25.2	22.3	18.9	15.1	19.1	12.9	19.4	17.2	19.7	21.9
Be(b)	-	0.6	-3.4	-9.4	-12.9	-6.6	-14	-7.3	-10.9	-8.2	-5.3
O2sat	-	99.9	99.9	99.7	99.9	99.9	99.7	99.8	99.7	99.6	99.8
Hgb	106	92	75	74	81	67	79	96	71	86	89
Hct	0.34	0.27	0.22	0.22	0.24	0.14	0.29	0.24	0.21	0.24	0.26
Na	134	139	136	140	141	148	147	149	143	152	155
K	3.7	3.6	4.1	3.9	3.4	3.1	2.9	2.7	3.6	3.7	3.1
iCa	2.21	1.27	1.14	1.01	0.72	0.49	0.68	2.23	1.22	1.26	1.28
Cl	100	-	-	106	108	103	111	107	108	107	111
Glu	-	155	228	357	302	281	240	271	201	216	179
Lac	-	0.56	2.49	6.97	8.45	12.04	12.48	12.54	15.6	18.0	14.32
Crea	70	0.93	0.89	1.0	1.12	1.24	0.96	1.04	1.17	1.08	1.07

Other interventions intra operatively included electrolyte corrections (sodium bicarbonate, potassium chloride, and calcium gluconate) and glucose correction with insulin as guided by the point-of-case test results. Hydrocortisone was also given to address adrenalin sufficiency from the adrenalectomy, noting increasing press or requirements. Vasopressin infusion for hemo dynamic support on top of the norepinephrine and epinephrine infusions was started 10 hours into the surgery; both vasopressin and epinephrine were discontinued by the end of the surgery.

Total operating time was 11 hours and 47 minutes. The complete surgical procedure done was laparotomy, adrenalectomy right, en bloc nephrectomy right, enblocnon-anatomic hepatic resection (segments V and VI), segmentectomy VI, cholecystectomy, tube thoracostomy right, and JP drain insertion. A 18 x 17 cm adrenal mass, grossly adherent to the right kidney and inferior border of the right liver lobe, was removed. Estimated blood loss was 20liters.

Fluid balance is detailed as follows:

Input	Output	Fluid balance
21,150mL RBC6600mL(22units) FFP3300mL(22units) PC900mL(18units) Crystalloids10350mL	23,600mL EBL20000mL UO100mL MF+RF3500mL	-2450mL

RBC: redbloodcells; FFP: fresh frozen plasma; PC: platelet concentrate; EB: estimated blood loss; UO: urine output; MF: maintenance fluid; RF: replacement fluid

Postoperatively, the patient was monitored in the surgical intensive care unit, still intubated and on sedation with fentanyl infusion 1 mcg/kg/hr, as well as press or support. Norepinephrine was discontinued the following day; she was arousable and able to follow commands by the second day postoperatively. She was monitored for complications of massive blood transfusion such as coagulopathy and transfusion-related lung injury using serial blood gas and chest radiographs. She was extubated 8 days after surgery, and was discharged well after another 4 days. She was on regular outpatient follow-up consultations with the urology service afterwards.

DISCUSSION

A protocol for massive transfusion is grounded not only on evidence but also the logistics of the institution using it. As the development of the MTP was initially grounded on trauma surgery principles, the index hospital uses the Assessment of Blood Consumption Score (ABC)[2]. Unlike several other scoring systems, the ABC score relies only on clinical parameters (heart rate >120, systolic blood pressure <90, FAST-positive, and presence of penetrating chest injury) to determine If MTP is warranted. This scoring system by passes the need to collect laboratory data and wait for results prior to using the system, which is advantageous for more resource-limited institutions like the index hospital, where laboratory turnaround times may take longer.

Blood product ratios and the availability of certain blood products are also areas of continued research. Review of literature shows conflicting evidence, with some studies citing FFP, platelet, and RBC ratio to 1:1:1 as conferring survival advantage. Other studies found no benefit to balanced transfusion with regards to either survival or morbidity outcomes[3]. Moreover, the use of whole blood in transfusion therapy has been associated with less total blood products received and increased survival in some studies[4]. In this institution, a pool of RBC, platelet concentrates, and FFP is reserved from the blood bags collected daily by the blood bank for exclusive use of MTP. Whole blood, however, is not available in the institution.

Any delay in the timing of blood transfusion can lead to unfavorable outcomes, such as poor tissue oxygenation, acidosis, coagulopathy, dysfunction in homeostasis and increased mortality. The index hospital algorithm dictates the availability of the first round (4-4-4) within 15 minutes of calling the MTP. While no definitive record was made, a group chat in the messaging app Telegram made specifically for correspondence concerning MTP provides approximations. Acknowledgment of MTP by the transfusion service was made within 1 minute of TP activation. Four units each of RBC and FFP were available 15 minutes after activation, and 4 units platelet followed after another 11 minutes of activating MTP. It must be noted that the operating rooms in the hospital are on a separate floor from the blood bank (approximately 1.5 kilometer away), and thus delivery of the blood products is limited by the designated runner.

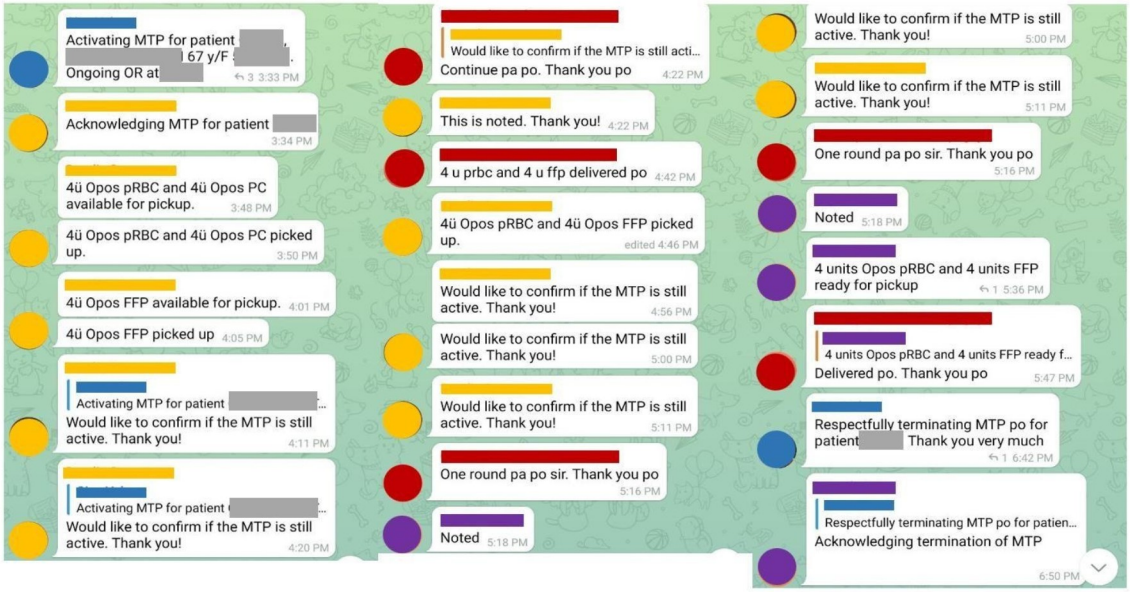

Figure2.Screenshots of the Telegram group chat from when the MTP was activated until termination.

After control of bleeding and resuscitation, adequacy of transfusion is ultimately determined by laboratory parameters. In the operating room, the most accessible means is with repeated point-of-care testing. Towards the end of the surgery, the index case showed an increase in hemoglobin to greater than 70g/dL, blood pressure and heart rate stability, as well as decreasing press or requirement. Standard and rapid thromboelastography as well as rotational thromboelastometry were also discussed in the MTP guidelines but are not readily available in the institution's setting. All blood products brought from the MTP were used for the patient, with no products wasted. As discussed by Paganini and colleagues[5], timely updates among the different services ensures efficient transfusion and minimal wastage. In this case, providers are prompted every 10 minutes whether to continue or terminate MTP. Blood products are not released until the referring service indicates so explicitly via the MTP chat, minimizing wastage.

CONCLUSION

The approach to massive blood loss and conduct of MTP in a low-resource setting, while lacking the sophistication and accuracy present in more well-equipped institutions, does not drastically differ from international standards. Rapid determination of the need for MTP, efficient response and delivery, moment to moment feedback on adequacy of transfusion, and timely termination are key elements to maximize proper execution of the protocol. Along with anticipatory interventions for hypovolemia, blood loss, and complications of transfusion, anesthetic management becomes proactive rather than reactive.

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