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Clinical Question: How closely related is the seat belt sign with intra-abdominal injuries in children with blunt torso trauma in motor vehicle collisions, and what is the significance of this sign?

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Introduction: There have been prospective studies and a review of crash injury network data indicating an association between the presence of the "seat belt sign" and intra-abdominal injury in adults. Pediatric studies of this matter have consisted primarily of case series or retrospective reviews. A large, prospective multi-center study examining the signs implications in children had not previously been conducted.

Methods:
STUDY POPULATION: The study was conducted at 20 pediatric EDs in the Pediatric Emergency Care Applied Research Network. 3,740 patients with blunt torso trauma were enrolled. This study included patients under the age 18 with blunt abdominal trauma after MVCs who were evaluated in the ED with presence or absence of seat belt sign documented during that initial evaluation. The median age was 12.2 years and 52% were female. They excluded children with pre-existing neurological disorders, traumatic injuries that occurred greater than 24 hours prior to presenting to the ED, and those who were transferred to a study ED after already having an abdominal CT.

DESIGN: A large, multi-center prospective study of children with blunt torso trauma. The ED physician completed an H&P. Clinical data was recorded prior to CT results or clinical outcomes were known. Abdominal CT was obtained at the physician's discretion. Seat belt sign was defined as "a continuous area of erythema, ecchymosis, or abrasion across the abdomen secondary to a seat belt restraint." Abdominal pain was recorded in those patients older than 2 years of age and not evaluated in those under the age of 2. Patients were divided into two cohorts based on the presence of seat belt sign or its absence.

OUTCOME MEASURE: "The main outcome was intra-abdominal injury undergoing acute intervention defined by 1) therapeutic laparotomy, 2) angiographic embolization of an actively bleeding abdominal organ or other abdominal organ or other abdominal vascular structure, 3) blood transfusion for intra-abdominal hemorrhage, 4) administration of intravenous fluids for two or more nights in patients with pancreatic or gastrointestinal injuries, or 5) intra-abdominal injury resulting in death. The secondary outcome was intra-abdominal injury identified by any modality (e.g. CT, laparotomy, autopsy)."

STATISTICS: For each cohort, the relative risk of intra-abdominal injury undergoing acute intervention was determined. They additionally determined the relative risk on intra-abdominal injury identified by any modality for each cohort. This study also estimated the relative risk of injury to specific organs: GI, spleen, liver, kidney, and pancreas. Researchers used multivariable regression analyses to identify the independent association of the seat belt sign with the two outcomes, adjusted for the following variables: vomiting, age-adjusted hypotension, GCS score less than 14, evidence of thoracic trauma, costal margin tenderness, decreased breath sounds, abdominal abrasion/contusion other than seat belt sign, and abdominal pain and/or tenderness.

Results: Of the 3,740 patients enrolled, 585 (16%) had seat belt signs. Of the 1,864 patients undergoing definitive abdominal testing such as CT, laparotomy or autopsy, intra-abdominal injuries were more common in patients with seat belt signs than those without them (19% vs. 12%, RR = 1.6, 95% CI = 1.3 to 2.1). 6.7% of patients had intra-abdominal injuries undergoing intervention. Of the 16% of patients with seat belt signs, 14.4% had intra-abdominal injuries and 6.8% had intra-abdominal injuries undergoing intervention. 50% of patients underwent definitive abdominal testing. Of those, with seat belt signs and definitive testing, 18.8% had intra-abdominal injuries and 9% had intra-abdominal injuries undergoing intervention. The rate of CT scanning was higher among those with seat belt signs with and absolute difference in rates of 31%. Of the 6.7% of patients with intra-abdominal injuries, 71% had solid organ injuries, 25% had

hollow viscous or mesentery injuries, and 6% had pancreatic injuries. Those with a seat belt sign were more likely to undergo intervention (RR = 4.5, 95% CI = 3.0 to 6.8) than those without. The presence of a seat belt sign was an independent predictor of intra-abdominal injury (RR = 1.8, 95% CI 1.3 to 2.4). A total of 1,714 patients did not have a seat belt sign, complaints of abdominal pain on initial history, or abdominal tenderness on initial physical exam and also had GCS scores of 14 or 15. Of these patients, 28% underwent CT scanning. 1.9% of these 1,714 patients had intra-abdominal injuries identified and 0.3% underwent acute intervention (three solid organ angiographic embolizations and two blood transfusions).

Discussion: Children with seat belt signs are more likely to have intra-abdominal injuries, mostly due to increased risks of GI injuries. There was no increased risk of solid organ injury identified. Patients with seat belt sign were 4.5 times more likely to undergo intervention and 9.5 times more likely to undergo laparotomy. 2% of patients with seat belt sign but without initial abdominal pain or tenderness and with GCS scores of 14 or 15 had injuries that underwent intervention. However, given the independent association of seat belt sign with intra-abdominal injury, despite the lower risk, additional evaluation is usually warranted in these patients with seat belt sign but without initial abdominal pain. This could include observation, laboratory screening, or CT scanning.

Limitations: Suggesting a certain degree of evaluation bias, the rate of CT use was higher among those patients with seat belt sign. Some of those patients with seat belt sign who were not imaged may have also had clinically silent injuries. Patients may also have been discharged from the ED with undiagnosed injuries; however, there was a one-week follow-up call to these patients was made. Further research is needed to determine the appropriate evaluation of those patients presenting with seat belt sign but without abdominal pain.