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Early Ambulation Does Not Affect Outcomes in Patients with Low-Grade (Grade I–II) Splenic Lacerations or Hematomas

Traumatic injuries are the leading cause of death in patients younger than the age of 45[1] years, with 20 to 25 per cent of all polytraumatized patients having intra-abdominal injuries[1] and 40,000 blunt splenic injuries occurring annually in the United States. Generally, splenic injuries have been treated with nonoperative management (NOM) for hemodynamically stable low-grade (grade I–II) splenic injuries.[1, 2] NOM includes bedrest to prevent delayed hemorrhage because teleologically, movement or an unintended patient fall could disrupt the clot overlying a splenic injury and lead to delayed hemorrhage, even up to several days after the initial trauma. This supposition has been contested in recent years, especially in pediatric trauma patients.[3] Abbreviated bedrest (24 hours) is shown to be safe and does not increase failure rates of NOM;[3, 4] the day of mobilization is not associated with an increased risk of delayed hemorrhage[4] in low-grade splenic injuries (LGSI). The present guidelines produced by the Eastern Association for the Surgery of Trauma do not specify whether bedrest is necessary and question the efficacy of bedrest in preventing delayed splenic hemorrhage.[4] At our institution, we evaluated the safety and complications of early ambulation within 24 hours in LGSI to evaluate clinical outcomes, such as length of stay (LOS), development of pneumonia, pleural effusions, and venous thrombosis and embolism. We hypothesized that early ambulation will not increase the risk of delayed hemorrhage and subsequent failure of NOM.

Our former NOM guideline for LGSI prescribed an abbreviated bedrest of one day. We reviewed our institution's Trauma Quality Improvement Program (TQIP) database from May 2015 to September 2016 to identify patients with the following characteristics: aged 18 to 99 years with splenic injuries (all grades) diagnosed on CT scan. This retrospective group identified 260 patients. In July 2017, we modified our protocol to ambulate patients with LGSI within 24 hours if they met these criteria: were not intubated within the first 24 hours, patients with full weight bearing status (determined by an orthopedic consultant), and no other injuries that could prevent early mobilization (previous amputation, multiple sclerosis, contractures, *etc.*). This second group was the prospective group and included patients from July 2017 to December 2018; 135 patients were identified with splenic injuries. We excluded in both groups grade III–V splenic injuries diagnosed on CT scan, intubated within the first 24 hours, immediate (within 6 hours) operative or interventional radiology intervention, nonweight bearing status, or any other injuries that prevented mobilization. This resulted in 100 patients in the retrospective group and 63 patients in the prospective group. Our institution's NOM entails monitoring patients with close laboratory and clinical monitoring. If they remain hemodynamically normal, they can be discharged with a close clinic follow-up. Our primary endpoint was failure of NOM within the hospital LOS, up to seven days. Our secondary endpoints were deep venous thrombosis (DVTs), pulmonary embolism (PE), pneumonia, splenic abscess, pleural effusion, deaths, and mean LOS. We defined early ambulation as ambulating >100 feet three times per day with assistance within the first 24 hours after injury with nursing staff, physical therapy, or ancillary staff. Categorical data, such as gender, failure of NOM, DVT, PE, pneumonia, splenic abscesses, pleural effusions, and death, were analyzed with chi-squared test and Fisher's exact test. Continuous data, such as LOS and age, were analyzed using Independent samples' *t* test. We used a P value of <0.05 for the determination of statistical significance. Statistical analysis was performed using SPSS version 25 (IBM, Armonk, NY).

The retrospective group consisted of 60 (60%) males and 40 (40%) females. The mean age was 41.69

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years (SD of 18 years) and median age of 40 years. The majority (97%) of patients were identified as white, with 2 (2%) identified as black. The prospective group consisted of 63 patients, of whom 44 (69.8%) were males and 19 (30.2%) were females. The mean age was 48.9 years (SD of 19.95) and median age of 51 years. Again, the majority (96.8%) of these patients identified as white, with 2 (3.2%) identified as black. The only statistically significant difference between the two groups was the mean age, with a *P* value of 0.02. Of the 163 total patients evaluated in both groups, 100 (61.3%) patients were on bedrest for at least 24 hours after their injury and 63 (38.7%) were ambulated within the first 24 hours. In the prospective group, there were no failures of NOM; in the retrospective patients, 6 (6%) failed NOM. This resulted in 3.7 per cent of the total 163 patients who failed NOM and this difference demonstrated a *P* value of 0.083 based on a chi-squared analysis. Regarding the secondary outcomes, there were no instances of DVT and PE. There were thee cases of pneumonia, with one case diagnosed in the prospective group and two cases in the retrospective group; this was not a statistically significant difference ($P = 1.0$). Only one splenic abscess was diagnosed in the retrospective group, but none in the prospective group ($P = 1.0$). There was an increased number of pleural effusions diagnosed in the prospective group (7 *vs* 5). Despite the increased incidence in the prospective group, this was not statistically significant ($P = 0.22$). One patient in the study populations died (retrospective) and this was unrelated to the patient's LGSI. The other outcome evaluated was LOS, with an average LOS of 4.71 days in the retrospective group (SD of 4.10 days) and 5.45 days in the prospective group (SD of 6.10 days). This was not a significant difference, with a *P* value of 0.357.

Our hypothesis for this study was valid—early ambulation did not increase the rate of failure of NOM for LGSI in our patient population. NOM of blunt splenic injuries has changed greatly over the last 30 years,[2, 3] but the practice of bedrest persists despite little evidence to support its clinical impact. Some studies have demonstrated an abbreviated bedrest protocol is effective and can reduce ICU and overall LOS in pediatric populations,[3] but this has not been well studied in adult populations. Even within the Eastern Association for the Surgery of Trauma guidelines for managing blunt splenic trauma, there is not a well-defined length for bedrest recommendations.[3, 4] Most splenic ruptures and splenectomies occur within 72 hours of presentation with a 0.27-1.4 per cent risk of delayed rupture in the outpatient setting, where patients are ambulatory and not monitored.[4] We examined 100 patients in our trauma population at UT Medical Center in Knoxville on a 24-hour bedrest protocol and compared their outcomes with those of 63 patients ambulated within the first 24 hours. These patient populations were comparable in their patient demographics, other than the mean age of the prospective group being slightly older. We had an overall failure rate of NOM of 3.7 per cent, which is less than the reported average of 7.7 per cent in a meta-analysis performed by Bhangu et al.[2] Based on the initial 395 patients who were selected from our TQIP database with a splenic injury (all grades), 20 of them failed NOM (5.1%); 70 per cent of these were grade III. Our data demonstrate early ambulation did not increase the incidence of NOM failure, supporting the results of the prospective study by Wang et al.;[3] but their study group only included nine patients with LGSI ambulated within 24 hours. Of our secondary outcomes, we found a higher incidence of pleural effusions in the prospective group with seven diagnoses (11.1%), resulting in a 3.5 times higher odds ratio. Five of these patients had a pleural effusion or hemothorax present on admission; the causation is questionable. The LOS was longer in the prospective group by almost 24 hours, contrary to what we hypothesized. Although not statistically significant, it can greatly increase health-care costs. It is possible the older mean age of the prospective group was contributory, as pre-injury comorbidities (Chronic Obstructive Pulmonary Disease, Coronary Artery Disease, *etc.*) may have impacted meeting discharge goals. Other secondary outcomes were not different between the two groups. Although we are excited that we had no NOM failures in the prospective group, this is the most significant limitation to the study. Patients with LGSI who failed NOM were excluded by our other criteria for establishing the study patient population. Based on the lack of significant differences between the groups, our observation that early ambulation did not increase the rate of NOM failure is a non-inferiority statement. We hope that other institutions will begin examining their bedrest protocols and examine the impact of early ambulation in LGSI.

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