Nosocomial Infection in the Intensive Care Unit: Case Control Comparison of Trauma vs Surgical vs Medical Patients

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INTRODUCTION:

Hospital-acquired infections, also known as nosocomial infections, are extremely common especially in the Intensive Care Units (ICUs). These infections are a serious concern to the welfare of all patients who enter the hospital. In 2002, an estimated 1.7 million healthcare-associated infections occurred, associated with 99,000 deaths. While all patients may be exposed and succumb to nosocomial infections, critically ill patients are at particular risk because of the greater number of devices and catheters used in their care. Surgical and trauma patients tend to have higher rates of nosocomial infections than the medical ICU patients in similar situations. (Kelly et. al)

The most prevalent and easily spread infection in hospitals is *Clostridium difficile* infection (CDI). *Clostridium difficile* (*C. difficile)* is bacteria that causes diarrhea ranging from mild to severe, often accompanied by inflammation of the colon and other intestinal conditions. Symptoms include watery diarrhea, fever, loss of appetite, nausea, and abdominal pain. CDI is more likely to occur in patients taking high doses of antibiotics, as this depletes the bacteria in the gut allowing the *C. difficile* bacteria to grow. This gives reason for its high instance in the ICU setting, where many patients are critically ill with weakened immune systems, accompanied by high rates of antibiotic use. *C. difficile* is spread through spores found in the feces of infected persons. Surfaces can become contaminated with feces, be touched by another person, and transferred to the mouth or nose. Healthcare workers can also transfer the bacteria with infected hands. Isolation precautions are used to help prevent its spread from patient to patient, but CDI continues to be highly prevalent today, with rates continually rising since 2000. (Chakra et. al)

Research into the factors and comorbidities associated with differing risks of CDI between trauma, surgery and medical patients can help to understand the necessary changes to decrease rates and better treat and protect against this prevalent bacterium. This research works to ascertain differences between these 3 types of patients with CDI, including the clinical features at the first day of new infection, predictors of time to infection, differences in prophylactic antibiotics, and comorbidity predictors.

METHODS:

A retrospective chart review was performed on all surgical, trauma and medical patients admitted to the ICU from January 2010 to December 2016 that appear in the infections disease database positive for CDI. General demographic data, patient specific data, and data from the initial day of infection was included. The data collection sheet can be found in **Appendix A**.

The groups will be as follows:

TRAUMA: trauma patients admitted to the ICU from January 2010 to December 2016 with confirmed positive CDI

SURG: surgical patients admitted to the ICU from January 2010 to December 2016 with confirmed positive CDI

MED: medical patients admitted to the ICU from January 2010 to December 2016 with confirmed positive CDI

Human Subjects: Patient confidentiality was maintained at all times. All forms including patients' names were kept in a locked file in a locked office in trauma administration at Cleveland Clinic Akron General Medical Center. Names were not used in the database, and will not be used in any publication that may be used from this study. All information is based on chart review, not including any current patients.

Data analysis: Data was input and analyzed using EpiInfo software and STATA data analysis software. Categorical variables were analyzed using Pearson chi-square and Fisher exact tests where appropriate. Normally distributed data was analyzed with t-test and skewed with Mann-Whitney when needed. Quantitative variables were analyzed using one-way ANOVA, with Bonferroni tabulation. Bartlett's test for equal variances was also calculated and considered.

RESULTS:

A total of 194 patient charts were reviewed comprised of 32 trauma, 13 surgery, and 149 medical patients. Age, sex, and race were normally distributed with no significant difference between groups.

Comorbidities analyzed included diabetes mellitus (DM), cancer, smoking, coronary artery disease (CAD), hypertension (HTN), congestive heart failure (CHF), peripheral vascular disease (PVD), cerebro-vascular disease (CVD), dementia, chronic obstructive pulmonary disease (COPD), ulcer, renal disease, hemiplegia, quadriplegia and HIV/AIDS. 4 of these showed significant differences between groups. Trauma (25%) and surgical (15.38%) patients both differed significantly from medical patients (47.65%) for DM (p=.008), where medical CDI patients were more likely to have DM. **(Table 1)** Cancer showed a significant difference in surgical CDI patients (38.46%) (p≈0.000) where these patients showed significantly higher rates than those in the trauma (15.63%) or medical (6.04%) group. **(Table 2)** For CVD, trauma (6.25%) and surgical (7.69%) patients had significantly higher rates than medical patients (0.67%) (p=0.044) **(Table 3)** Finally the surgery group (7.69%) showed a significantly higher instance of HIV than the trauma (0%) or medical groups (0%) (p= 0.001). HIV, however, was only found in 1 patient in all of the data, so this may be a skewed representation. No other comorbidities showed significance between groups.

DM	Trauma	Medical	Surgery
no	4	78	11
yes	8	71	2
percent yes	25	47.65	15.38

Table 1. Data for CDI patients with diabetes mellitus. Pearson chi-square p=0.000. Fisher's exact p=0.001

Cancer	Trauma	Medical	Surgery
no	27	140	8
yes	5	9	5
percent yes	15.63	6.04	38.46

Table 2. Data for CDI patients with cancer. Pearson chi-square p=0.000. Fisher's exact p=0.001

CVD	Trauma	Medical	Surgery
no	30	148	12
yes	2	1	1
percent yes	6.25	0.67	7.69

Table 3. Data for CDI patients with cardiovascular disease. Pearson chi-square p=0.044. Fisher's exact p=0.055

HIV	Trauma	Medical	Surgery
no	32	149	12
yes	0	0	1
percent yes	0	0	7.69

Table 4. Data for CDI patients with human immunodeficiency virus. Pearson chi-square p=0.001. Fisher's exact p=0.067

The total length of stay in the ICU significantly differed between groups (p=0.0001), with the difference being significant specifically between trauma and medical patients (0.000). The mean length of stay for trauma patients was 12.7 days, medical was 6.9 days, and surgical was 10.6 days. **(Fig. 1)**

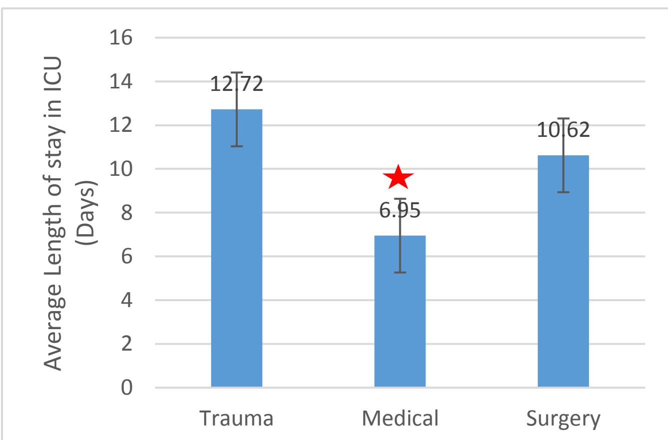

Figure 1. Average number of days spend in the ICU. P=0.001. ★ indicates significance

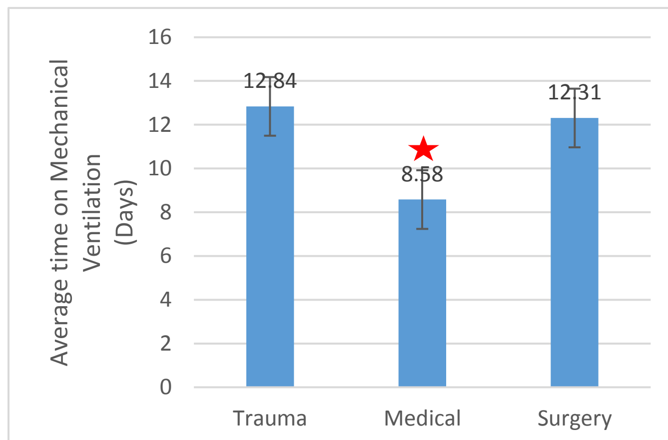

Figure 2. Average number of days on mechanical ventilation. P=0.0094. ★ indicates significance

significant difference between any 2 individual groups specifically. Trauma and medical showed correlation (p=0.061) but was not actually significant. **(Fig. 3)**

Finally, the length of hospital stay total differed significantly between groups (p=0.0022), with the difference between trauma and medical patients showing the significance (p=0.004). **(Fig. 4)**

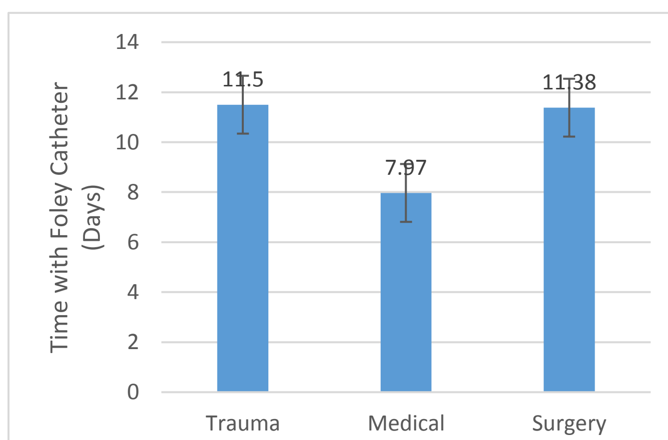

Figure 3. Average number of days with a Foley catheter. P=0.0312. ★ indicates significance

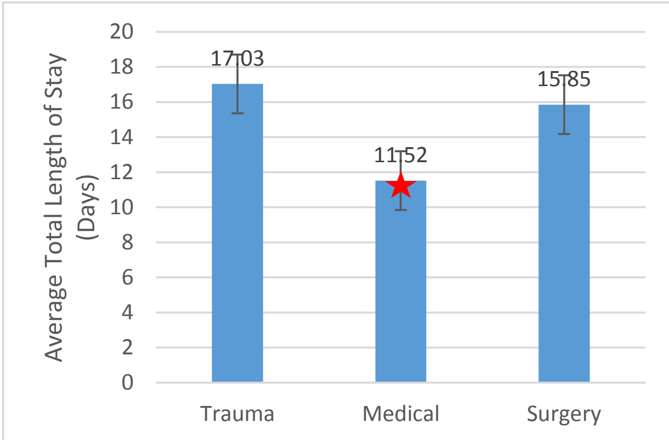

Figure 4. Average number of days total spent in the hospital. P=0.0022. ★ indicates significance

DISCUSSION:

Comorbidities:

DM, cancer, CVD and HIV were each found to significantly differ between at least two of the three study groups. First is diabetes. DM was significantly lower in trauma and surgery patients than in medical patients. This likely has more to do with the nature of the original condition than the onset of CDI. Medical patients enter the hospital for a multitude of health issues, with obesity high on the list of problems. As diabetes commonly occurs in overweight and obese people, it is a common comorbidity for all medical patients, not only those contracting CDI. Trauma patients are more often there due to crashes, falls, etc, and therefore are not as likely to necessarily have DM. Surgery patients are also often in for mechanical problems rather than purely internal health issues, and so DM is not as prevalent.

Surgical patients with CDI had higher rates of cancer than trauma or medical patients as well. This also, is likely due to the original condition leading to hospitalization rather than due to correlation to CDI. Many of these patients were undergoing surgery to remove cancer or for resections. Because of this, all surgical patients likely have higher rates of cancer as a comorbidity rather than just CDI surgical patients.

CVD had higher rates of prevalence in trauma and surgery CDI patients than in medical patients. This is interesting, as CVD is an internal, ongoing health problem and would therefore seem to be more likely in all medical patients than in trauma or surgery. This leads to the idea that it is possible CVD in trauma and surgery patients affects the ease of contraction of *C. difficile* bacteria and CDI. Cardiovascular problems often lead to more complications and longer hospital stays after surgery or trauma, as the cardiovascular system takes on much of the stress of these two admissions. Longer hospitalization time, ICU time, and increased antibiotic use are predictors of nosocomial infections, particularly CDI. This could give reason for why more CVD patients in trauma and surgery had CDI than those in the medical group. It should also be considered that only 4 patients total had CVD (trauma=2, surgical=1, medical=1). This low overall frequency should be taken into account.

Finally HIV was higher in surgical patients than in the other two groups. There was, however, only 1 instance of HIV in all of the CDI patients, so this percentage may be skewed. It is also interesting to consider, however, such a low rate of HIV in patients with this hospital-acquired infection. Subjects with immunodeficiency should be more likely to contract nosocomial infections, as they cannot fight off these foreign bacteria easily. In this study, however, this was not the case. This could be due to the higher initial precautions taken for HIV patients in the hospital to prevent their exposure to pathogens. If this is the case, these measures should be looked into and expanded throughout the hospital to help lower the rates of CDI and nosocomial infections in general throughout.

Quantitative Variables:

Total length of stay in the ICU was significantly longer for trauma patients when compared to medical patients. This could be the result of several issues. First, trauma patients tend to have long ICU stays in general due to their often critical conditions on admission to the hospital. This would mean that the infection didn't actually play a role in this difference. However, it could instead be at least in part caused by the severity of the CDI in these critical patients. With bodies trying to heal from major traumas, it is going to take a longer period of time for the patients to fight off infections, and can also result in increased severity of the infection. The increased length of ICU stay in trauma CDI patients is likely not due to one or the other of these possible explanations, but is rather a combination of both. This being said, this is certainly a major difference between CDI trauma and medical patients.

Total amount of days on mechanical ventilation was also significantly higher in the trauma group when compared to medical. This, similar to length of ICU stay, could be due to trauma patients in general needing longer mechanical ventilation. This, however, could also have a causal relationship with CDI. Mechanical ventilation is an extra entrance into the body where bacteria can accumulate and cause a myriad of infections. With longer ventilation time, there is a higher chance of these bacteria to be internalized and cause infection. Because trauma patients are on these ventilators for more days, they increase their chances of contracting CDI. Finding a way to better clean and care for this equipment, as well as being sure not to prolong its use more than necessary could both work to lower CDI rates throughout the hospital, particularly for post-trauma bay patients in the ICU.

Number of days with a Foley catheter also showed difference between all groups. The foley acts in a similar way as the mechanical ventilation, providing another pathway for *C. difficile* into the body. The average number of days with a Foley for trauma and surgery patients was greater (although not significantly) than medical patients, and so similar ideas as for ventilation when it comes to cleanliness and limited use should apply.

Finally, total length of stay differed significantly between trauma and medical CDI patients. Again, this is correlated with the longer length of ICU stay, and the longer stay in general needed for trauma patients due to their diagnoses on admission. It also can be causal, in that the longer stay for trauma patients can be a potential hazard and contribute to their contraction of CDI. In turn, the infection itself in very weakened and healing bodies could also lengthen the total length of stay needed for recovery after trauma and infection.

Limitations:

The retrospective method of data collection that was used in this study is not as accurate as prospective data collection would be. Prospective data collection could give more accurate results, but at the cost of time and possibly sample size. The data was also collected from one single hospital, which could limit the generalizability of these findings to other ICU settings. Finally, as an observational study, selection bias may have occurred from unmeasured variables.

Continuation:

Nearly all of the statistics for trauma and surgical patients did not significantly differ, but rather were nearly identical. It would be interesting to combine these two groups and compare them to a baseline of medical CDI patients, and see how this changes the interpretation of data. In addition, the calculation and use of APACHE scores for comparison of the severity of CDI on the initial day of infection would also yield possibly pertinent information on the difference of infection severity between the 3 study groups sampled.

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