THORACOLUMBAR SPINE EVALUATION AND SCREENING AFTER TRAUMA

THE T.E.S.T. STUDY

STUDY PROTOCOL

Version V

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BACKGROUND

Traumatic fracture of the thoracolumbar spine is a common sequelae of severe blunt force trauma.[1] These injuries can be highly clinically significant, associated with both poor short- and long-term outcomes[2] and have been shown to directly impact health-related quality of life.[3] The early detection of those at highest risk for fractures of the thoracolumbar (TL) spine is important not only for stabilization and the prevention of neurologic deterioration, but also for optimizing resource utilization by appropriately selecting out those patients who require screening imaging with CT scanning.

The development of effective clinical screening criteria however, for reliably identifying those at greatest risk for TL spine fractures and therefore require imaging, remains a challenge. Although practice guidelines for clearance of the cervical spine following blunt trauma utilizing the NEXUS[4] or Canadian C-spine[5] Rules have been well validated, the development of similar guidelines for injuries of the thoracolumbar region has proven disappointing.[6-8] To date, no single screening test or constellation of findings on history or clinical examination has demonstrated adequate sensitivity for the detection of these injuries.

Recently, our research group completed a prospective observation trial aimed at determining the sensitivity and specificity of a protocolized, structured clinical examination for the evaluation of the thoracolumbar spine in trauma patients injured after blunt trauma. The results of this study demonstrated that clinical examination as a stand-alone screening tool for evaluation of the thoracolumbar spine was inadequate, with a sensitivity of only 48.2% for all fractures and 78.4% for clinically significant fractures, requiring operative intervention or thoracolumbar spine orthosis (TLSO). In this series however, all of the clinically significant missed fractures were diagnosed on a CT that was obtained for evaluation of the visceral torso.

A combination of both clinical examination and CT screening based on mechanism will likely be required to ensure adequate sensitivity with an acceptable specificity for the diagnosis of clinically significant injuries of the thoracolumbar spine. Further research is warranted, specifically targeting the at risk patient with a negative clinical examination, to determine what injury mechanisms warrant evaluation with a screening CT.

RATIONALE

There is a lack of evidence-based data to support a diagnostic algorithm that can determine which patients will require screening imaging of the TL spine. The purpose of this prospective observational study is to determine which injury mechanism characteristics and clinical findings warrant screening imaging of the TL spine with a high sensitivity but adequate specificity so that unnecessary radiation exposure is minimized. This will allow for the development of evidence-based guidelines for the evaluation of the TL spine. Our objective is to identify clinical findings and mechanism characteristics that will ensure a high sensitivity and specificity for the detection of TL spine injuries. We aim to test the hypothesis that those patients who sustain a blunt mechanism of injury and present to the hospital fully alert, without a neurologic deficit or a distracting injury, without spinal pain on physical examination and without the need for a torso CT scan to rule out significant intra-thoracic and intra-abdominal injuries due to the significance of the mechanism of injury, are at a very low risk of having a TL spine injury.

STUDY DESIGN

This is a multicenter, prospective study that is observational and non-randomized. All patients admitted to the participating trauma centers meeting inclusion criteria will be eligible for enrollment in this study. Data capture will begin immediately after admission and will include a standardized clinical examination, directed imaging and follow-up throughout the entire hospital stay. A detailed description follows.

SELECTION OF SUBJECTS

It is expected that both male and female subjects age 15 and older that have been injured due to a blunt mechanism will be enrolled. A non-enrolled patient log will be kept to evaluate for any selection bias that may occur.

SUBJECTS PLANNED

Up to 4,600 patients will be enrolled from up to 8 centers. In Phase I, 700 patients will be enrolled for a futility assessment. In Phase II, the remainder of the patients will be enrolled to meet the total number of subjects required, based on the power analysis.

INCLUSION CRITERIA

1) Blunt mechanism of injury
2) Age ≥15
3) Patient is evaluable on clinical examination. This includes:
   - Glasgow Coma Scale 15
   - Cooperative
   - Not intoxicated
   - With no painful distracting injuries

   The treating physician will determine whether the patient is evaluable or not. A positive toxicology screen will not preclude the patient from being enrolled if the treating physician deems the patient as able to reliably report pain.
4) Absence of pre-existing paraplegia/tetraplegia
5) Assessed within 24 hours of injury
6) Absence of cervical spine injury causing neurodeficit

EXCLUSION CRITERIA

1) Age <15
2) Glasgow Coma Scale < 15
3) Uncooperative
4) Intoxication
5) Mechanism of injury:
   - Penetrating
   - Burns
6) Pre-existing paraplegia/tetraplegia
7) Injury > 24 hours prior to admission

For patients meeting inclusion criteria, details of the injury mechanism will be documented on a datasheet. A structured clinical examination of the TL spine will also be performed to determine the presence or absence of clinical signs that may indicate TL spine injury. These signs include spinal or paraspinal pain, spinal or paraspinal tenderness, hematoma, palpable abnormalities or neurological deficit.

DESCRIPTION OF STUDY PROCEDURES

Data will be gathered by the examining physicians at participating study sites. These physicians will conduct the structured physical examination and report the details of the injury mechanism through the American Association for the Surgery of Trauma – Multi-Institutional Trials (AAST MIT) electronic portal. Data collection will be conducted *prior* to obtaining imaging studies including CT scan of the chest, abdomen and pelvis, but should never interfere with patient care. Data collection can be delayed at the discretion of the treating physician in cases in where a delay is felt to be capable of producing harm. In such cases, physicians will complete the data collection at the earliest opportunity. This process will not threaten study validity, as the vast majority of unstable patients will automatically be excluded since they will not fulfill the inclusion criteria that require that the patient be evaluable.

DATA COLLECTION

All data will be collected through the AAST MIT online data entry system. All trauma centers interested in participating will express their intent by communicating directly with the PI. Participating centers will provide details on the CT scanner to be used and the local protocol for TL spine imaging.

Data collection will be biphasic. A screening form (page 1 – demographics and inclusion criteria) with a pre-determined study number will be completed for all admitted patients to all participating centers. Completion of the first portion of this form will determine whether the subject meets inclusion criteria or not. If not, then the remaining data points in the form will not be completed. These subjects however, will be assigned a study number that will be recorded on the form. This procedure will determine the number of excluded subjects and the reason for exclusion.

If the patient fulfills inclusion criteria data regarding basic demographics and details of the injury mechanism then the results of the structured clinical examination of the TL spine will be collected. The patient will then undergo imaging evaluation with CT of the chest, abdomen and pelvis, dedicated spine x-rays, MRI or will be admitted for at least 24 hours. If injuries are identified, Page 3 will be completed, recording data on any acute TL spine injuries detected during the hospital stay, as well as all treatments provided and all de-identified radiology reports will be submitted.

PATIENT CONSENT

This is an observational study with all patient care decisions being made by the clinical team. Inclusion in the study will not directly impact patient care. Patient data will be coded. These codes will not be linked to any patient information to ensure confidentiality. This study poses no risk to patients. A waiver of consent is therefore warranted based on the following:

1. A subject's participation does not involve additional medial risk since no medical care is being offered for study participation.
2. There is minimal risk of a breach in confidentiality associated with the collection of data variables for the purpose of this study and specific standardized measures will be taken to mitigate this risk.
3. The data obtained from this study will contribute to the evidence-driven practice that, by its nature, is beneficial for future patients sustaining TL spine injuries.

SAMPLE SIZE CALCULATION

Two sample sizes were calculated based on the overall incidence and sensitivity of TL spine injuries and clinically significant TL spine injuries, respectively, that were found in our previously conducted study:

A. *For all TL spine injuries:*

Confidence Interval, 1-α	0.95	0.95	0.99	0.99
Expected proportion, π (sensitivity)	0.48	0.48	0.48	0.48
Distance from proportion to limit, ω	0.10	0.05	0.10	0.05
Total patients with injuries required	96	384	166	663
Total evaluable patients required	**1,143**	**4,571**	**1,976**	**7,893**

B. *For clinically significant TL spine injuries:*

Confidence Interval, 1-α	0.95	0.95	0.99	0.99
Expected proportion, π (sensitivity)	0.78	0.78	0.78	0.78
Distance from proportion to limit, ω	0.10	0.05	0.10	0.05
Total patients with injuries required	64	255	111	441
Total evaluable patients required	**3,200**	**12,750**	**5,550**	**22,050**

Based on these estimations and for feasibility reasons, the total sample size of evaluable patients required for the study is **4,571**. This sample size will provide

1) An estimate of a 48% sensitivity with a 95% CI and width of ±5% (prevalence rate of 8.4%) and
2) An estimate of a 78% sensitivity with a 95% CI and width of ±10% (prevalence rate of 2.0%)

DATA ANALYSIS

Standard statistical tools will be utilized for the purposes of the analysis. The primary outcomes will be:

1) Sensitivity of clinical examination for TL injuries following blunt mechanism of injury
2) Sensitivity of clinical examination for clinically significant TL spine injuries following blunt mechanism of injury, as previously defined.

In addition, all variables related to the mechanism of injury will be included in a forward logistic regression analysis to identify factors independently associated with TL spine injury.

STUDY TIMELINE

It is expected that the study will be completed within a 24-month period, according to the following schedule:

- Review by the AAST Multi-Institutional Trials Committee: 1 month
- Recruiting of trauma centers and local IRB approvals: 4 months
- Enrollment of patients: Up to 18 months
- Data analysis and manuscript preparation: 1 month

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