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### A Double-edged Sword! Management of Elevated Intracranial Pressure and Massive Transfusion with Minimal Coagulopathy during a Cerebral Tumor Debulking Procedure

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## Introduction

To prevent coagulopathy when excising a large cerebral mass with elevated intracranial pressure (ICP), the dual goals are **brain relaxation** and **blood management**. Coagulopathy due to massive amounts of blood loss and blood replacement may cause postoperative bleeding within the closed cranium. Our aim in this case was to provide adequate brain relaxation and blood management to prevent perioperative coagulopathy.

## Case Description

A 68-year-old female with a large, highly vascular metastatic cerebral mass and elevated ICP presented for a debulking procedure. Our dual goals were to maintain ICP and prevent coagulopathy. Anesthesia was maintained with propofol and remifentanyl total intravenous anesthesia (TIVA) with normocarbida. Mannitol (1 Gm /Kg ) was administered over 30 minutes prior to dural opening. Blood loss (5.3L) was replaced with 3.6 L crystalloids and 1:1:1 of PRBC, FFP and platelets as per principles of damage control resuscitation (DCR). Patient did not develop coagulopathy or thrombocytopenia, was extubated the next day and discharged home in 5 days.

## DISCUSSION

**Why a “double-edged sword”? What are our dual goals?**

1. Management of ICP and brain relaxation
2. Adequate blood management to prevent coagulopathy and postoperative intracranial bleeding

**What are the critical times that increase ICP during the debulking procedure?**

1. Intubation
2. Insertion of Mayfield pins
3. Surgical incision
4. Emergence

## STRATEGIC MEASURES TO PROVIDE ADEQUATE BRAIN RELAXATION / NEUROPROTECTION<sup>1</sup>

*Smooth induction with maintenance of MAP greater than 70 mm Hg (lower end of dynamic autoregulation)*

Transient hyperventilation prior to intubation to prevent hypercarbia during the period of apnea at intubation

*Maintain low peak airway pressures during mask ventilation*

Laryngotracheal spray with lidocaine to prevent hemodynamic response at intubation

*TIVA with propofol and remifentanyl infusions<sup>1,2</sup>*

Avoid volatile anesthetic agents<sup>1,2</sup>

*Remifentanyl bolus 1 mcg/kg at intubation to prevent hemodynamic response*

Remifentanyl bolus 1 mcg/kg prior to insertion of Mayfield pins.

*Continue TIVA with remifentanyl to prevent hemodynamic response to surgical stimulation*

Maintain adequate depth of anesthesia

*Close hemodynamic monitoring with an arterial line*

Administer mannitol 1gm/kg (20% mannitol) over 20 minutes for brain relaxation.

*Avoid rapid injection of mannitol to prevent transient increase in ICP and sudden circulatory overload*

Maintain arterial paCO<sub>2</sub> at 35 mm Hg (lower end of normocarbida)

*Identify PaCo<sub>2</sub> end tidal CO<sub>2</sub> gradient (dead space) using blood gas analysis at frequent intervals and maintain end tidal CO<sub>2</sub> as per this changing dead space.*

Avoid hypocarbida and hypercarbia.

*Maintain normothermia during the entire perioperative period*

Maintain adequate oxygenation throughout the procedure

Maintain normoglycemia

## Principles of DCR<sup>3</sup>

1. Avoid massive amount of crystalloids
2. Hypotensive resuscitation
3. Surgical control of ongoing hemorrhage
4. Withhold blood and blood products, if possible, until hemostasis is achieved
5. Administer blood and blood products at 1:1:1 of packed red blood cells (PRBC), fresh frozen plasma (FFP), and platelets
6. Tranexamic acid (TXA) as anti-fibrinolytic agent to reduce blood loss

## Our Modified DCR

1. Maintain MAP over 70mm Hg to maintain cerebral autoregulation
2. Limit crystalloids
3. Early administration of PRBC/FFP/Platelets at a ratio of 1:1:1 in the pace of slow ongoing hemorrhage during this 8-hour surgery
4. We did not administer TXA

## Our Success Story

- ✓ Patient did not develop coagulopathy or thrombocytopenia
- ✓ No post-procedure intracranial hemorrhage secondary to coagulopathy
- ✓ Patient was extubated the following day
- ✓ Patient was discharged home after 5 days
- ✓ No neurological deficits

## CONCLUSION

**We successfully avoided postoperative intracranial bleeding with our modified DCR technique.**

**Moreover, we successfully provided optimum surgical conditions and brain relaxation to prevent blood loss during this 8-hour surgical debulking procedure of a vascular cerebral tumor.**