Published in final edited form as:

Plast Reconstr Surg. 2014 September ; 134(3): 457e–463e. doi:10.1097/PRS.0000000000000422.

Mortality Trends and the Effects of Debridement Timing in the Management of Mediastinitis in the United States (1998–2010)

Oluseyi Aliu, MD, MS¹, Rafael J. Diaz-Garcia, MD², Lin Zhong, MD, MPH³, Evan McGlinn, BS⁴, and Kevin C. Chung, MD, MS⁵

¹House Officer, Section of Plastic Surgery, Department of Surgery, The University of Michigan Health System; Ann Arbor, MI

²House Officer, Section of Plastic Surgery, Department of Surgery, The University of Michigan Health System; Ann Arbor, MI

³Clinical Research Coordinator, Section of Plastic Surgery, Department of Surgery, The University of Michigan Health System; Ann Arbor, MI

⁴Clinical Research Assistant, Section of Plastic Surgery, Department of Surgery, The University of Michigan Health System; Ann Arbor, MI

⁵Professor of Surgery, Section of Plastic Surgery, Department of Surgery, The University of Michigan Health System; Ann Arbor, MI

Abstract

Background—We examined practice patterns in the timing of initial debridement for patients with mediastinitis and evaluated the relationship between debridement delay and in-hospital mortality. We also assessed the trends of in-hospital mortality for mediastinitis patients between 1998 and 2010.

Methods—We conducted a retrospective cross-sectional study with data from the Nationwide Inpatient Sample, 1998 to 2010. Study observations were adult patients ≥ 18 years of age who were surgically treated for mediastinitis. We used a logistic regression model adjusted for patient demographic and clinical characteristics to evaluate the association between timing of first operative debridement after admission and in-hospital mortality. Lastly, we calculated adjusted predictions of the probability of in-hospital mortality for each year of the study from 1998 to 2010.

Results—Results from the adjusted logistic model showed that initial debridement after the 4th day of admission increased the odds of in-hospital mortality by 50% (OR 1.5; 95% CI 1.0–2.1). Although patients with significant comorbidities had up to 70% increased odds of debridement > 4 days after admission (OR 1.7; 95% CI 1.1–2.6), approximately one-third (29.3%) of patients debrided after the 4th day of admission were clinically stable. With regards to the trend of in-

Corresponding author and reprint requests sent to: Kevin C. Chung, MD, MS, Section of Plastic Surgery, The University of Michigan Health System, 1500 E. Medical Center Dr., 2130 Taubman Center, SPC 5340, Ann Arbor, MI 48109-0340, Telephone: 734-998-6022, Fax: 734-763-5354, kecchung@med.umich.edu.

Disclosures: None of the authors has a financial interest in any of the products, devices, or drugs mentioned in this manuscript.

Level of evidence: Risk, II.

hospital mortality over the duration of the study, the adjusted probability of in-hospital mortality for an average patient treated for mediastinitis decreased from 10.6% in 1998 to 3.1% in 2010.

Conclusions—There is survival advantage from timely debridement in mediastinitis patients. However, analysis of national population-level data demonstrates that approximately one-third of mediastinitis patients who had initial debridement delayed until > 4 days after admission (when the odds of mortality significantly increase) had no clinical indications for debridement delay.

Keywords

debridement delay; mediastinitis; mortality

INTRODUCTION

Median sternotomies are performed at an estimated rate of 760,000 annually for a catalog of indications including, ischemic cardiac disease, valvular dysfunction and aortic disease.¹ Many patients who undergo median sternotomies have serious co-morbidities and have a considerable risk of mortality with their operations. This risk is further compounded by mediastinitis. Although affecting approximately only 1–2% of the patients who undergo median sternotomy, mediastinitis poses significant danger to affected patients with mortality rates currently up to 16%.^{2–4} Mediastinitis as a complication also increases the overall cost of treatment.^{5,6} One study found that for patients who underwent coronary artery bypass grafting, mediastinitis nearly quadruples the cost of treatment.⁶

Treatment delay has been shown to adversely affect outcomes of several major surgical in-patient procedures. For example, in patients with open tibia fractures, delay of surgical treatment has been correlated with a higher probability of amputation.⁷ Similarly, for patients with endocarditis, those treated within 48 hours of admission to the hospital were less likely to have embolic events in the subsequent 6 weeks.⁸ Delay of surgical treatment has also been shown to influence mortality rates. Daugaard et al. found that hip fracture patients had a 30% increase in odds of mortality for every 24 hours of delayed treatment.⁹ Cabbabe, et al. in their small series compared the outcomes of mediastinitis patients who received immediate debridement and patients who had delayed treatment at a single institution.¹⁰ They found that patients with delayed-treatment had a considerable increase in mortality compared to those treated with immediate debridement—4.7% versus 1.0%.

Population level studies characterizing patterns of management of costly and morbid conditions such as mediastinitis and the effects of these practice patterns on patient outcomes are necessary. Findings from such studies can help to develop best practices that can be disseminated to make treatment cost-effective. Hence, the aim of this study was to characterize nationwide practice patterns in the timing of debridement in mediastinitis patients. We also aimed to evaluate the effect of debridement timing on in-hospital mortality.

MATERIAL AND METHODS

Data Source

We conducted a retrospective analysis of administrative data from the Nationwide Inpatient Sample (NIS), 1998 to 2010.¹¹ The NIS is an all-payer publicly available database developed for the Healthcare Cost and Utilization Project by the Agency for Healthcare Research and Quality. The database contains discharge information from a 20% stratified sample of U.S. community hospitals. The NIS is the largest all-payer inpatient care database with roughly 8 million discharges captured annually. The data lack any personal patient identifiers, and thus this study has a non-regulatory status from our institutional review board.

Patient Selection

We identified and included adult patients ≥ 18 year of age with diagnoses of mediastinitis, mediastinal/thoracic abscess and complex open chest wounds respectively who were admitted to an acute care hospital and underwent surgical debridement. The full inclusion and exclusion algorithm is outlined in Figure 1.

Variables of Interest

The primary outcome was in-hospital mortality. The NIS database contains a variable labeled “DIED” which indicates whether the patient was discharged alive or deceased. The key predictor variable was the hospital-day (timing) of debridement from admission. The NIS database contains variables representing procedures performed during an admission recorded as ICD-9 CM procedure codes. The following ICD-9 CM codes were used to identify debridement with or without partial sternectomy: 77.61, 86.22, and 86.28. The timing of each procedure from day of admission was determined by using variables available in the dataset. We used a dichotomous predictor variable based on the day of admission that patients underwent debridement as follows: days 0 to 4 and days 5 and greater. Dichotomizing the predictor increased our statistical power to detect significant associations with the outcome, in-hospital mortality. The cut-point (day 4) in the adjusted logistic model was based on the results of unadjusted comparisons demonstrating increased odds of the outcome when initial debridement occurred after day 4 of admission.

Control variables included patient demographic data of age and sex; economic characteristics include payer status; and medical comorbidities include those shown in previous studies to be associated with mortality in mediastinitis patients and patients undergoing other major inpatient procedures.^{4,12–14}

Data Analysis

We first performed unadjusted bivariate analysis to determine the relationship between explanatory variables, including the key predictor and control variables, and the outcome variable. Variables that were significantly associated with the outcome in the unadjusted bivariate analysis were included in the final adjusted multivariate regression model along with the key predictor. We used estimates from the multivariate logistic model to calculate

the adjusted probability of in-hospital mortality for an average patient in each year of the study.

Lastly, we examined factors that may contribute to debridement delay. We used descriptive statistics and a logistic model with “timing of debridement” as the outcome and “patient comorbidity burden” as predictor to examine the association between patient comorbidity burden and debridement delay.

Results

From 1998 to 2010, the NIS database contained 2,099 sampled patients admitted with diagnosis of either mediastinitis, mediastinal/thoracic abscess, or complicated chest wound who underwent surgical debridement during their hospitalization and had no crucial missing data. Patient demographic and clinical characteristics are shown in Table 1.

In the adjusted multivariate model, day of debridement measured from time of admission significantly predicted in-hospital mortality. Patients debrided after hospital day 4 had at least 50% greater odds of in-hospital mortality than those debrided earlier (Table 2).

The probability of mortality for an average patient was 10.6% in 1998 and steadily declined to 3.1% in 2010 (Figure 2). This decline in mortality persisted despite an increasing mean number of comorbidities per patient from 0.64/patient in 1998 to 1.39/patient in 2010 (Figure 3). Patients with significant comorbidities were had up to 70% higher odds of debridement > 4 days after admission (OR 1.7; 95% CI 1.1–2.6) (Table 3). However, up to one-third of patients who underwent delayed debridement had no significant comorbidities or hemodynamic instability recorded (Figure 4).

DISCUSSION

Debridement Delay

The adjusted odds of in-hospital mortality for mediastinitis patients in this study are clearly worse with delay of debridement. These results are consistent with findings from smaller studies of mediastinitis patients and patients with traumatic lower extremity wounds, demonstrating a clear association between delayed debridement and adverse outcomes^{7, 10}. Presumably, in a fraction of patients in this study, debridement was delayed as a result of critical illness and hemodynamic instability. In fact, the adjusted estimates on Table 3 show that patients with specific comorbidities are up to 70% likelier to have debridement delayed. However, this analyses of population level data also demonstrates that approximately one-third of patients who underwent delayed first debridement, with the odds of mortality significantly increased, did not have significant comorbidities present.

The delayed debridement in these patients who had no clinical indications such as hemodynamic instability, heart failure, significant liver disease or coagulopathy to delay surgical intervention may reflect variations in practice patterns in timing of debridement for non-clinical reasons. Non-clinical reasons such as limited access to specialist surgeons, surgeon availability in the setting of busy elective practices and operating room availability are a few factors that have been previously shown to be direct causes of delayed

debridement in clinical situations where timely debridement is paramount to better outcomes¹⁵. Given that there is a clearly demonstrable benefit in avoiding mortality with earlier debridement, there must be concerted efforts within institutions and amongst the various specialty providers involved in the care of mediastinitis patients to avoid delays especially in clinically stable patients.

Decreasing Mortality Trend

Our study results also demonstrate that the adjusted probability of in-hospital mortality for an average patient with surgically treated mediastinitis in the United States decreased 3-fold from 10.6% to 3.1% between 1998 and 2010. Additionally, the overall decline seen in the mortality rate for mediastinitis patients persisted despite an increase, over the study duration, in the mean number of comorbid diagnoses in mediastinitis patients (Figure 3). In essence, the probability of in-hospital mortality steadily declined in this time interval despite a worsening in clinical risk factor profile of the average patient.

In general, there have been advances in the care of critically ill patients and in the care of critical wounds as well. Negative-pressure wound therapy (NPWT) is one of the more notable wound care advances^{16–18}. Notably, some case series in the current literature have suggested an associated survival benefit with NPWT in mediastinitis patients^{19–21}. Hence, there may be the temptation to cursorily associate the common use of NPWT either as definitive treatment or an intermediate measure to prepare mediastinal wounds for vascularized coverage with the decline in mortality demonstrated in this study. However, data on the effects of treatment with NPWT on mortality in mediastinitis patients are at best conflicting since a recent review study of available evidence did not find a significantly beneficial effect of NPWT on overall mortality.²² Unfortunately, there are no ICD-9 CM procedure codes for NPWT. Hence, we were unable to determine the trends or prevalence of the use of NPWT and its impact on in-hospital mortality in our cohort. However, given the widespread use of NPWT for managing mediastinitis patients, it is a necessary undertaking to design population level studies that properly evaluate its effect on mediastinitis patient outcomes in order to determine effective ways of incurring its added cost.

There are limitations of this study that are common to using administrative data. The dataset variables are pre-set and studies using administrative data are usually retrospectively designed. Hence, variables measuring additional relevant explanatory and confounding factors may not be available in the database. For instance, we were unable to evaluate the effects of therapies such as NPWT or definitive flap closure because the database does not include variables for CPT® codes, which are generally more specific for such procedures. Moreover, the accuracy of capturing diagnoses and procedures to properly categorize patients is dependent on the diligence of coders at institutions that contribute to the database. However, the Healthcare Cost and Utilization Project databases are designed and widely used to study healthcare resource utilization and patient outcome trends across a wide breadth of clinical conditions.²³

The value of this study is that we have used representative nationwide population level data to quantify the benefit of early debridement and to demonstrate the prevalence of delays in initial debridement of mediastinitis patients. These findings set the stage for evaluating

healthcare system and institutional factors that contribute to treatment delays for mediastinitis patients, which is particularly important in the treatment of patients without clinical indications for debridement delay. Non-clinical factors that delay debridement in mediastinitis patients should be considered in the context that delay of debridement is associated with a 50% increase in odds of mortality.

Acknowledgments

This study was supported by the Robert Wood Johnson Foundation Clinical Scholars Program/VA Scholar (to Dr. Oluseyi Aliu).

This study is also supported in part by a Midcareer Investigator Award in Patient-Oriented Research (K24AR053120) and 2R01AR047328 - 06 from the National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS), and R01AR062066 from NIAMS and the National Institute on Aging (to Dr. Kevin C. Chung

References

1. Song DH, Lohman RF, Renucci JD, Jeevanandam V, Raman J. Primary sternal plating in high-risk patients prevents mediastinitis. *Eur J Cardiothorac Surg*. 2004 Aug; 26(2):367–72. [PubMed: 15296898]
2. El Oakley RM, Wright JE. Postoperative mediastinitis: classification and management. *Ann Thorac Surg*. 1996 Mar; 61(3):1030–6. [PubMed: 8619682]
3. Loop FD, Lytle BW, Cosgrove DM, Mahfood S, McHenry MC, Goormastic M, et al. J. Maxwell Chamberlain memorial paper. Sternal wound complications after isolated coronary artery bypass grafting: early and late mortality, morbidity, and cost of care. *Ann Thorac Surg*. 1990 Feb; 49(2): 179–186. discussion 186–187. [PubMed: 2306138]
4. Atkins BZ, Onaitis MW, Hutcheson KA, Kaye K, Petersen RP, Wolfe WG. Does method of sternal repair influence long-term outcome of postoperative mediastinitis? *Am J Surg*. 2011 Nov; 202(5): 565–7. [PubMed: 21924401]
5. Graf K, Ott E, Vonberg R-P, Kuehn C, Haverich A, Chaberny IF. Economic aspects of deep sternal wound infections. *Eur J Cardiothorac Surg*. 2010 Apr; 37(4):893–6. [PubMed: 19896860]
6. Speir AM, Kasirajan V, Barnett SD, Fonner E Jr. Additive costs of postoperative complications for isolated coronary artery bypass grafting patients in Virginia. *Ann Thorac Surg*. 2009 Jul; 88(1):40–45. discussion 45–46. [PubMed: 19559186]
7. Davis Sears E, Davis MM, Chung KC. Relationship between timing of emergency procedures and limb amputation in patients with open tibia fracture in the United States, 2003 to 2009. *Plast Reconstr Surg*. 2012 Aug; 130(2):369–78. [PubMed: 22842411]
8. Kang D-H, Kim Y-J, Kim S-H, Sun BJ, Kim D-H, Yun S-C, et al. Early surgery versus conventional treatment for infective endocarditis. *N Engl J Med*. 2012 Jun 28; 366(26):2466–73. [PubMed: 22738096]
9. Daugaard CL, Jørgensen HL, Riis T, Lauritzen JB, Duus BR, van der Mark S. Is mortality after hip fracture associated with surgical delay or admission during weekends and public holidays? A retrospective study of 38,020 patients. *Acta Orthop*. 2012 Dec; 83(6):609–13. [PubMed: 23140106]
10. Cabbabe EB, Cabbabe SW. Immediate versus delayed one-stage sternal débridement and pectoralis muscle flap reconstruction of deep sternal wound infections. *Plast Reconstr Surg*. 2009 May; 123(5):1490–4. [PubMed: 19407620]
11. HCUP-US NIS Overview [Internet]. [cited 2013 Nov 3]. Available from: <http://www.hcup-us.ahrq.gov/nisoverview.jsp>
12. Memtsoudis SG, Pumberger M, Ma Y, Chiu Y-L, Fritsch G, Gerner P, et al. Epidemiology and risk factors for perioperative mortality after total hip and knee arthroplasty. *J Orthop Res*. 2012 Nov; 30(11):1811–21. [PubMed: 22517400]
13. Osborne NH, Upchurch GR Jr, Mathur AK, Dimick JB. Explaining racial disparities in mortality after abdominal aortic aneurysm repair. *J Vasc Surg*. 2009 Oct; 50(4):709–13. [PubMed: 19703760]

14. Borger MA, Rao V, Weisel RD, Ivanov J, Cohen G, Scully HE, et al. Deep sternal wound infection: risk factors and outcomes. *Ann Thorac Surg.* 1998 Apr; 65(4):1050–6. [PubMed: 9564926]
15. Namdari S, Baldwin KD, Matuszewski P, Esterhai JL, Mehta S. Delay in surgical débridement of open tibia fractures: an analysis of national practice trends. *J Orthop Trauma.* 2011 Mar; 25(3): 140–4. [PubMed: 21278609]
16. De Feo M, Vicchio M, Santè P, Cerasuolo F, Nappi G. Evolution in the treatment of mediastinitis: single-center experience. *Asian Cardiovasc Thorac Ann.* 2011 Feb; 19(1):39–43. [PubMed: 21357316]
17. De Feo M, Della Corte A, Vicchio M, Pirozzi F, Nappi G, Cotrufo M. Is post-sternotomy mediastinitis still devastating after the advent of negative-pressure wound therapy? *Tex Heart Inst J.* 2011; 38(4):375–80. [PubMed: 21841864]
18. Sjögren J, Malmjö M, Gustafsson R, Ingemansson R. Poststernotomy mediastinitis: a review of conventional surgical treatments, vacuum-assisted closure therapy and presentation of the Lund University Hospital mediastinitis algorithm. *Eur J Cardiothorac Surg.* 2006 Dec; 30(6):898–905. [PubMed: 17056269]
19. Sjögren J, Gustafsson R, Nilsson J, Malmjö M, Ingemansson R. Clinical outcome after poststernotomy mediastinitis: vacuum-assisted closure versus conventional treatment. *Ann Thorac Surg.* 2005 Jun; 79(6):2049–55. [PubMed: 15919308]
20. Sjögren J, Nilsson J, Gustafsson R, Malmjö M, Ingemansson R. The impact of vacuum-assisted closure on long-term survival after post-sternotomy mediastinitis. *Ann Thorac Surg.* 2005 Oct; 80(4):1270–5. [PubMed: 16181853]
21. Fuchs U, Zittermann A, Stuetgen B, Groening A, Minami K, Koerfer R. Clinical outcome of patients with deep sternal wound infection managed by vacuum-assisted closure compared to conventional therapy with open packing: a retrospective analysis. *Ann Thorac Surg.* 2005 Feb; 79(2):526–31. [PubMed: 15680828]
22. Damiani G, Pinnarelli L, Sommella L, Tocco MP, Marvulli M, Magrini P, et al. Vacuum-assisted closure therapy for patients with infected sternal wounds: a meta-analysis of current evidence. *J Plast Reconstr Aesthet Surg.* 2011 Sep; 64(9):1119–23. [PubMed: 21256819]
23. Healthcare Cost and Utilization Project (HCUP) [Internet]. [Cited 2014 Feb 10]. Available from: <http://www.ahrq.gov/research/data/hcup/index.html>

Figure 1.

The algorithm used to select the study population. The patients included in the study are a representative nationwide sample of mediastinitis patients treated over the study period.

We included these ICD-9 CM diagnosis codes after consultation with coders at our institution confirmed that these diagnosis codes are routinely used for sternal wound dehiscence and mediastinitis. We recognize that coding practices differ between institutions.

[†]Using the variables available the database, we calculated the “timing of debridement” from the day of admission for mediastinitis. We excluded mediastinitis patients who were never

discharged from their index operation because “timing of debridement” would be otherwise erroneously calculated based on the admission date for their index operation.

Figure 2.
The declining trend in the probability of in-hospital mortality for an average patient treated for mediastinitis over the study period.

Figure 3.

Increasing mean co-morbidity burden (# of co-morbidities/patient) of patients treated for mediastinitis over the study period. The rate of in-hospital mortality declined over the same period in this patient population (Figure 2).

Table 1

Characteristics of patients in the study sample

	Discharge status: “Deceased”	Discharge status: “Not deceased”
No. of patients (%)	196 (9.3)	1,903 (90.7)
Predictor variable (debridement delay)		
Day 5 and greater	68 (34.7)	419 (22.0)
Patient Demographics		
Mean age (SD)	66.2 (12.9)	58.1 (15.8)
Sex, <i>n</i> (%)	112 (57.1)	1,286 (67.6)
Male	84 (42.9)	617 (32.4)
Female		
Payer, <i>n</i> (%)	139 (70.9)	1,054 (55.5)
Government (Medicare/Medicaid)	47 (24.0)	615 (32.4)
Private	10 (5.1)	229 (12.1)
Other		
Clinical Characteristics		
Congestive heart failure, <i>n</i> (%)	74 (37.8)	378 (19.9)
Valvular disease, <i>n</i> (%)	29 (14.8)	159 (8.4)
Chronic renal failure, <i>n</i> (%)	46 (23.5)	217 (11.4)
Chronic liver failure, <i>n</i> (%)	9 (4.6)	26 (1.4)
Coagulation disorder, <i>n</i> (%)	31 (15.8)	72 (3.8)
Electrolyte abnormality, <i>n</i> (%)	86 (43.9)	417 (21.9)
Complicated hypertension, <i>n</i> (%)	35 (17.9)	194 (10.2)
SIRS, <i>n</i> (%)	99 (50.5)	340 (17.9)
Hemodynamic instability [†] , <i>n</i> (%)	16 (8.2)	27 (1.4)

Systemic Inflammatory Response Syndrome

[†] This categorization includes patients on vasopressors and those who required cardiopulmonary resuscitation by closed cardiac massage, defibrillation or cardioversion.

Table 2

Multivariate logistic regression model evaluating the relationship between debridement timing (key predictor variable) and in-hospital mortality (outcome variable) in mediastinitis patients

	OR	95% CI	p
Patient Demographics			
Age	1.03 [†]	1.02 – 1.05	< 0.01
Sex Male Female	1.31	Reference group 0.94 – 1.82	0.12
Payer Government (Medicare/Medicaid) Private Other	0.89 1.04	Reference group 0.59 – 1.34 0.49 – 2.19	0.58 0.93
Treatment Timing Factors			
Year	0.90 [†]	0.85 – 0.94	< 0.01
Day of debridement (from admission) Days 0 to 4 Days 5 and greater	1.46 [†]	Reference group 1.02 – 2.08	0.04
Clinical Characteristics			
Congestive heart failure	1.42 [†]	1.00 – 2.02	0.05
Valvular disease	1.35	0.84 – 2.19	0.21
Chronic renal failure	2.35 [†]	1.19 – 4.62	0.01
Chronic liver failure	3.21 [†]	1.19 – 8.64	0.02
Coagulation disorder	2.93 [†]	1.75 – 4.91	< 0.01
Electrolyte abnormality	1.88 [†]	1.40 – 2.52	< 0.01
Complicated hypertension	0.75	0.36 – 1.58	0.45
SIRS ^{††}	3.61 [†]	2.59 – 5.04	< 0.01
Hemodynamic instability ^{†††}	2.89 [†]	1.38 – 6.07	< 0.01

Adjustment variables in the model include variables that showed significant association with the outcome in bivariate analyses

Odds ratios

[†] Statistically significant odds ratios

^{††} Systemic Inflammatory Response Syndrome

^{†††} This categorization includes patients on vasopressors and those who required cardiopulmonary resuscitation by closed cardiac massage, defibrillation or cardioversion

Table 3

The relationship between the presence of comorbidities (key predictor variable) and likelihood of debridement delay (outcome variable) in mediastinitis patients

	OR	95% CI	p
Congestive heart failure			
No		Reference group	
Yes	1.05	0.80 – 1.37	0.716
Chronic renal failure			
No		Reference group	
Yes	1.07	0.79 – 1.46	0.642
Chronic liver failure			
No		Reference group	
Yes	1.34	0.65 – 2.77	0.43
Coagulation disorder			
No		Reference group	
Yes	1.70 [†]	1.11 – 2.59	0.01
Electrolyte abnormality			
No		Reference group	
Yes	1.27 [†]	0.98 – 1.64	0.07
SIRS ^{††}			
No		Reference group	
Yes	1.38 [†]	1.06 – 1.79	0.02
Hemodynamic instability ^{†††}			
No		Reference group	
Yes	1.58	0.84 – 3.00	0.16
No co-morbidities			
No		Reference group	
Yes	0.64 [†]	0.47 – 0.87	< 0.01

Odds ratios

[†] Statistically significant odds ratios

^{††} Systemic Inflammatory Response Syndrome

^{†††} This categorization includes patients on vasopressors and those who required cardiopulmonary resuscitation by closed cardiac massage, defibrillation or cardioversion

Liver failure, coagulation disorders, electrolyte abnormalities, SIRS and hemodynamic instability increase the odds of delayed debridement by a third or more