

The Forequarter Lateral Implosion Injury: A Diagnostic Paradigm

Albert George, MD; Peter A. Cole, MD; Thomas Z. Paull, MD; Joshua Levine, BS

Purpose: This study describes outcomes and associated injuries of patients with combined lesions of the chest and shoulder—the forequarter lateral implosion injury. This complex was defined as 2 or more rib fractures plus an ipsilateral shoulder girdle injury (scapula-clavicle-proximal humerus fracture or dislocated AC-SC [acromioclavicular-sternoclavicular] joints). The Ch-Sh (pronounced che-sha) classification system was created to stratify the interpretation and understanding of this pathology and study prognosis of injury severity.

Methods: Patients from a Level I trauma center from 2018-2022 were included. Demographics, injury characteristics, associated injuries, and outcomes were recorded. Chest injuries were grouped into 3 categories: (Ch1) 2-4 fractured ribs, (Ch2) 5+ fractured ribs, or (Ch3) 2+ fractured ribs with contralateral rib fractures and /or sternal fracture. Shoulder girdle injuries were also grouped into categories: (Sh1) clavicle acromion, and /or AC/SC joint injury only; (Sh2) scapula and /or proximal humerus injury; or (Sh3) a combination of injuries Sh1 and Sh2, resulting in 9 subgroups. The electronic medical record was mined for associated injury, morbidity, length of stay, and mortality to associate with each of the 9 levels of injury (Ch1-3 x Sh1-3) to determine prognosis and risk factors.

Results: 354 consecutive patients were included in the study. As the classification scales from Ch1 to Ch3, higher rates of ICU admission, 30-day mortality, chest tube placement, mechanical ventilation, and spinal fracture are observed with longer hospitalizations and increased ISS. On the other hand, the Sh2 classification is associated with increased morbidity and mortality relative to the Sh1 and Sh3 groups, implying a protective effect of a broken shoulder girdle. Reviews had almost perfect interobserver agreement (kappa = 0.81) and substantial intraobserver agreement (kappa = 0.66).

Conclusion: The greater the chest wall injury, the greater the morbidity and mortality, but the same is not true for shoulder injury severity. In the Forequarter Lateral Implosion Injury Complex, the Ch3-Sh2 class injury was associated with the greatest morbidity and mortality. Multiple disruptions of the shoulder seen in the Sh3 group may be associated with better outcomes due to dispersion of force from an “accordion effect” or “crumple zone,” where the shoulder collapses with the rib cage. Reviewers also found the Ch-Sh classification to be reliable.

	Comparison among Chest Classifications			Comparison among Shoulder Classifications		
	Ch1 % or mean	Ch2 % or mean	Ch3 % or mean	Sh1 % or mean	Sh2 % or mean	Sh3 % or mean
ISS	17* [#]	21* ^Δ	26 ^{#Δ}	20*	24* ^Δ	20 ^Δ
Hospital LOS (days)	5* [#]	8* ^Δ	12 ^{#Δ}	8	9	8
ICU admission	14%* [#]	39%* ^Δ	65% ^{#Δ}	39%	45%	31%
30 Day Mortality	0%* [#]	12%* [#]	17% [#]	10% [#]	16% ^Δ	19% ^{#Δ}
Chest Tube	11%* [#]	54%* [#]	51% [#]	41%	48% ^Δ	30% ^Δ
Mechanical Ventilation	10%* [#]	25%* ^Δ	43% ^{#Δ}	22%*	35%* ^Δ	22% ^Δ
Pneumothorax/Hemothorax	42%* [#]	79%* [#]	83% [#]	63%*	78%*	72%
Head Injury	44% [#]	55%	66% [#]	53%	57%	57%
Any Spinal Fracture	23%* [#]	42%* [#]	60% [#]	39%*	53%* ^Δ	32% ^Δ
Other Orthopaedic Injury	23% [#]	27% ^Δ	44% ^{#Δ}	31%	33%	26%
Pulmonary Contusion	25%* [#]	41%* [#]	48% [#]	33%*	47%*	38%
Solid Organ Injury	15%	16%	23%	11%*	23%*	18%

* - significant difference between Ch1/Sh1 and Ch2/Sh2 (p-value<0.05)
 # - significant difference between Ch1/Sh1 and Ch3/Sh3 (p-value<0.05)
 Δ - significant difference between Ch2/Sh2 and Ch3/Sh3 (p-value<0.05)

The FDA has stated that it is the responsibility of the physician to determine the FDA clearance status of each drug or medical device they wish to use in clinical practice.