Title of Presentation
Motor vehicle protective device usage associated with decreased rate of flail chest: a retrospective database analysis

Background
Protective equipment, including shoulder belts, lap belts, and airbags, have dramatically reduced the morbidity associated with motor vehicle collisions (MVCs). Although generally associated with reduced rate of injury, protective equipment has been shown to alter injury patterns in abdominal trauma and orthopedic injuries. The effect of motor vehicle protective equipment on patterns of chest wall trauma is unknown. We hypothesized that protective equipment would affect the rate of flail chest after MVC.

Methods
This was a retrospective analysis of the 2019 iteration of the American College of Surgeons Trauma Quality Program (ACS-TQP) database. Patients with age $\geq$ 16 years with rib fracture after a MVC, as described by primary external cause coding, were included. Patients were excluded for missing if automobile protective devices was unknown or missing and/or missing pre-existing condition coding. Rib fracture type was categorized non-flail chest rib fractures (single or multiple rib fractures) and flail chest using ICD-10 diagnosis coding. The primary outcome was occurrence of flail chest. Patients were categorized by protective devices as defined by pre-existing ACS-TQP variables. 2 types of
protective equipment were evaluated, seatbelts (categorized as none, lap belt, or shoulder belt) and airbags (categorized as not present, present and not deployed, or deployed). Other variables of interest included age, sex, Abbreviated Injury Scale (AIS) scoring in non-chest regions, and pre-existing conditions. We performed bivariate analysis of risk factors for flail chest injury using Chi-Square or rank sum test. To reduce confounding, we also performed a multivariate logistic regression examining the interaction of seatbelts and airbags.

Results
The analysis includes 25,101 patients with rib fractures after motor vehicle collisions who met inclusion criteria, and included 4,704 single rib fractures (18.7%), 19,506 multiple rib fractures (77.7%), and 891 flail chest injuries (3.6%). The demographic characteristics of the patients is shown in table 1. In bivariate analysis, the severity of the rib fractures was associated with seatbelt type, airbag status, smoking history, and history of CVA.

In multivariable analysis, seatbelt use (lap belt OR 0.72 CI 0.57-0.90, shoulder belt OR 0.73 CI 0.63-0.86) and airbag deployment (OR 0.76 CI0.65-0.89) were each independently associated with decreased rate of flail chest (table 2). However, in an interaction analysis (table 3), flail chest was only reduced when a lap belt was used in combination with the deployed airbag (OR 0.59 CI 0.43-0.80), when a shoulder belt was used without airbag deployment (0.69 CI 0.49-0.97), or when a shoulder belt was used with airbag deploying (0.57 CI 0.46-0.70).

Conclusion
Although motor vehicle protective equipment is associated with decreased rate of flail chest after motor vehicle collision, the benefit is only when lap belt and airbags are used simultaneously or a shoulder belt is used (with or without airbag). There was no decrease in flail chest rate among unbelted passengers when airbags deployed. These data highlight the importance of occupant seatbelt use compliance, and suggest synergy in motor vehicle restraint systems in reducing severe chest wall injuries.