What Is the Incidence of In-Hospital Complications and Mortality in Patients with High Cervical Spine Fractures?

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Introduction

- Damage to the cervical spine is often the result of traumatic injury, and is associated with increased morbidity and mortality among patients.
- Fractures of the high cervical spine (C1 and C2) constitute greater than 60% of all cervical fractures.[5]
- Current literature reports high incidences of mortality and complication within the first year of injury, but little information exists on the in-hospital mortality and complications among high cervical fracture patients.[11,12]
- This study seeks to investigate the incidence of in-hospital mortality and complications, the length of stay (LOS), and disposition in patients with high cervical fractures.

Methods

- The Nationwide Inpatient Sample was queried from 2000–2015 to identify rates of in-hospital mortality and complications associated with high cervical fracture.
- 62,774 patients were identified as meeting inclusion criteria, and were subsequently stratified into groups based on fracture of: C1(22.5%), C2 (67.3%), or both C1 and C2 (10.2%).
- In-hospital mortality and complications for patients with fracture of C1, C2, or C1 and C2 were recorded.
- Chi-Square analysis and ANOVA were utilized to determine if the intervention was associated with differences in in-hospital complications/mortality, and to determine if differences existed between high cervical fracture in-hospital mortality rates and in-hospital mortality rates of other common diagnoses/surgical procedures.

Results

- Fracture of C1 and C2 was associated with the highest rate of mortality (10.83%), followed by C1 fracture (7.24%), and C2 fracture (6.20%).
- C1 fractures had lower rates of mortality, ARF, ARDS, CA, than fractures of both C1 and C2.
- C2 fracture exhibited higher rates of mortality, sepsis, ARDS and, but lower rates of UTI, CHF and discharge to destination other than home (Figure 1).
- Fracture of C1 and C2 exhibited higher rates of mortality, ARF, ARDS, CA, UTI, CHF, discharge to destination other than home and LOS ($p<0.001$) compared to fractures of C2.
- Cervical fractures had higher rates of in-hospital mortality than hip fractures, colon cancer, breast cancer, prostate cancer, and other common diagnosis (Figure)

Figure 1: In-Hospital Complications and Mortality in Patients with High Cervical Fractures

Complication [OR (95% CI)	C1 vs. C1 and C2	C1 vs. C2	C1 and C2 vs. C2
Mortality	**0.64 (0.58-0.71)**	**1.18 (1.10-1.27)**	**1.84 (1.68-2.01)**
Hypovolemic Shock	0.76 (0.43-1.35)	1.12 (0.75-1.69)	1.47 (0.89-2.42)
Pneumonia	0.97 (0.84-1.13)	1.08 (0.98-1.19)	1.11 (0.97-1.27)
Acute Renal Failure	**0.71 (0.62-0.81)**	0.93 (0.85-1.02)	**1.31 (1.17-1.47)**
Mechanical Ventilation	**1.1 (1.01-1.19)**	**1.38 (1.31-1.45)**	**1.26 (1.17-1.35)**
Sepsis	1.04 (0.84-1.29)	**1.27 (1.10-1.46)**	**1.22 (1.00-1.47)**
Acute Respiratory Distress Syndrome	**0.76 (0.69-0.84)**	**1.1 (1.02-1.18)**	**1.44 (1.32-1.58)**
Cardiac Arrest	**0.5 (0.41-0.60)**	0.98 (0.84-1.14)	**1.97 (1.68-2.31)**
Deep Vein Thrombosis	0.81 (0.61-1.07)	1.02 (0.84-1.24)	1.26 (0.99-1.61)
Pulmonary Embolism	1.02 (0.71-1.46)	1.06 (0.84-1.34)	1.04 (0.75-1.45)
Urinary Tract Infection	**0.66 (0.60-0.72)**	**0.8 (0.75-0.86)**	**1.22 (1.12-1.31)**
Pulmonary Edema	1 (0.35-2.88)	0.84 (0.43-1.65)	0.84 (0.33-2.14)
Congestive Heart Failure	**0.63 (0.57-0.70)**	**0.81 (0.76-0.87)**	**1.28 (1.18-1.39)**
Cerebrovascular Accident	1.18 (0.91-1.53)	**1.23 (1.05-1.45)**	1.04 (0.82-1.33)
Myocardial infarction	0.60 (0.36-1.01)	0.93 (0.63-1.38)	**1.55 (1.00-2.4)**

Figure 2: Odds Ratios of In-Hospital Complications and Mortality in High Cervical Spine Fractures

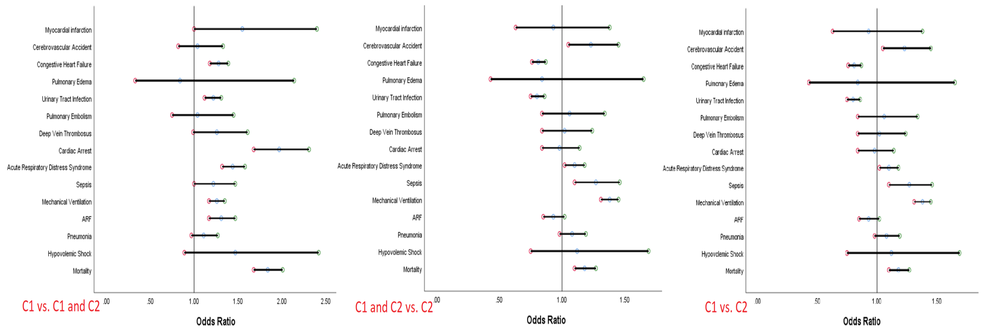
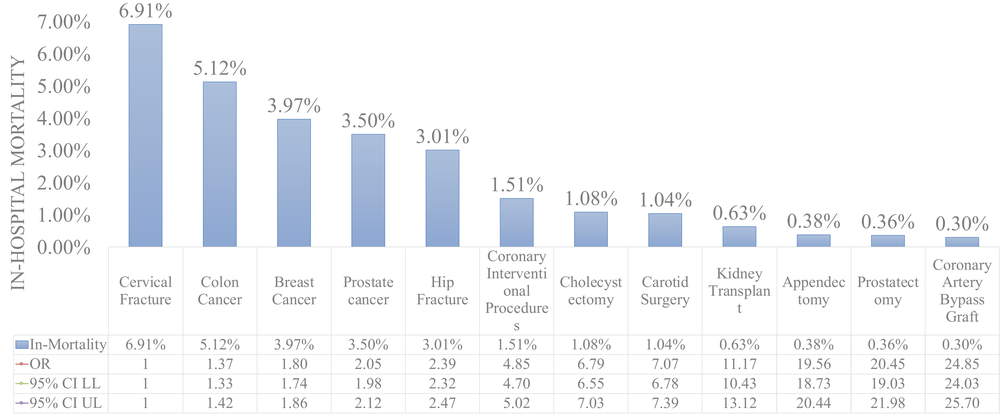


Figure 3: In-Hospital Mortality Rates for High Cervical Fractures and Other Common Surgeries and Diagnoses (2000 – 2015)



	Cervical Fracture	Colon Cancer	Breast Cancer	Prostate cancer	Hip Fracture	Coronary Interventional Procedures	Cholecystectomy	Carotid Surgery	Kidney Transplant	Appendectomy	Prostatectomy	Coronary Artery Bypass Graft
In-Mortality	6.91%	5.12%	3.97%	3.50%	3.01%	1.51%	1.08%	1.04%	0.63%	0.38%	0.36%	0.30%
OR	1	1.37	1.80	2.05	2.39	4.85	6.79	7.07	11.17	19.56	20.45	24.85
95% CI LL	1	1.33	1.74	1.98	2.32	4.70	6.55	6.78	10.43	18.73	19.03	24.03
95% CI UL	1	1.42	1.86	2.12	2.47	5.02	7.03	7.39	13.12	20.44	21.98	25.70

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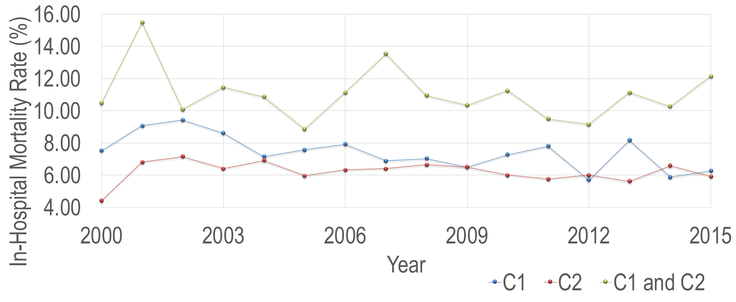
Discussion

- Those with fracture of C1 and C2 demonstrated higher rates of in-hospital mortality. This is likely a consequence of sequential vertebral compromise, leading to a decrease in cervical spine stability.
- Those sustaining fracture of C1 and C2 demonstrated higher incidences of ARF, ARDS, CA, CHF, and UTI than either isolated fracture of C1 or C2.
- Those with isolated fracture of C1 showed higher rates of MV, sepsis, ARDS, and CVA than those with isolated C2 fractures. This finding may be the result of spinal cord involvement at a more superior level, perhaps contributing to greater loss of autonomic and sympathetic function.
- High cervical fractures displayed greater incidence of in-hospital mortality than several common surgeries/diagnoses. This finding is potentially a result of cervical spine fractures more commonly resulting from traumatic, high energy injuries.
- When compared to procedures demonstrating lower incidences of in-hospital mortality, e.g. cholecystectomy, appendectomy, prostatectomy, these procedures are typically scheduled allowing for preoperative optimization.
- It is also noteworthy that delays in surgical decompression of high cervical fractures could potentiate rates of in-hospital mortality, complications, decreased neurological improvement, although this remains controversial

Figure 4: Trend of In-Hospital Mortality following High Cervical Fractures



Conclusion

- Based on these results, it appears that the in-hospital mortality rate of high cervical fracture is in increased with involvement of both C1 and C2 vertebrae
- Fracture of C1 and C2 had higher rates of in-hospital mortality and were more likely to have in-hospital complications, a longer LOS, and disposition to a destination other than home than fracture of only C1 or C2.
- Additionally, high cervical fractures had a significantly high odds of resulting in in-hospital mortality than other common procedures.
- We encourage physicians to optimize care for these patients and take steps to reduce modifiable risks that may result in subsequent in-hospital mortality or complications.