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Post-Operative Complications After Lower Extremity Arterial Bypass Increase the Risk of New Deep Venous Thrombosis

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Abstract

Background—Deep venous thrombosis (DVT) after any surgical operations is considered a preventable complication. Lower extremity bypass surgery (LEB) is a commonly performed operation to improve blood flow to lower extremities in patients with severe Peripheral Arterial Disease (PAD). Despite advances in endovascular surgery, lower extremity arterial bypass remains the gold standard treatment for severe, symptomatic PAD. The purpose of this study is to identify the clinical risk factors associated with development of DVT after lower extremity bypass surgery.

Methods—The American College of Surgeons' NSQIP database was utilized and all lower extremity bypass procedures performed in 2013 were examined. Patient and procedural characteristics were evaluated. Univariate and multivariate logistic regression analysis was used to determine independent risk factors for the development of post-operative DVT.

Results—A total of 2,646 patients (65% males and 35% females) underwent lower extremity open revascularization during the year 2013. The following factors were found to be significantly associated with post-operative DVT: transfusion >4 units of packed red blood cells (OR 5.21, CI 1.29–22.81, p=0.03), post-operative UTI (OR 12.59, CI 4.12–38.48, p<0.01), LOS >28 days (OR 9.30, CI 2.79–30.92, p<0.01), bleeding (OR 2.93, CI 1.27–6.73, p=0.01), deep wound infection (OR 3.21, CI 1.37–7.56, p<0.01), unplanned reoperation (OR 4.57, CI 2.03–10.26, p<0.01). Of these, multivariable analysis identified the factors independently associated with development of DVT after lower extremity bypass surgery to be unplanned re-operation (OR 3.57, CI 1.54 – 8.30, p<0.01), re-intubation (OR 8.93, CI 2.66 – 29.97, p<0.01) and urinary tract infection (OR 7.64, CI 2.27 −25.73, p<0.01). Presence of all three factors was associated with a 54% incidence of DVT.

Conclusions—Development of DVT after lower extremity bypass is a serious but infrequent complication. Patients who require unplanned return to the operating room, re-intubation, or

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develop a postoperative urinary tract are at high risk for developing postoperative DVT. Increased monitoring of these patients and ensuring adequate DVT prophylaxis for such patients is suggested.

INTRODUCTION

Post-operative deep venous thrombosis (DVT) is considered a preventable patient safety indicator[1]. Unfortunately, most DVT episodes are asymptomatic[2]. Duplex ultrasonography and D-dimer serum levels can identify new DVTs in asymptomatic patients in the postoperative time period[3,4]. Vascular surgery patients characteristically have co-existing morbidities, which would increase their risk for development of DVT. Our previous analysis has shown that vascular surgery patients are more prone to developing postoperative DVTs as compared to general surgery patients[5]. Patients who undergo open surgical bypasses in the current era likely represent patients with more advanced atherosclerotic disease, many of whom have already likely failed prior endovascular interventions. They are not usually ambulating well because of their symptomatic peripheral arterial disease and in the post-operative time period will be limited due to pain of the lower extremity incisions. Patients requiring complicated operations with prolonged stasis of blood in leg veins are at a high risk for developing DVT. While administration of heparin during the operations can be reassuring, evidence[5] clearly shows that incidence of DVT among vascular surgery and cardiac surgery patients is higher than other surgical specialties. The purpose of this study was to determine the incidence of postoperative DVT among patients undergoing peripheral arterial bypasses and to help identify the clinical factors associated with this complication.

METHODS

Data set:

The American College of Surgeons' (ACS) National Surgical Quality Improvement Program (NSQIP) is one of the largest surgical databases, which has been validated and used extensively for clinical studies. The ACS-NSQIP provides data in the form of Participant Use Files (PUF)[6], which consist of a large number of pre-operative, intra-operative and post-operative variables. In order to maintain patient privacy and compliance with Health Insurance Portability and Accountability Act (HIPAA), ACS deletes all patient identifiers. Prior publications have described the methods used to extract data from NSQIP database[7–11]. The number of participant institutions in this registry has increased since the inception of NSQIP and it is estimated that more than 800 institutions are now included in this database. A nurse especially trained for ACS-NSQIP enters data at each site. Database audits are performed annually to confirm accuracy of data entry, which has been shown to be reproducible and highly reliable[9]. Since there are no patient identifiers in the NSQIP database, no Institutional Review Board (IRB) approval or patients' consent was required.

Patients:

All patients who underwent lower extremity open revascularization procedures at the sites participating in ACS-NSQIP during the year 2013 were identified. Only unilateral infra-inguinal bypass procedures were included in this study. Patients were divided into two groups: no DVT and DVT groups, and this was used as the outcome variable in a bivariate analysis of potential predictor variables.

Outcomes:

The primary outcome was a new diagnosis of deep venous thrombosis within 30 days after lower extremity revascularization surgery. Demographic data and pre-operative clinical variables were analyzed: age, gender, race, body mass index (BMI), symptoms, pre-operative use of aspirin and statins, transfer status, diabetes mellitus, dialysis dependency, congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD), hypertension, smoking, emergency operation, leg infection, and transfusion of more than 4 units of packed red blood cells (PRBCs) within 72 hours before surgery.

Intra-operative variables examined included: wound classification, type of operation, duration of operation, anatomic high risk factors, type of anesthesia and American Society of Anesthesiology (ASA) classification. Post-operative variables included urinary tract infection (UTI), length of hospital stay (LOS), bleeding requiring transfusion, major amputation within 30 days, untreated loss of patency, deep wound infection, acute renal failure, unplanned reoperation, cardiac arrest, myocardial infarction, wound dehiscence, organ space infection, pneumonia, unplanned intubation, superficial surgical site infection (SSI) and mortality.

Statistical Analysis:

All variables were initially summarized with frequencies and percentages or means, medians, and standard deviations. Binomial logistic regression was used to determine any bivariate associations of independent variables with DVT within 30 days after lower extremity revascularization surgery. Odds ratios were used to quantify the magnitude and direction of any significant associations. The statistically significant ($p<0.05$) independent variables from the bivariate analysis along with demographic variables were then used in a process of stepwise selection to find the group of variables collectively that were most significantly associated with DVT in a multivariable logistic regression model. Prior to the multivariable analysis, the independent variables were checked for multicollinearity using variance inflation factor (VIF) statistics. With so many variables and a large sample size, a more stringent entry criteria of $p<0.05$ and a stay criteria of $p<0.05$ were used for the stepwise process of variable selection to be more conservative. Forward and backward selection methods were also employed to check for other potential models, but the three approaches resulted in similar reduced models. The fit of the final model was checked using the Pearson and Deviance goodness-of-fit statistics). The c-statistic ($c=0.682$) shows adequate prediction strength of the final model. All analyses were performed using SAS version 9.4 (SAS Institute, Cary, NC).

RESULTS

Demographics and preoperative comorbidities:

A total of 2,646 patients (65% Males, 35% Females) underwent lower extremity open revascularizations in the year 2013. Mean age was 67.7 (± 11.3) years. Among these patients, 2622 (99.1%) did not have any DVT within 30 days after operation, while 24 (0.9%) developed a new DVT within 30 days after operation.

Univariate analysis of 30-day readmission:

Patient distribution was as follows: no DVT (N=2646) and DVT (N=24) groups, and this was used as the outcome variable in a bivariate analysis of potential predictor variables. The following factors were found to be significantly associated with post-operative DVT in bivariate analysis using logistic regression: transfusion of more than 4 units of packed red blood cells in 72 hours before surgery (OR 5.21, CI 1.29–22.81, p=0.03), post-operative urinary tract infection (UTI) (OR 12.59, CI 4.12–38.48, p<0.01, LOS >28 days (OR 9.30, CI 2.79–30.92, p<0.01), bleeding requiring transfusion (OR 2.93, CI 1.27–6.73, p=0.01), major amputation within 30 days (OR 4.02, CI 1.18–13.72, p=0.03), deep wound infection (OR 3.21, CI 1.37–7.56, p<0.01), acute renal failure (OR 8.11, CI 1.02–63.18, p=0.05), unplanned reoperation (OR 4.57, CI 2.03–10.26, p<0.01), cardiac arrest requiring cardiopulmonary resuscitation (OR 12.46, CI 2.74–56.75, p<0.01) and unplanned intubation (OR 13.60, CI 4.44–41.69, p<0.01) (Table I).

Multivariable analysis:

The following factors were found to have significant associations with postoperative DVT in a multivariable model: unplanned re-operation (OR 3.57, CI 1.54–8.30, p<0.01), re-intubation (OR 8.93, CI 2.66–29.97, p<0.01) and urinary tract infection (OR 7.64, CI 2.27–25.73, p<0.01) (Table II).

Predicted probability of DVT:

The probability of developing post-operative DVT was calculated for all of the factors identified to be significant in the multivariable analysis, either alone or combined. The probability of post-operative DVT was 0.49% in absence of unplanned re-operation, UTI and re-intubation. Probability of DVT was 1.72% in patients who required unplanned re-operation, 3.61% in patients who developed a UTI and 4.19% for patients who required re-intubation. In the presence of unplanned re-operation, UTI and re-intubation, the probability of developing post-operative DVT was 54.42%.

DISCUSSION

Development of DVT during a hospital admission is considered an indicator of poor quality of health care by the Agency for Healthcare Research and Quality (AHRQ). The Joint Commission uses in-hospital DVT as a benchmark for hospital performance. For the past several years, the Centers for Medicare and Medicaid Services (CMS) has refused to reimburse hospitals for certain hospital acquired conditions, which include a new diagnosis of DVT[12]. However, DVT is a common hospital-acquired complication although it is now considered preventable. The Office of the Surgeon General considers thromboembolism to be a major public health problem affecting more than 350,000 people per year[13]. One of the reasons for strong emphasis on this issue stems from the fact that adequate DVT prophylaxis has been shown to be an effective strategy in DVT prevention[14]. For example, it has been shown that in the absence of adequate prophylaxis, almost half of hip replacement patients will develop DVT and almost 20% will develop pulmonary embolism (PE)[15]. However, the argument that all DVT can be prevented and that the occurrence of any DVT reflects substandard care has not been substantiated and is physiologically unlikely.

Patients with peripheral arterial disease represent a cohort of patients with significant risk factors for the development of DVT. Over the past decade, the advancements in endovascular technology have led to an exponential increase in the number of endovascular interventions to treat patients with lower extremity peripheral arterial disease. Presently, patients who require open surgical bypasses for lower extremity PAD are a likely a sub-group of patients who have either failed prior endovascular interventions or have anatomy not feasible for even attempted endovascular therapy. Mortality, wound infection, UTI, myocardial infarction, pneumonia and acute renal failure are known index complications after open surgical bypasses[16]. It has been shown that despite the administration of intra-operative anticoagulation, vascular and cardiac surgery patients are at a high risk for developing postoperative DVT when compared to general surgery patients[5]. Our univariate analysis identified only one pre-operative variable (pre-operative transfusion of more than 4 units of blood) to be associated with increased risk of postoperative DVT. Univariate analysis revealed numerous post-operative factors associated with an increased risk of developing DVT, however, multivariable analysis showed a strong independent correlation only with unplanned re-operation, re-intubation, and UTI. Although, it is difficult to establish a direct cause and effect relationship between these postoperative complications, our data clearly shows that in presence of all three of these complications, the calculated probability of DVT is in excess of 50% (Table III). These findings have potentially important implications for vascular surgeons. Traditionally, quality improvement projects in the surgical field have focused on determining the incidence of several postoperative complications and their clinical consequences. The concept of failure to rescue (FTR)[17–20] is built on the fact that a hospital's complication rate correlates with the ability of its health care providers to respond to and treat complications. Institutions in which post-operative complications are managed promptly and appropriately tend to have better outcomes as compared to facilities where initial warning signs of pending complications are ignored, leading to development of a subsequent series of complications. A thorough understanding of the epidemiology of postoperative complications is therefore crucial to developing strategies to preventing complications. Review of the surgical literature shows that development of index complications predisposes patients to developing subsequent, secondary complications[21,22] Unless physicians develop a heightened sense of the patterns of complications after specific operations, we will continue to have high complication rates after surgical procedures. A recent analysis of patients undergoing peripheral arterial bypasses[16] failed to recognize post-operative DVT as an index complication. Our data shows that patients who develop any of these complications should be monitored for development of DVT and physicians should ensure adequate mechanical and pharmacologic prophylaxis for such patients.

Development of any infectious complications, such as UTI, should be monitored very closely. Inflammation is strongly associated with vascular endothelial dysfunction and endothelial activation may lead to venous thrombosis[23–26]. It has been shown that even in the outpatient setting, when patients are usually ambulatory, the risk of venous thromboembolism is substantially higher after development of any infection[27]. Hospitalized patients are generally less mobile and are at even higher risk for developing thromboembolic complications[28]. Surgical patients are a unique subgroup of hospitalized patients, as any operation is a systemic stress, initiating the release of inflammatory makers. In addition, immediately after surgery, most patients are not mobile due to postoperative pain. Patients after lower extremity bypass have incisions on the leg and this may make them even less prone to movement of their legs and ambulation. A combination of all these factors predisposes lower extremity bypass patients to be the development of thrombotic complications.

This study has several limitations. It is a retrospective analysis and the data is limited to only those variables which were recorded in NSQIP and during the 30 days after surgery. Several important variables, which are associated with DVT (history of malignancy, hypercoagulability, anticoagulant use and previous history of DVT) are unfortunately not recorded in this database. The results of this analysis should be interpreted with caution. Despite having a large sample size, only 24 patients had an episode of DVT. This may make the statistical model over fitted. The strength of this analysis is that ACS-NSQIP is the largest surgical database, represents the spectrum of care across the U.S. and previous publications based on this database have shown reproducible results. Fortunately for patients, the incidence of DVT is low, however, create a dilemma when creating a suitable statistical model, which cannot be improved any further. A potential solution for solving such problems is increasing the sample size by including data from more than one year, however, given the fact that the overall incidence of DVT is so low that this issue cannot be fully mitigated and hence readers should interpret this study's results with caution.

To summarize, post-operative DVT after lower extremity open surgical bypass is an infrequent but serious complication. Our analysis shows a strong correlation between unplanned return to the operating room, re-intubation, UTI and the development of DVT. Occurrence of any of these complications in a patient after lower extremity bypass should alert physicians to the increased probability of developing DVT and elevate their level of suspicion and possibly increased monitoring. Additionally, DVT prophylaxis should be ensured and/or additional preventative measures should be employed.

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Table I:

Univariate Analysis

Variables	Total (n=2,646)	DVT (n=24)	No DVT (n=2,622)	OR (CI)	p-value
Pre-Operative Variables					
Age (years)					
- <75	1969 (74.4%)	20 (1.0%)	1949 (99.0%)	Reference	
- 75–85	525 (19.8%)	2 (0.4%)	523 (99.6%)	0.37 (0.08–1.6)	
- >85	152 (5.7%)	2 (1.2%)	150 (98.7%)	1.29 (0.3–5.6)	0.37
Gender					
- Male	1713 (64.7%)	12 (0.7%)	1701 (99.3%)	Reference	
- Female	933 (35.3%)	12 (1.3%)	921 (98.7%)	1.85 (0.83–4.13)	0.14
Race					
- Non-Hispanic White	1731 (73.4%)	15(0.87%)	1716 (99.1%)	Reference	
- Hispanic	123 (5.3%)	1 (0.8%)	122 (99.2%)	0.94 (0.02–6.2)	
- Non-Hispanic Black	454 (19.4%)	7 (1.5%)	447 (98.5%)	1.8 (0.61–4.7)	
- Non-Hispanic Other	36 (1.5%)	0 (0%)	36 (100%)	2.28 (0–10.9)	0.53
BMI					
- <25	887 (34.3%)	7 (0.8%)	880 (99.2%)	Reference	
- 25–29	877 (33.9%)	5 (0.6%)	872 (99.4%)	0.72 (0.23–2.3)	
- 30–39	731 (28.3%)	9 (1.2%)	722 (98.8%)	1.57 (0.58–4.23)	
- ≥40	89 (3.4%)	1 (1.1%)	88 (98.9%)	1.43 (0.17–11.75)	0.55
Pre-operative Symptoms					
- Other	55 (2.1%)	0 (0%)	55 (100%)	Reference	
- Claudication	684 (26.2%)	3 (0.4%)	681 (99.6%)	0.31 (0.05-Infinity)	
- Rest Pain	844 (32.3%)	12 (1.4%)	832 (98.6%)	1.1 (0.22-Infinity)	
- Tissue Loss	1032 (39.5%)	9 (0.9%)	1023 (99.1%)	0.67 (0.13-Infinity)	0.20
High Risk Physiologic					
- No	2046 (78.5%)	18 (0.9%)	2028 (99.1%)	Reference	
- Yes	562 (21.6%)	6 (1.1%)	556 (98.9%)	1.3 (0.48–3.1)	0.68
Pre-Operative Aspirin					
- No	489 (18.6%)	5 (1.1%)	484 (98.9%)	Reference	

Variables	Total (n=2,646)	DVT (n=24)	No DVT (n=2,622)	OR (CI)	p-value
- Yes	2139 (81.4%)	19 (0.9%)	2120 (99.1%)	0.87 (0.32–2.34)	0.78
Pre-Operative Beta Blockers					
- No	1012 (38.7%)	8 (0.8%)	1004 (99.2%)	Reference	
- Yes	1606 (61.3%)	16 (1%)	1590 (99%)	1.26 (0.54–2.96)	0.59
Pre-Operative Statins					
- No	809 (30.8%)	4 (0.49%)	805 (99.5%)	Reference	
- Yes	1816 (69.2%)	20 (1.1%)	1796 (98.9%)	2.24 (0.76–6.6)	0.14
Diabetes Mellitus					
- None	1472 (55.6%)	10 (0.68%)	1462 (99.3%)	Reference	
- IDDM	711 (26.9%)	7 (1.0%)	704 (99.0%)	1.45 (0.55–3.84)	
- NIDDM	463 (17.5%)	7 (1.5%)	456 (98.5%)	2.24 (0.85–5.93)	0.26
Dialysis Dependent					
- No	2499 (94.4%)	23 (0.9%)	2476 (99.1%)	Reference	
- Yes	147 (5.6%)	1 (0.7%)	146 (99.3%)	0.74 (0.09–5.5)	0.77
Congestive Heart Failure					
- No	2574 (97.3%)	23 (0.9%)	2551 (99.1%)	Reference	
- Yes	72 (2.7%)	1 (1.4%)	71 (98.6%)	1.6 (0.21–11.73)	0.66
COPD					
- No	2296 (86.8%)	22 (1.0%)	2274 (99.04%)	Reference	
- Yes	350 (13.2%)	2 (0.6%)	348 (99.4%)	0.59 (0.14–2.5)	0.48
Hypertension					
- No	446 (16.9%)	1 (0.22%)	445 (99.8%)	Reference	
- Yes	2200 (83.14%)	23 (1.05%)	2177 (99.0%)	4.7 (0.63–34.9)	0.13
Smoking					
- No	1560 (59.0%)	12 (0.8%)	1548 (99.2%)	Reference	
- Yes	1086 (41.0%)	12 (1.1%)	1074 (98.9%)	1.4 (0.65–3.2)	0.37
Emergency Operation					
- No	2495 (94.3%)	22 (0.9%)	2473 (99.1%)	Reference	
- Yes	150 (5.7%)	2 (1.3%)	148 (98.7%)	1.52 (0.35–6.52)	0.57
Transferred from other hospital					
- No	287 (10.9%)	4 (1.4%)	283 (98.6%)	Reference	

Variables	Total (n=2,646)	DVT (n=24)	No DVT (n=2,622)	OR (CI)	p-value
- Yes	2359 (89.2%)	20 (0.9%)	2339 (99.2%)	1.65 (0.56–4.87)	0.36
Wound Infection					
- No	1730 (65.4%)	16 (0.9%)	1714 (99.1%)	Reference	
- Yes	916 (34.6%)	8 (0.87%)	908 (99.1%)	0.94 (0.4–2.2)	0.89
Transfusion of >4 units of PRBCs in 72 hrs. pre-op					
- No	2599 (98.2%)	22 (0.9%)	2577 (99.2%)	Reference	
- Yes	47 (1.8%)	2 (4.3%)	45 (95.7%)	**5.2 (1.2–22.8)**	**0.03**
Intra-Operative Variables					
Wound Classification					
- 1 (Clean)	2496 (94.3%)	24 (0.9%)	2472 (99.0%)	Reference	
- 2 (Clean/Contaminated)	63 (2.4%)	0 (0%)	63 (2.4%)	1.16 (0–5.3)	
- 3 (Contaminated)	36 (1.4%)	0 (0%)	36 (1.4%)	2.03 (0–9.5)	
- 4 (Dirty/Infected)	51 (1.9%)	0 (0%)	51 (100%)	1.43 (0–6.62)	0.78
Type of Operation					
- Other	677 (25.6%)	9 (1.3%)	668 (98.7%)	Reference	
- Fem-distal with prosthetic	265 (10.0%)	1 (0.4%)	264 (99.6%)	0.55 (0.01–4.6)	
- Fem-distal with vein	491 (18.6%)	4 (0.8%)	487 (99.2%)	1.2 (0.25–5.08)	
- Fem endarterectomy	35 (1.3%)	1 (2.9%)	34 (97.1%)	4.3 (0.09–36.8)	
- Fem-pop with vein	882 (33.4%)	6 (0.7%)	876 (99.3%)	1.96 (0.62–6.75)	
- Fem-pop with prosthetic	58 (2.2%)	1 (1.7%)	57 (98.3%)	2.56 (0.06–21.64)	
- Pop-distal bypass with prosthetic	55 (2.1%)	1 (1.8%)	54 (98.2%)	2.7 (0.06–22.8)	
- Pop-distal with vein	175 (6.6%)	1 (0.6%)	174 (99.4%)	0.84 (0.02–6.98)	
- Profundoplasty	7 (0.3%)	0 (0%)	7 (100%)	15.97 (0–94.5)	0.60
Duration of Operation (minutes)					
- 0–169	677 (25.6%)	5 (0.7%)	672 (99.3%)	Reference	
- 170–224	636 (24.1%)	5 (0.8%)	631 (99.2%)	1.1 (0.31–3.7)	
- 225–300	664 (25.1%)	4 (0.6%)	660 (99.4%)	0.82 (0.22–3.05)	
- >300	668 (25.3%)	10 (1.5%)	658 (98.5%)	2.04 (0.69–6.0)	0.33
Anatomic High Risk Factors					
- None	1594 (60.2%)	13 (0.8%)	1581 (99.2%)	Reference	
- Previous bypass	606 (22.9%)	6 (1.0%)	600 (99.0%)	1.22 (0.46–3.2)	

Variables	Total (n=2,646)	DVT (n=24)	No DVT (n=2,622)	OR (CI)	p-value
- Previous endo intervention	446 (16.9%)	5 (1.1%)	441 (98.9%)	1.38 (0.49–3.9)	0.81
Anesthesia					
- General	2525 (95.4%)	22 (0.9%)	2503 (99.1%)	Reference	
- Epidural	30 (1.1%)	0 (0%)	30 (100%)	2.7 (0–12.74)	
- MAC/IV sedation	11 (0.4%)	1 (9.1%)	10 (90.9%)	11.3 (0.25–86.2)	
- Regional	5 (0.2%)	0 (0%)	5 (100%)	17.13 (0–97.4)	
- Spinal	75 (2.8%)	1 (1.3%)	74 (98.7%)	1.54 (0.04–9.7)	0.17
ASA Classification					
- 1	135 (5.1%)	1 (0.7%)	134 (99.3%)	Reference	
- 2	1937 (73.3%)	17 (0.9%)	1920 (99.1%)	1.2 (0.16–8.98)	
- 3	572 (21.6%)	6 (1.1%)	566 (98.9%)	1.4 (0.17–11.89)	0.91
Post Operative Variables					
Urinary tract infection					
- No	2601 (98.3%)	20 (0.8%)	2581 (99.3%)	Reference	
- Yes	45 (1.7%)	4 (8.0%)	41 (91.1%)	**12.6 (4.1–38.5)**	**<0.0001**
Length of Stay (days)					
- <7	1473 (55.7%)	9 (0.6%)	1464 (99.4%)	Reference	
- 7–<14	751 (28.4%)	5 (0.7%)	746 (99.3%)	**1.09 (0.36–3.3)**	
- 14–<21	255 (9.6%)	4 (1.6%)	251 (98.4%)	**2.6 (0.79–8.5)**	
- 21–<28	93 (3.5%)	2 (2.2%)	91 (97.9%)	**3.6 (0.76–16.8)**	
- >28	74 (2.8%)	4 (5.4%)	70 (94.6%)	**9.3 (2.8–30.9)**	**0.003**
Bleeding Requiring Transfusion					
- No	2190 (82.8%)	15 (0.7%)	2175 (99.3%)	Reference	
- Yes	455 (17.2%)	9 (1.9%)	446 (98.03%)	**2.93 (1.3–6.7)**	**0.01**
Major Amputation Within 30 days					
- No	2553 (96.5%)	21 (0.82%)	2532 (99.2%)	Reference	
- Yes	93 (3.5%)	3 (3.2%)	90 (96.8%)	**4.0 (1.2–13.7)**	**0.026**
Untreated loss of patency					
- No	2595 (98.1%)	24 (0.92%)	2571 (99.1%)	Reference	
- Yes	50 (1.9%)	0 (0%)	50 (100%)	1.5 (0–7.03)	1.00
Deep wound infection					

Variables	Total (n=2,646)	DVT (n=24)	No DVT (n=2,622)	OR (CI)	p-value
- No	2284 (86.4%)	16 (0.7%)	2268 (99.3%)	Reference	
- Yes	361 (13.7%)	8 (2.2%)	353 (97.8%)	**3.2 (1.4–7.6)**	**0.0007**
Acute Renal Failure					
- No	15 (0.6%)	1 (6.7%)	14 (93.3%)	Reference	
- Yes	2631 (99.4%)	23 (0.9%)	2608 (99.1%)	**8.1 (1.02–63.2)**	**0.05**
Unplanned Reoperation					
- No	2225 (84.1%)	13 (0.6%)	2212 (99.4%)	Reference	
- Yes	421 (15.9%)	11 (2.6%)	410 (97.4%)	**4.6 (2.0–10.3)**	**0.0002**
Cardiac Arrest Requiring CPR					
- No	21 (0.8%)	2 (9.5%)	19 (90.5%)	Reference	
- Yes	2625 (99.2%)	22 (0.84%)	2603 (99.2%)	**12.46 (2.7–56.75)**	**0.001**
Myocardial Infarction					
- No	62 (2.3%)	1 (1.6%)	61 (98.4%)	Reference	
- Yes	2584 (97.7%)	23 (0.9%)	2561 (99.1%)	1.8 (0.24–13.74)	0.56
Wound Dehiscence					
- No	2603 (98.4%)	24 (0.9%)	2579 (99.1%)	Reference	
- Yes	43 (1.6%)	0 (0%)	43 (100%)	1.8 (0–8.2)	1.00
Organ Space Infection					
- No	2629 (99.4%)	24 (0.9%)	2605 (99.1%)	Reference	
- Yes	17 (0.64%)	0 (0%)	17 (100%)	4.6 (0–22.1)	1.00
Pneumonia					
- No	2613 (98.8%)	23 (0.88%)	2590 (99.1%)	Reference	
- Yes	33 (1.3%)	1 (3%)	32 (96.9%)	3.52 (0.46–26.9)	0.23
Unplanned Intubation					
- No	2604 (98.4%)	20 (0.77%)	2584 (99.2%)	**Reference**	
- Yes	42 (1.6%)	4 (9.5%)	38 (90.5%)	**13.6 (4.4–41.7)**	**<0.0001**
Superficial Wound Infection					
- No	2482 (93.8%)	21 (0.85%)	2461 (99.2%)	Reference	
- Yes	164 (6.2%)	3 (1.8%)	161 (98.2%)	2.2 (0.65–7.4)	0.21
Mortality					
- No	2585 (97.7%)	2564(99.2%)	21 (0.8%)	Reference	

Variables	**Total (n=2,646)**	**DVT (n=24)**	**No DVT (n=2,622)**	**OR (CI)**	**p-value**
- Yes	61 (2.3%)	58 (95.1%)	3 (4.7%)	1.0 (1.0–1.0)	0.02

Table II:

Multivariate Analysis

Variables	**OR (CI)**	**p-value**
Unplanned Re-Operation	**3.6 (1.5 – 8.3)**	**<0.05**
Re-Intubation	**8.9 (2.7 – 30.0)**	**<0.05**
Urinary Tract Infections	**7.6 (2.3 – 25.7)**	**<0.05**

Table III:

Risk Prediction Model

Unplanned Re-Operation	UTI	Re-Intubation	Probability of DVT (%)
No	No	No	0.48
Yes	No	No	1.72
No	Yes	No	3.61
No	No	Yes	4.19
Yes	Yes	Yes	54.42