Tracheostomy in critically ill liver disease patients with coagulopathy: A retrospective study at a tertiary center

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ABSTRACT

Introduction: Critically ill patients with liver disease commonly present to the intensive care unit (ICU) with need for prolonged ventilation, difficult weaning, and refractory coagulopathy. These patients experience both bleeding and thrombotic complications with a precarious state of coagulopathy. The purpose of this study was to assess the bleeding complications of tracheostomy in critically ill patients with liver disease.

Methods: A retrospective study was conducted in liver ICU of a tertiary teaching institute. Medical records were analyzed to assess procedure complication rate among 73 critically ill liver disease patients who had undergone tracheostomy during the period of October 2017 to September 2018.

Results: Ten out of 73 patients (13%) required transfusion of blood products after 12 h of procedure, despite thromboelastography (TEG)-based correction prior to procedure. Of these, 7 patients (9%) underwent surgical tracheostomy (ST) and three patients (4%) underwent percutaneous tracheostomy. Statistically no significant difference in bleeding was seen among the two groups, but a rising trend was seen with the ST group (P = 0.52). None of the patients experienced procedure-related pneumothorax and subcutaneous emphysema, as observed in the chest X-ray.

Conclusion: We conclude that coagulopathy should not be a deterrence for the performance of tracheostomy in critically ill patients with liver disease. Adequate clotting support guided by the global tests of coagulation, such as TEG, ensures lesser incidence of bleeding.

Key Words: Bleeding, coagulopathy, liver disease, tracheostomy

INTRODUCTION

Tracheostomy is one of the commonly performed procedures in critically ill patients requiring prolonged mechanical ventilation, weaning from assisted mechanical ventilation, airway suction, and airway protection.[1] Percutaneous tracheostomy (PCT) is the popular choice currently due to fewer airway manipulations, low risk of bleeding, and lower incidence of hypoxia and hypercarbia.[1] It also avoids the risk of transport of critically ill patients to the operating room. Surgical tracheostomy (ST) is reserved for cases with difficult anatomy, emergency situations, or when the percutaneous technique fails.[1]
Critically ill patients with liver disease commonly present to the intensive care unit (ICU) with need for prolonged mechanical ventilation and refractory coagulopathy. Liver disease causes changes in both the pro-hemostatic and anti-hemostatic pathways, resulting in a net balance.[3] Therefore, it has been postulated that routine correction of coagulopathy is not required before invasive procedures in patients with end-stage liver disease.[3] However, this balance is precarious and unstable compared to healthy individuals.[3] This explains the potential of bleeding and thrombotic complications in patients with liver disease.

The objective of this retrospective study was to study the incidence of early complications of bleeding, pneumothorax, and subcutaneous emphysema for up to 12 h after tracheostomy in patients with liver disease. We also aimed to compare the complication rate between ST and PCT in patients with liver disease.

**METHODS**

**Study design**

After institutional ethics committee approval, retrospective data were collected for adult patients with liver disease admitted in the ICU, who had undergone tracheostomy during the period of October 2017 to September 2018 at our institute. Patients with age < 18 years and those undergone tracheostomy in an outside institute were excluded. Data collection was done by going through electronic and scanned records in the medical record department. Demographic characters of age, sex, and etiology of liver disease were noted. Preprocedure international normalized ratio (INR), platelet count, thromboelastography (TEG)-based coagulation index (CI), and blood products transfused were recorded. Severity of illness was assessed with Sequential Organ Failure Score (SOFA), Child–Turcotte–Pugh score (CTP), and Model for End-Stage Liver Disease Sodium (MELD Na) score. Postprocedure complications of bleeding, pneumothorax, subcutaneous emphysema, and blood products transfused were recorded for up to 12 h after the procedure.

**Setting**

The study was conducted in a 20-bed ICU dedicated to critically ill patients with liver disease. PCT was performed by a single experienced operator. ST was performed in case of short neck, obesity, inability of neck extension, and unavailability of the operator. Decision for tracheostomy was taken by the clinician in charge of ICU. ST was performed by any one of the five surgeons doing the procedure at our institute.

**Definitions**

ST was defined as the placement of a tracheostomy cannula under direct vision after dissection of pretracheal tissues and incision of tracheal wall in the operation theater. PCT was defined as the blunt dissection of pretracheal tissues followed by serial dilatation of trachea over the guide wire and insertion of tracheal cannula using Seldinger technique at the bedside of the patient. Coagulopathy was defined as a platelet count of < 50 x 10⁶ cells/L or INR ≥ 1.5 or TEG derived CI < 3, single criteria or any combination on the day of tracheostomy.[4] Bleeding was defined as continuous stoma bleeding persisting after placement of the tracheostomy tube with hemoglobin drop of at least 1 g% and requiring transfusion of blood products.[3]

**Statistical analysis**

Mean ± standard deviation was used for normally distributed continuous variables, while median with interquartile range for data if not normally distributed and as percentage for counts. The Chi-square test was used to determine whether abnormal test results were associated with an increased risk of bleeding. Unpaired t-test was used for comparing parametric data between groups and Mann–Whitney rank sum test for nonparametric data. Chi-square analysis and Fisher’s exact test were applied as appropriate for comparing proportions between groups. Receiver operating characteristics analysis was used for determining area under the curve and cutoff values. Sensitivity, specificity of clotting index, and laboratory parameters were calculated. All statistical tools were two tailed, and a significant level P < 0.05 was used using IBM® SPSS Statistics version 22 (IBM Corp., Armonk, USA).

**RESULTS**

There were 723 admissions to the ICU in the study period. Out of these, 280 patients required mechanical ventilation. Seventy-three patients underwent tracheostomy in the study period. All the 73 patients were coagulopathic as per laboratory parameters, of which 10 patients bled (13%). Out of the 73 patients, 49 were found to be coagulopathic according to TEG. Out of the 49 patients with abnormal TEG, 10 (20%) developed postprocedure bleeding necessitating transfusion [Table 1]. Patients those who had significant bleeding had a higher CTP score, elevated INR, a deranged CI on TEG, and an increased duration of mechanical ventilation compared to those who did not bleed [Table 2].

The AUC for INR as predictor of bleeding was 0.88 [Figure 1], with a cutoff of 2.83, showing a sensitivity of 80% and a specificity of 82.5% [Table 3]. The AUC for the CI as predictor of bleeding was 0.92 [Figure 2], with a cutoff of 3.3, showing a sensitivity of 90% and a specificity of 85.7% [Table 3].

Out of the 73 patients, 42 underwent ST and 31 patients underwent PCT (Griggs method). There was no missing data in any of the patients.
Those undergoing ST were in the higher age group as compared to the PCT group. This difference was statistically significant [Table 4]. The distribution of patients with diagnosis of acute-on chronic liver failure and chronic liver disease was comparable in both groups. No patient with acute liver failure underwent an ST. The severity of liver disease and overall illness was comparable in both groups as shown by CTP, MELD Na, and SOFA scores. The duration of mechanical ventilation prior to tracheostomy did not differ between the two groups. Severity of disease and duration of mechanical ventilation was comparable among the groups [Table 4]. Platelet count and clotting index were comparable in both groups, but the INR was higher in ST group [Table 5].

**Complications**

Ten out of the 73 (13%) patients required transfusion of blood products within 12 h of procedure [Table 6]. Of these, seven patients (9%) had undergone ST and three patients (4%) had undergone PCT. Statistically no significant difference in bleeding was seen among the two groups, but a rising trend was seen with ST group of patients. None of the patients had pneumothorax and subcutaneous emphysema as observed in postprocedure chest X-ray.

**DISCUSSION**

Endothelial dysfunction, bacterial infection, and renal failure are considered to be important contributors to coagulopathy in patients with liver disease.[3] Apart from this, the presence of thrombocytopenia and sepsis in critically ill patients with liver disease is found to increase the risk for bleeding.[6] In our study, all our patients fulfilled the definition of coagulopathy according to laboratory parameters, out of which 13% (10/73) had significant bleeding. Among those who were coagulopathic according to TEG variables, 20% (10/49) had significant bleeding. A number of invasive procedures such as central venous cannulation, thoracentesis, and paracentesis have been studied in patients with liver disease to evaluate the risk of bleeding,[4,7] The results of these studies have established the superiority of the TEG over conventional laboratory parameters for prediction of bleed. Apart from coagulopathy, local complications can also contribute to significant bleeding in these patients, whose coagulation status is precariously balanced.[7]
We found that clottability index as a significant predictor of bleeding. We have also compared the incidence of bleeding complications between patients undergoing ST and PCT. There has been an increased incidence of bleed with ST, however this difference was not found to be significant. Therefore, ST can be offered in liver disease patients in whom PCT may not be possible, after adequate correction of TEG. The overall SOFA score and MELD Na were high, indicating the severity of liver disease as well as illness in this group of patients. Auzinger et al. also reported a higher mortality due to increased severity of illness (median Acute Physiology and Chronic Health Evaluation II score = 19) in these group of patients. Assessment of mortality was not a part of our study design. We found that the higher CTP score was significantly associated with the risk of bleeding, but not the MELD Na or SOFA score. This could be due to INR, which is a component of CTP score, and has been found to be a significant predictor of bleed in our study.

We found INR with cutoff value >2.83 to be a significant predictor of bleed. This result is similar to that of Pandey et al.,[4] who found that an INR of >2.6 was a significant predictor of bleed in patients with liver disease undergoing central venous cannulation. TEG variables have been found to be better predictors of bleed in patients with liver disease.[4,10] They measure changes in clot tensile strength over time and give information on the dynamics of clot formation (coagulation factor and anticoagulant activity), clot strength (platelets and fibrinogen), and clot stability.[11] In our study, we found that, CI with cutoff value <−3.3 was a significant predictor of bleeding in liver disease patients undergoing tracheostomy.

Table 5: Coagulation profile in both the groups

| Lab parameters | Overall | ST | PCT | P    |
|----------------|---------|----|-----|------|
| Hemoglobin, g/dl | 8.3 (7.5–10.5) | 8.2 (7.5–10.5) | 8.3 (7.6–9.2) | NS   |
| Platelets, k/µl | 79 (27–176) | 79 (27–176) | 80 (40.5–132) | NS   |
| INR            | 2.42    | 2.77 | 2.34 | 0.001|
| CI             | (1.74–3.32) | (1.74–3.32) | (1.74–2.94) | NS   |
| (-3.56–−1.18) | (-3.56–−1.18) | (-3.31–1.72) |           |      |

NS: Not Significant; CI: Coagulation index; INR: International normalized ratio, ST: Surgical tracheostomy, PCT: Percutaneous tracheostomy

Table 6: Bleeding complications in both the groups

| Bleeding complications, n (%) | All (n = 73) | ST (n = 42) | PCT (n = 31) | P |
|-------------------------------|-------------|------------|-------------|---|
| 10 (13.70)                   | 7 (16.66)  | 3 (9.67)   | 0.52        |

ST: Surgical tracheostomy, PCT: Percutaneous tracheostomy

Figure 2: Clottability index as a significant predictor of bleeding
CONCLUSION

We conclude that coagulopathy should not be deterrence for the performance of tracheostomy in critically ill patients with liver disease. Adequate clotting support guided by the global tests of coagulation such as TEG ensures lesser incidence of bleeding. A prospective study which studies the long-term complications and outcome of this procedure in this group of patients will be more useful.

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Nil.

Conflicts of interest
There are no conflicts of interest.

Ethical conduct of research
This study was approved by the Institutional Review Board / Ethics Committee. The authors followed applicable EQUATOR Network (http://www.equatornetwork.org/) guidelines during the conduct of this research project.

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