ABSTRACT
Introduction: Pain control following traumatic rib fractures is essential to avoid respiratory complications and prolonged hospitalization. Narcotics are commonly utilized, but associated with multiple side effects. Adjuvant medications, such as ibuprofen, may be beneficial. Hypothesis: Early IV ibuprofen (IVIb) decreases narcotic requirement following traumatic rib fractures.

Methods: A retrospective review of traumatic rib fracture patients managed according to a predefined guideline was performed at a Level I trauma center. Unless contraindicated, patients received IVIb for at least 48 hours following admission before conversion to oral ibuprofen. Patients who received IVIb and narcotics for pain control (Treatment) were matched by age and number of rib fractures to patients who received narcotics alone (Control). Pain medication requirement was evaluated for the first 7 days of hospitalization. All medication dosages were converted to either IV morphine or IVIb equivalent to facilitate comparison. Complications related to ibuprofen administration were collected. Data are reported as mean ± standard deviation and compared using Mann-Whitney U-test.

Results: 21 Treatment patients were matched to 21 Control patients with respect to age (52 ± 14 vs. 53 ± 16 years; p=0.83) and rib fractures (5 ± 3 vs. 4 ± 2; p=0.73). Mean daily IVIb dose was 2070 ± 880 mg. Mean daily IV narcotic dose was 19 ± 16 vs. 32 ± 24 mg (p<0.0001). Daily narcotic requirement did not differ between Treatment and Control groups on Day 1 or Day 2. However, narcotic requirement was significantly decreased in the Treatment group on each of Days 3 through 7 (p<0.05). Hospital days were 4.4 ± 3.3 vs. 5.4 ± 2.9 days (p=0.17). There were no significant complications associated with ibuprofen therapy.

Conclusions: Early IVIb therapy in patients with traumatic rib fractures treated with narcotics decreases narcotic requirement and results in clinically significant decreases in hospital length of stay (LOS). It is well tolerated without complications. IVIb should be started upon admission to augment pain control. A prospective study is warranted.

INTRODUCTION
Pain management for traumatic rib fractures can be a challenge. Inadequate pain control can result in significant respiratory insufficiency, pneumonia, need for prolonged mechanical ventilation, and even death. Narcotic analgesics are the core of pain management therapy, but are associated with multiple side effects. Adjuvant medications, such as ibuprofen, are frequently used to reduce the narcotic dose necessary to achieve pain control. Intravenous ibuprofen (IVIb) (Caldolor®, Cumberland Pharmaceuticals, Nashville, TN) has recently become available and could improve rib fracture pain management and reduce the risks of narcotic administration.

The purpose of this study is to determine whether adjunctive IVIb therapy in patients with traumatic rib fractures is an effective pain management therapy and reduces the need for narcotics.

METHODS
A retrospective chart review was performed analyzing traumatic rib fracture-related pain management among patients treated at the Level I trauma center at Orlando Regional Medical Center (ORMC). This study was approved by both the ORMC and UCF College of Medicine Institutional Review Boards. Traumatic rib fracture-related pain was treated according to a predefined clinical guideline with either narcotics or IVIb or narcotics alone depending upon whether contraindications to IVIb were present (long-bone fracture, allergy, history of gastrointestinal bleeding/ulcer, or acute intracranial hemorrhage). Unless contraindicated, patients received IVIb for at least 48 hours following admission before conversion to oral ibuprofen. Exclusion criteria included age ≥ 18 years and pre-existing rib fractures. Exclusion criteria included initial intensive care unit admission/intubation that precluded pain assessment. Narcotics were titrated to achieve patient comfort while IVIb was dosed at 600-800 mg IV Q 6 hrs.

Patients receiving both IVIb therapy and narcotics (Treatment) were matched by age, number of rib fractures, and mechanism of injury to patients who received narcotics alone (Control). Pain medication requirements during the first 7 days of hospitalization were analyzed. Oral ibuprofen dosages were converted to an IV equivalent and all narcotics (morphine, fentanyl, hydromorphone, oxycodone) were converted to an IV morphine equivalent to facilitate data analysis. Patient demographics, thoracic abbreviated injury score (AIS), Injury Severity Score (ISS), number of rib fractures, mechanism of injury, and daily pain scores were recorded. Ibuprofen-related complications were noted. Data are reported as either percentage or mean ± standard deviation and compared using either Fisher’s Exact test or Mann-Whitney U-test.

RESULTS
Twenty-one Treatment patients were compared to 21 Control patients. The two study groups were well-matched with regard to age, mechanism of injury was motor vehicle-related trauma (71% vs. 62%; p=0.74), Hemo/pneumothorax (71% vs. 62%; p=0.74), tube thoracostomy (33% vs. 43%; p=0.75), clavicle fracture (19% vs. 14%; p=1.0), and scapula fracture (14% vs. 29%; p=0.45) were similar between groups. One-third of patients in each group had no associated injuries. There was no difference in the need for operative intervention (0% vs. 14%; p=0.23). There were no mortalities in either group.

Mean daily IV narcotic dose was significantly different between Treatment and Control patients (Table 2). Daily pain scores were consistently lower in the Treatment patients (Figure 1). Daily narcotic requirement did not differ between the study groups on Day 1 or Day 2; however, narcotic requirement was significantly decreased in Treatment patients on each subsequent day of therapy (Days 3 through 7) (p<0.05) (Figure 2). On average, Treatment patients stayed in the hospital one day less than Control patients. There were no significant differences in either pharmacy or hospital charges.

No patient in either group developed pneumonia or renal dysfunction. One patient in each group required tracheostomy; the indication was enteral secretion clearance, and may also decrease mechanical ventilation. Enteral NSAID administration is not always possible and achieving adequate blood concentrations has an inherent delay. IVIb facilitates early NSAID administration, reducing the narcotic dose required and achieving better pain control. This may decrease the risk of acute respiratory failure, due to inadequate spontaneous tidal volumes and decreased pulmonary secretion clearance, and may also decrease hospital length of stay as a result.

CONCLUSIONS
Early IVIb therapy in patients with traumatic rib fractures significantly decreases narcotic requirements and results in clinically significant decreases in hospital length of stay. IVIb should be given upon admission to augment pain control. A prospective study to evaluate the efficacy of IVIb therapy in traumatic rib fracture patients is warranted.