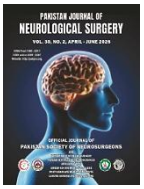

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Editorial

Neurosurgical Procedures in Patients with Liver Cirrhosis

Dear Readers:

In this editorial, I have outlined the challenges and considerations associated with neurosurgical procedures in patients with liver cirrhosis. Neurosurgery in these patients is associated with significantly higher rates of perioperative morbidity and mortality compared with the general population. Clinical decision-making is often complicated by the need to balance the urgency of neurosurgical intervention against severity of hepatic dysfunction. Myriad scenarios involving traumatic brain injury, intracranial hemorrhage, spinal surgery, brain tumors, and cerebrovascular disorders in patients with liver disease require consensus regarding perioperative optimization, risk stratification, and postoperative management. This editorial examines the practical realities of this particular patient population, with a focus on risk stratification and operative decision-making that is relevant to surgeons practicing in Pakistan.

When Crises Intersect: Pakistan has one of the world's heaviest burdens of chronic liver disease secondary to viral hepatitis as well as metabolically associated steatotic liver disease (MASLD)-commonly known as fatty liver disease. Neurosurgeons routinely encounter cirrhotic patients requiring emergency or elective procedures. Neurological pathologies requiring surgical intervention and decompensated liver disease combine to create a physiologically complex surgical scenario. Hemostatic failure, electrolyte imbalance, fluid dysregulation, encephalopathy, decreased immune function and compromised wound healing are significant challenges. Also, the metabolic/fatty liver disease group may bring further compounders to the operating table i.e. heart disease, diabetes and high blood pressure.[1-4]

Significance for the Pakistani Neurosurgeon: The significance stems from the fact that the Pakistani neurosurgeon is already receiving patients in a country where liver disease is endemic. It is therefore inevitable that neurosurgical teams will be called to operate on patients with advanced liver disease as a (major) co-morbidity. Neurosurgical emergencies need immediate intervention, without giving time for attaining optimal liver function in patients with advanced liver disease. Studies show extremely high morbidity, mortality and post-surgical complications after undergoing cranial or spinal surgery in these patients. The presence of hepatic encephalopathy (HE), manifest overtly as confusion, asterixis, and altered sensorium, can blur signs of actual neurological deterioration.[5-7]

Assessing Risk: Using the Child Pugh Score as a guide: The Child-Pugh (CTP) score is the core pre-surgical assessment of the cirrhotic patient. It is widely validated and accessible due to its simplicity, incorporating bilirubin, albumin, INR, ascites, and encephalopathy. Mortality risk differs across CTP classes: Patients with CTP A have a 5-10% risk, approaching that of non-cirrhotic patients. Patients with CTP B have a 20-40% risk and need optimization before elective procedures. CTP C patients have a prohibitive 60-90% risk, and emergency neurosurgery requires detailed prognosis counselling, joint decision making with patients and their attendants, with respect to major surgery on the background of advanced liver disease and multi-disciplinary ICU care. Besides CTP, the Model for End Stage Liver Disease-Sodium (MELD-Na) scores also provide prognostic value, particularly for predicting 90-day outcomes (<10 safe, 10-15 elevated risk, >15 very high risk).[8,9]

Hemostasis and why INR alone is (literally) half the story in cirrhosis: Coagulopathy in cirrhosis is unique, as these patients are technically "balanced out" due to simultaneous reduced production of pro- and anti-coagulant factors. They may bleed due to thrombocytopenia and high PT/INR, but their hemodynamic system favours clot formation. Conventional INR/PT overestimates bleeding risk because it does not reflect the parallel reduction in anticoagulant proteins. Viscoelastic testing with thromboelastography (TEG) provides a better assessment of clot formation, strength, and fibrinolysis. Studies show that TEG parameters can be largely normal in such patients, while mean INR and platelet counts are universally outside normal ranges. INR only evaluates procoagulant factors, while TEG evaluates clot initiation, strength, and breakdown. INR is poor at predicting bleeding risk, whereas TEG accurately guides transfusion needs and predicts bleeding risk. INR is often falsely elevated because the failing liver cannot make clotting factors, missing the body's compensatory mechanisms. TEG, however, accounts for reduced levels of naturally occurring anticoagulants (e.g., Protein C, Antithrombin). Whilst interpreting TEG, an increased r value outside the normal range requires a single unit of fresh frozen plasma. An MA value below normal requires a single unit of platelets. Increased *k*-time or decreased α-angle is managed by a single unit of cryoprecipitate. There is also a "culture" to correct INR with FFP transfusion. This has limited efficacy as the INR "correction" is transient, while FFP carries a risk of TRALI and even thrombotic complications. A 2023 RCT showed no benefit of prophylactic FFP in cirrhotic patients undergoing major surgery. Factor VIIa and fibrinogen should be reserved for refractory hemorrhage. Platelet transfusions are recommended if counts fall below 50×10^9/L. For patients receiving antiplatelet and/or anticoagulant agents, these should be managed following the same guidelines as in patients without cirrhosis prior to surgery [8,10,11]. A well-stocked and managed blood bank is therefore essential.

Challenges for anesthesia and intensive care teams: Cirrhosis represents a state of altered pharmacodynamics of nearly all anesthetic agents. There is reduced hepatic blood flow and hypoalbuminemia with reduced plasma protein binding and a prolonged half-life of drugs (opioids, benzodiazepines, and neuromuscular blockers). Hepatic hydrothorax may need drainage prior to surgery and may routinely recur immediately after. Amongst anesthetic agents, propofol is preferred but may risk hypotension due to preexisting decreased effective intravascular volume in patients with ascites. Sevoflurane and desflurane are also considered safe. For the intensivist, intracranial pressure (ICP) monitoring and management are critical factors, as cerebral autoregulation is impaired. Safety of commonly used drugs combined with electrolyte imbalances make these patients a particular challenge for the anesthetist and intensivist teams. Dexamethasone may affect fluid and electrolyte balance adversely. Mannitol may be used with close monitoring due to the risk of hepatorenal syndrome. Hyponatremia is common, but use of hypertonic saline is only recommended in an ICU setting.

The role of hepatologist in pre and post-operative phases: Besides emergency surgeries that leave no window for pre-operative optimization, procedures where even a 24-hour window may be considered safe by the neurosurgeon provide valuable time for the hepatologist to improve basic hepatic parameters, leading to better outcomes. In elective procedures, whereby a longer pre-operative period may be available, prehabilitation, i.e. a more comprehensive optimization, may be done. In addition to the factors discussed above, nutrition is an often-ignored aspect in these patients as cirrhotics are routinely malnourished and show sarcopenia. Both undernutrition (BMI <18.5 kg/m^2) and marked obesity (BMI >40 kg/m^2), latter seen in cirrhotic patients with MASLD, as well as sarcopenia, lead to increased morbidity and mortality in the pre and post-operative phases. Hence, comprehensive nutritional intervention, by a trained nutritionist, ably guided by the hepatologist, should be implemented before elective surgeries with special focus on treating protein malnutrition [8,12,13]. Post-operatively, up to a third of cirrhotic patients may decompensate (encephalopathy, GI bleed, spontaneous bacterial peritonitis, hepatorenal syndrome). More, if CTP & MELD-Na scores were higher preoperatively. This usually occurs within the first week of surgery. Hence, early and regular coordination with the hepatologists (and other relevant teams such as nephrology, endocrinology and pulmonology) is essential. Similar to the pre-operative phase, nutritional intervention is even more important is a vital component of post-operative optimization, both in the short and long-term periods. A well-balanced nutritional plan will ensure a lower incidence of adverse outcomes.[14]

Conclusion: Neurosurgical procedures on cirrhotic patients represent an inescapable reality in a country like Pakistan, where chronic liver disease secondary to viral hepatitis and metabolic syndrome are among the highest globally. Staging of liver disease severity (with the CTP score) for pre-operative risk assessment, realistic patient/attendant counselling regarding risks/prognosis, meticulous multi-disciplinary ICU care and, most importantly, close liaison with the hepatologist (pre and post-op, short and long term) can lead to more favorable outcomes in this extremely high-risk population.

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