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Determining the impact of culture on venous thromboembolism prevention in trauma patients: A Southwestern Surgical Congress Multicenter trial

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ABSTRACT

Introduction: Venous thromboembolism (VTE) remains one of the principal causes of morbidity and death in trauma patients that survive the first 24 h. Recent literature on VTE prevention focuses on choice of chemoprophylaxis, specifically unfractionated heparin (UFH) versus low molecular weight heparin (LMWH). This singular focus on a multifactorial process may be inadequate to fully understand the optimal approach to VTE prevention. We hypothesized that variations in care between trauma centers could be used to identify key components of VTE prevention associated with better outcomes.

Methods: A 50 question survey of VTE management for years 2014–2016 was sent to 15 trauma centers. The survey included: demographics of the trauma centers, type and timing of chemoprophylaxis, ambulation expectations, and complementary services (geriatric trauma service (GTS), mobility teams, physical and occupational therapy (PT/OT)). Each center submitted their American College of Surgeons Trauma Quality Improvement Program (TQIP) Benchmark Report for Spring 2017. TQIP data included: mortality, observed rates of deep vein thrombosis (DVT) and pulmonary embolus (PE), and time to VTE prophylaxis. The survey and TQIP reports were blinded for analysis; descriptive statistics were utilized. The top DVT & PE TQIP performers were used to identify potential aspects of better care on the survey responses. The institutions' DVT and PE rates were then compared for these responses using Wilcoxon-Rank-Sum test.

Results: Fifteen trauma centers (13 Level-1, 2 Level-2) completed the survey; the centers admitted 1050–7200 trauma patients per year (median 3000). The majority of centers were University-affiliated (11 of 15) with general surgery residencies (14 of 15), Acute Care Surgery or Surgical Critical Care Fellowships, (9 of 15) and critical care boarded-surgeons only on-call (9 of 15). Few have geriatric trauma services (3 of 15) or mobility teams (1 of 15). Half the trauma centers have dedicated PT/OT teams for trauma or weekend coverage. With a total of 20,878 TQIP patients analyzed, the average observed DVT and PE rates were 1.27% (range 0.1–5.2%) and 0.68% (range 0–1.6%), respectively. Weekly lower extremity surveillance duplex (2 of 15) increased DVT detection (4.15% vs 0.80%, $p = 0.034$) but did not decrease PE rates (1.05% vs 0.62%, $p = 0.229$). Great variance was seen in choice, dosing and timing of chemoprophylaxis: UFH,⁴ LMWH daily,¹ LMWH twice-daily,⁵ LMWH weight-based dosing,⁴ and LMWH anti-Xa dosing.¹ The top 3 performers for DVT and PE all used different types of chemoprophylaxis. These top performers had a prominent culture of mobility: dedicated PT/OT teams for trauma or weekends and an expectation to ambulate 3-times per day. Weekend PT/OT teams were associated with lower DVT rates (median 0.40%, range 0.10–1.10% vs 1.30%, 0.60–5.20%, $p = 0.018$), and ambulation 3-times per day was associated with lower PE rates (median 0.20%, range 0.00–0.20% vs 0.80%, 0.40–1.60%, $p < 0.005$).

Conclusions: Considerable variation in VTE chemoprophylaxis exists among trauma centers. “Best practices” in this area requires further investigation. An expectation of mobility and investment in mobility resources may serve to decrease VTE rates in trauma patients compared to a singular focus on type of chemoprophylaxis administered.

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Introduction

In trauma patients that survive the first 24 h, venous thromboembolism (VTE) persists as one of the top causes of potentially preventable morbidity and mortality. The “true” incidence of VTE in patients following trauma ranges from 1 to 43%^(1,2). This broad range is a reflection of the patient’s pre-existing risk profile, the specific trauma patient population studied, the total trauma burden and injury pattern, chemical thromboprophylaxis (TPX), use of deep vein thrombosis (DVT) surveillance, and hospital-based care factors.^(2,3,4,5)

Despite the many factors affecting the VTE risk profile, the principle focus of VTE prevention remains on chemical TPX. This focus has centered on the comparison of unfractionated heparin (UFH) versus low molecular weight heparin (LMWH) and on the type of dosing models for LMWH (daily, twice daily, weight-based, anti-Xa guided, and thromboelastography).^(6,7,8,9,10,11,12) While potentially promising for high risk trauma groups, the LMWH dosing models can be labor intensive and may not confer better protection against VTE.^(3,9,10)

In 2017, two studies based on patients in the American College of Surgeons Trauma Quality Improvement Program (ACS-TQIP) database found LMWH to be superior to UFH in the prevention of DVT and pulmonary embolism (PE) for both severe traumatic brain injury (TBI) patients and all trauma patients^(8,13). In addition, both studies concluded that LMWH conferred a decreased risk of mortality as compared to UFH. This benefit in VTE prevention and mortality is difficult to apply clinically since the TPX dosing regimen and other VTE prevention strategies are not collected in the ACS-TQIP database. The Michigan Trauma Quality Improvement Program (MTQIP) attempted to better define the TPX regimen by surveying its member hospitals.⁸ The survey revealed that 83% of the hospitals preferred LMWH as the choice of VTE chemoprophylaxis however only 57% of admitted trauma patients received LMWH in the study. This divergence in preference and practice could reveal bias on the surgeon’s part and be responsible for the perceived improvement in mortality with LMWH.

The TQIP database studies offer great benefits, specifically the chance to compare patients with similar injuries and co-morbidity burdens in risk-adjusted models⁽¹⁾. However, the database does not reflect other aspects of patient care, specifically, dosing regimens of chemical TPX, VTE guidelines, trauma team design, patient care responsibilities, or the effectiveness of multi-disciplinary approach. Our group hypothesized that these variations in care between trauma centers could be used to identify key components of VTE prevention associated with better outcomes, when combined with TQIP benchmark reports.

Methods

After obtaining approval from the Baylor Scott & White Research Institute Institutional Review Board, a 50-question online survey regarding VTE prevention in the injured patient for the years 2014–2016 was created. The survey was designed to evaluate current controversies in VTE management and assess interventions that may be underreported in literature. Participating members of the Southwestern Surgical Congress Multicenter Trials Committee reviewed the survey for errors and clarity prior to distribution. The online survey was created through Qualtrics[®] and was not anonymous. Participating institutions were recruited through surgeon membership in the Southwestern Surgical Congress. In order to be a part of this trial, the surgeons agreed to answer the survey in conjunction with their trauma director, trauma surgeons and trauma program manager, and submit their institution’s Spring 2017 ACS-TQIP Benchmark Report. Data Use Agreements were

obtained if required by participating hospitals.

The survey assessed the following: demographics of the trauma centers and trauma teams, VTE prophylaxis protocols, ambulation expectations, and complementary services (geriatric trauma service (GTS), mobility teams, physical and occupational therapy (PT/OT)). TQIP data included: mortality, major complications, observed rates of deep vein thrombosis (DVT) and pulmonary embolus (PE), and time to VTE prophylaxis. The survey and TQIP reports were blinded for analysis; descriptive statistics were utilized. The top three DVT & PE TQIP performers were used to identify potential aspects of better care on the survey responses. The institutions’ DVT and PE rates were then compared for these survey responses using Wilcoxon-Rank-Sum test. All statistical analysis used SAS[®].

Results

The fifteen institutions that participated in this study represent a wide variety of trauma centers, including Level 1 and Level 2 ACS-designated trauma centers, high volume and low volume centers, and academic, community and hybrid programs (Table 1). The majority of the programs (93%, 14 of 15) had general surgery residencies, but only 9 of 15 had fellowships in Surgical Critical Care or Acute Care Surgery. More than half of the centers (60%, 9 of 15) had 8 or fewer trauma surgeons participate in trauma call, and most centers’ on-call trauma surgeons had additional board certification in Surgical Critical Care (67%, 10 of 15).

Table 1

Trauma Center Demographics as Collected from the survey. A VTE top performer was defined as the three institutions with the lowest DVT rate and the four institutions with the lowest PE rate. Three institutions were tied for the second lowest PE rate. Two institutions were a top performer in DVT and PE.

Demographic Questions	VTE Top Performer (n = 5)	Total (n = 15)
What is your ACS Level?		
Level 1	3	13
Level 2	2	2
Trauma admits per year?		
≤3000 admissions	3	10
>3000 admissions	2	5
How would you describe your trauma center?		
Academic/University Setting	3	11
Community	1	1
Hybrid	1	3
Do surgical residents participate in the care of trauma patients at your trauma center?		
Yes	4	14
Does your institution have a fellowship in Acute Care Surgery or Surgical Critical Care?		
Yes	2	9
How many surgeons participate in trauma call? ¹	10 ^{7–20}	9.5 ^{6–20}
How many surgeons participate in trauma call (with 8 surgeons as the breakpoint)?		
≤8	2	9
>8	3	6
What “team” is responsible for the daily care of trauma patients if admitted to the ICU?		
Both ICU and Trauma teams	0	3
Primarily ICU team	2	9
Primarily Trauma team	3	3
What “team” is responsible for daily care of trauma patients once admitted to the hospital wards?		
Trauma Team and Other Teams	1	4
Trauma Team Only	4	11
Does your center have a dedicated geriatric trauma service?		
Yes	1	3
Does the trauma team round on ALL admitted trauma patients?		
Yes	4	10

ICU = Intensive Care Unit.

(1) = Reported median and range (min-max).

The primary team managing the injured patient varies both from center to center and admission status. The ownership of trauma patients admitted to the intensive care unit (ICU) range from primarily ICU (60%, 9 of 15) to primarily trauma (20%, 3 of 15) to a combination of both (20%, 3 of 15). Most patients admitted to the surgical floor are managed by the trauma team only (73%, 11 of 15) or are at least rounded on by the trauma team (67%, 10 of 15). Very few centers had a dedicated geriatric trauma service (20%, 3 of 15).

The only survey question with universal agreement was that bilateral lower extremity sequential pneumatic compression devices (SCD) were standard of care, however great variance was seen in the contra-indications to placement on lower extremities and use of SCDs on the upper extremities or feet (Table 2). Almost all of the centers have a dedicated VTE prevention guideline for trauma patients (93%, 14 of 15), and the majority (67%, 10 of 15) have had the guideline in place for at least 4 years. Only two of the centers perform routine surveillance duplex for asymptomatic extremity DVTs (13%, 2 of 15), and only one center has specific indications for CTA of the chest (1 of 15) for the detection of PE as part of the DVT guidelines. Few centers have daily VTE prevention checklists (33%, 5 of 15) or monitor for adherence to the protocol regularly (0 of 15 for daily or weekly, 9 of 15 monitor monthly). There was little agreement on the timing of initiation of chemical TPX with regard to any of the surveyed trauma categories (Table 2) or on the specific regimen of chemical TPX (Table 3), even among the top performers.

While most centers do have a mobility expectation for trauma patients (73%, 11 of 15), only the top performers for DVT and PE (5 of 5) versus the others (0 of 10) had an expectation of at least three times daily (TID) ambulation. Half the centers (53%, 8 of 15) attempt to ambulate ventilated patients, but only 4 centers do this on a daily basis. Half the centers have PT/OT teams dedicated to trauma or PT/OT on the weekend, but only the top performers in DVT and PE had PT/OT services on the weekend (Table 2). Only 1 center has dedicated mobility services for trauma patients.

Our centers' TQIP Benchmark reports represent 20,878 (6.3%) of the 329,321 injured patients included for the national 2017 Spring TQIP report. Our average observed DVT and PE rates were 1.27% (range 0.1–5.2%) and 0.68% (range 0–1.6%) and compare similarly to the national rates for DVT (1.30%) and PE (0.6%) from the same 2017 TQIP report. The decile ranges for Mortality, Major Complications, and PE are broad and similar to the national decile ranges (Table 4). As a whole, our 15 centers seem to be a representative sample of the 441 centers represented in the 2017 Spring Benchmark report. Our top performers in DVT and PE were all 1st decile centers on the TQIP Benchmark report. The top 3 centers for DVT had a DVT rate of 0.2% (range 0.1–0.3%) compared to mean of 1.4% (range 0.4–5.2%) for the other centers. The top 4 performers for PE (3 centers had the same rate) had a PE rate of 0.2% (range 0–0.2%) compared to 0.9% (range 0.4–1.6%) for the rest. Two centers were top performers for both DVT and PE. In comparing the top performing centers to others based on survey questions, only weekend mobility or PT/OT services, VTE protocol in place for >4 years, and ambulation TID significantly decrease DVT or PE rates (Table 5).

All our top performers in DVT and PE use different VTE TPX regimens, including UFH 5000 units TID, LMHW 30 mg BID, and LMWH weight-based BID (Table 3). Fig. 1 represents the comparison of the initiation of chemoprophylaxis from the center's survey reported times to the TQIP documented times (in patients with length of stay greater than 4 days reported by 25th, 50th and 75th quartiles). Few centers actually initiate TPX as early as their reported survey times. Centers are most likely to initiate chemoprophylaxis in the hemorrhagic shock cohort within their survey reported times. The traumatic brain injury cohort revealed the

Table 2

Process Questions from the Survey.

A VTE top performer was defined as the three institutions with the lowest DVT rate and the four institutions with the lowest PE rate. Three institutions were tied for the second lowest PE rate. Two institutions were top performers in DVT and PE. Unless otherwise stated, the frequencies and percentages given are for the institutions who responded yes to the survey question.

Process Questions	VTE Top Performer (n = 5)	Total (n = 15)
At your institution, are lower extremity pneumatic compression devices mandatory or standard of care for all trauma patients?	5	15
Are certain patient populations excluded from lower extremity pneumatic compression devices for:		
Extremities with EX-Fix in place	3	10
Extremities at risk of crush injury or compartment syndrome	2	9
Recently diagnosed lower extremity DVT	3	7
No patient population is excluded	1	3
What time range is "usual" for your center to initiate Chemical VTE prophylaxis in:		
Traumatic Brain Injury		
<24 h	0	0
24–48 h	1	5
48–72 h	1	7
>72 h	3	3
Spinal Cord Injury		
<24 h	2	3
24–48 h	0	3
48–72 h	1	6
>72 h	2	3
Solid Organ Injury		
<24 h	2	3
24–48 h	2	9
48–72 h	1	3
>72 h	0	0
Elderly		
<24 h	4	11
24–48 h	0	3
48–72 h	1	1
>72 h	0	0
Hemorrhagic Shock		
<24 h	0	3
24–48 h	3	10
48–72 h	2	2
>72 h	0	0
Does your institution:		
Use foot pumps for DVT prophylaxis?	2	6
Use upper extremity Pneumatic Compression Devices?	0	3
Have a trauma specific VTE chemoprophylaxis protocol or guideline?	4	14
Perform routine lower extremity DVT screening or surveillance?	0	2
Routinely screen for DVT of the upper extremities?	0	1
Have a guideline regarding CTA of the chest to screen/diagnose PE?	0	1
Have a mobility Expectation?	3	11
Have a dedicated PT/OT Team for Trauma?	2	7
Have a mobility Team Separate from PT/OT or Nursing?	0	1
Have a mobility Team or PT/OT Team on Weekends?	5	7
Mobilize or ambulate intubated trauma patients?	3	7

greatest difference in survey reported times of TPX initiation at less than 4 days (15 of 15) compared to the TQIP median time to TPX initiation of 5 days (range 2–9 days). As a whole our top performers do not appear to start TPX any earlier than the other centers in the survey, except for in the hemorrhagic shock cohort (Fig. 1).

Discussion

VTE remains one of the most common and potentially preventable causes of morbidity and mortality in trauma patients that survive the first 24 h. The major focus of trauma literature on VTE

Table 3
Preferred VTE Chemoprophylaxis as reported on the Survey.

What is the preferred Chemoprophylaxis at your institution?	Top Performer (n = 5)	Total (n = 15)
Daily Lovenox 40 mg		1 (7%)
Heparin 5000 mg TID, Daily Lovenox 40 mg	1 (20%)	3 (20%)
Heparin 5000 mg TID, Lovenox 30 mg BID	1 (20%)	1 (7%)
Lovenox 30 mg BID	1 (20%)	3 (20%)
Lovenox 30 mg BID, BID Weight Adjusted	1 (20%)	2 (13%)
Lovenox BID Weight Adjusted	1 (20%)	3 (20%)
Lovenox BID Weight Adjusted & BID based on Anti-Xa levels		1 (7%)
Lovenox 40 mg BID		1 (7%)

Table 4
Descriptive Data from the Spring 2017 ACS-TQIP Benchmark Report.
The national average for all patients in TQIP for DVT = 1.30% and PE = 0.6%.

Variable	Minimum	25 th Pctl	Median	75 th Pctl	Maximum
NTDB ¹ registry number per institution	1054.00	1985.00	2721.00	3414.00	7164.00
TQIP ² registry number per institution	583.00	936.00	1067.00	1843.00	3198.00
TQIP Risk-Adjusted Mortality for All Patients per institution (%)	3.30	5.60	6.70	7.70	9.90
Risk-Adjusted Mortality for All Patients – TQIP Decile	1.00	3.00	5.00	7.00	10.00
TQIP Risk-Adjusted Major Complications for All Patients per institution (%)	2.90	5.80	7.20	9.10	15.10
Risk-Adjusted Major Complications for All Patients – TQIP Decile	1.00	4.00	7.00	9.00	10.00
TQIP DVT (%) per institution	0.10	0.40	0.90	1.40	5.20
TQIP PE (%) per institution	0.00	0.20	0.80	0.90	1.60
Risk-Adjusted for PE – TQIP Decile	1.00	3.00	8.00	9.00	10.00

DVT = Deep Vein Thrombosis.

PE = Pulmonary Embolism.

(1) = National Trauma Database.

(2) = American College of Surgeons – Trauma Quality Improvement Program.

Table 5
Univariate Analysis of Survey Questions for improved VTE outcomes.
Continuous variables are reported with median and range (min-max).

Rate	Variable	Median (Min-Max)	p-value
DVT	Weekend mobility		0.0177
	Yes	0.40 (0.10–1.10)	
	No	1.30 (0.60–5.20)	
	Ambulate TID		0.1332
	Yes	0.50 (0.10–1.10)	
	No	1.00 (0.30–5.20)	
	VTE Protocol in place ¹		0.0177
	0–4 years	1.00 (0.30–1.40)	
	>4 years	0.80 (0.10–5.20)	
	Dedicated PT/OT team for trauma		0.8622
Yes	0.90 (0.20–2.00)		
No	0.90 (0.65–1.15)		
PE	Weekend mobility		0.1429
	Yes	0.20 (0.00–1.60)	
	No	0.80 (0.40–1.30)	
	Ambulate TID		0.0045
	Yes	0.20 (0.00–0.20)	
	No	0.80 (0.40–1.60)	
	VTE Protocol in place ¹		0.1429
	0–4 years	0.80 (0.40–0.90)	
	>4 years	0.80 (0.20–1.60)	
	Dedicated PT/OT team for trauma		0.7695
Yes	0.50 (0.20–1.30)		
No	0.80 (0.45–0.80)		

(1) = One institution did not answer the question about how long the protocol has been in place.

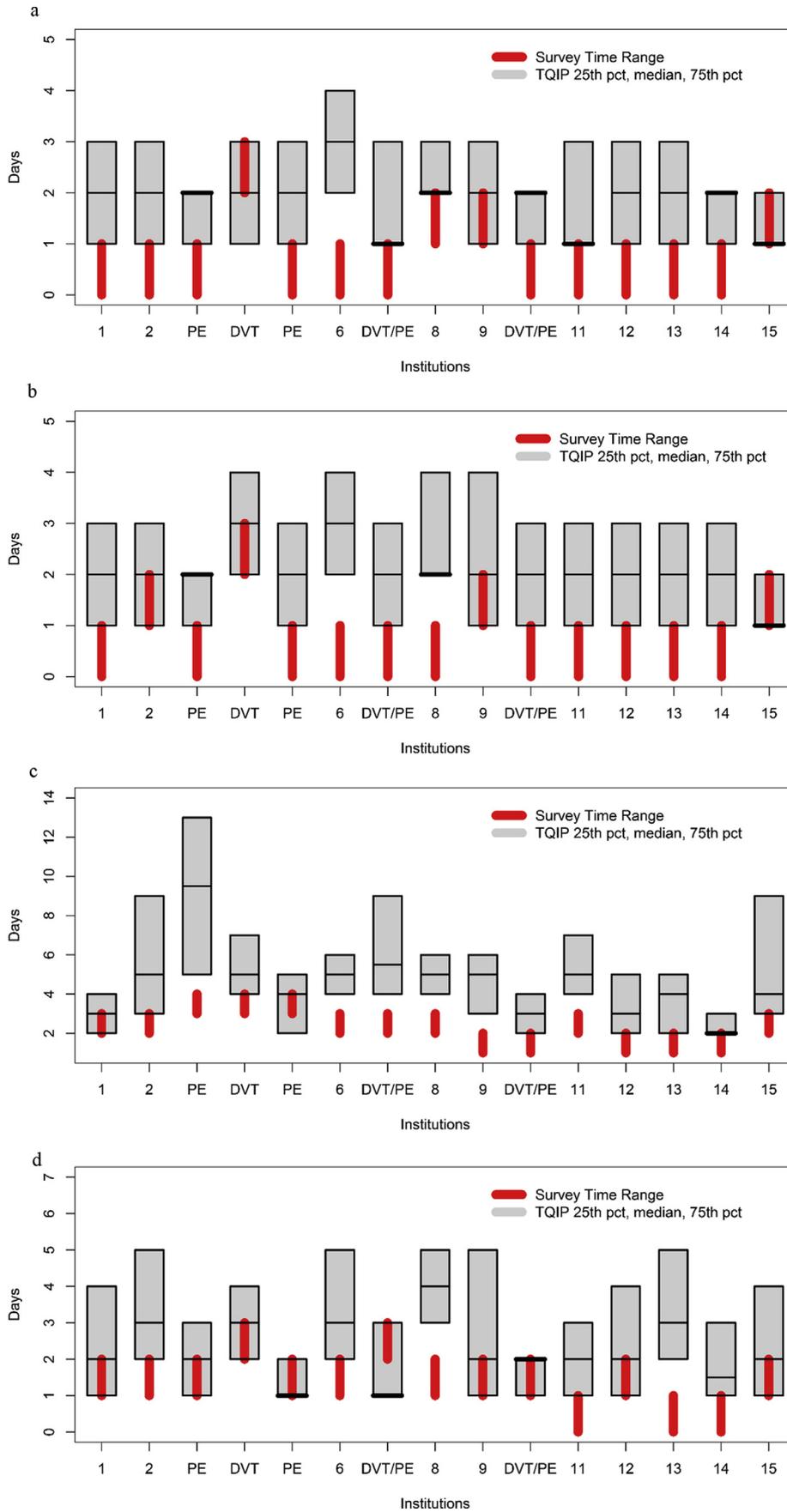
prevention centers on the use of chemoprophylaxis, including time to initiation, type and dosing of TPX, and anticoagulation goals based on weight, anti-Xa levels or TEG values.^{6–12} Virchow's triad of venous stasis, endothelial injury, and hypercoagulability is readily accepted as the pathophysiology for VTE events in the injured patient,¹⁴ however only the hypercoagulability arm has extensively been studied. Our study suggests the trauma

community may be overlooking other aspects of VTE prevention that may be equally important.

Our survey combined with the results of each center's Spring 2017 ACS-TQIP Benchmark Report suggest that VTE prevention may be more complex than the dichotomous comparison of UFH versus LMWH alone. The top performers in VTE have DVT and PE rates (0.2%, range 0.1–0.3% and 0.2%, range 0–0.2%, respectively) significantly lower than the national average for this time period (DVT 1.3% and PE 0.6%). While institutes employ a variety of TPX regimens, all 5 top performing institutions place a significant emphasis on a culture of mobility. The only survey questions statistically significant for lower DVT or PE rates were seven days per week of PT/OT/Mobility services (DVT rates - median 0.40%, range 0.10–1.10 vs 1.30%, 0.60–5.20%, $p = 0.018$) and daily ambulation of at least three times (PE rates - median 0.20%, range 0.00–0.20% vs 0.80, 0.40–1.60%, $p < 0.005$). Only the top performing institutions perform both of these measures. This mobility commitment requires a unified team approach, including surgeons, nurses, PT/OT, and hospital resources. This joint team investment in mobility may help augment the chemoprophylaxis regimen in lowering the VTE rates.

Our survey spotlights the great variation in care of the injured patient. While it is not powered to determine if trauma patients are better cared for by trauma only teams in the ICU or surgical wards, the survey can serve to better align processes of care in VTE prevention. Use of SCDs on lower extremities was the only question with 100% agreement, however there was little agreement on the contraindications to its use. Future VTE prevention guidelines could better define contraindications for use, and further elucidate which patients would benefit from upper extremity SCDs or foot pumps. These studies could then provide evidence of the efficacy of these measures.

Our centers displayed great variation in the timing of initiation of VTE chemoprophylaxis both on the survey and in the TQIP reports (Table 2 and Fig. 1). This is not surprising based on the high-



risk subsets of trauma patients assessed. Most studies attempt to focus on one specific patient population's risk of VTE and exert great resources to determining VTE prevention strategies.^{3,9–12} It would seem more reasonable to create a practical guideline for all levels of trauma centers and surgical subspecialties to apply to their patients. Creating a complete VTE practice management guideline is beyond the scope of this study. However, reasonable data currently exists to make some recommendations. Several recent studies suggest that it is not only safe but may provide a survival benefit to initiate VTE chemoprophylaxis in less than 72 h from admission for patients with TBI.^{13,15,24} The goal should be to have all patients with TBI initiated on chemoprophylaxis in less than 72 h with the understanding that the majority of patients with TBI can be initiated on prophylaxis at the 24-h mark.¹⁵ Patients with spinal cord injury or spine fractures had the greatest time range of survey answers from <24 h (3 of 15) to greater > 72 h (3 of 15). This divergent range creates significant disparities in patient care between trauma centers. Recent studies on traumatic spinal cord injury and spine injuries requiring fixation support the use of chemoprophylaxis at or before the 48-h mark to reduce VTE rates.^{16–18} None of the studies revealed an increase in perioperative blood loss, postoperative seroma or hematoma formation, progression of spine canal bleeding or new onset/progression of paralysis. The solid organ injury, elderly, and hemorrhagic shock cohorts were more aligned across the surveyed centers with about 80% agreeing to initiate chemoprophylaxis by 72 h, however the TQIP data reveals a very different story. Future recommendation would support the initiation of chemical TPX no later than 48 h with the understanding that <24 h will be safe for the majority of elderly patients or patients with solid organ injury.^{12,25–27} These “general” practice guidelines would help bring the standards of VTE prevention nationally to more acceptable norms.

All 5 of our top performers used different heparin moieties for their VTE chemoprophylaxis regimens, however given recent research in the use of anti-platelet medications and the prominence of antithrombin III deficiency in trauma patients, this may not be as an important focus in VTE prevention in future years.^{19–23} Rather, it is the culture of adherence to a center's chosen guideline that is important. Our survey revealed that only half of the centers monitor for adherence to their VTE guideline, and these centers only monitored adherence on a monthly basis. Given the divergence in survey answers and the TQIP data for the initiation of chemical TPX, more focus should be on attaining universal alignment with the center's guidelines. This alignment will improve future adherence to recommendations for ambulation, mobility, aspirin, or other VTE prevention strategies.

This study has clear limitations. Our survey of VTE management relies on the recall of each trauma center's trauma medical director and/or trauma team members for the preceding two years 2014–2016. The analysis then links these responses to TQIP outcomes. The TQIP outcomes and survey responses are casually

related at best. We are not able to verify the effectiveness of each center in accomplishing the ambulatory goals and are only able to extrapolate responses and outcomes over this time period. In addition, our trauma centers represent a fraction of the total hospitals participating in the Spring 2017 ACS-TQIP Benchmark report (3.4%, 15 of the 441). We assume that our centers are representative of the other level 1 and 2 trauma centers in TQIP. However, our subset may truly be different than the aggregate, and our outcomes may not apply to all centers. Likely most important, we are unable to verify that the patients that suffered a VTE event received the “standard of care” for that center, including the mobility goals. Finally, our paper assumes that the survey adequately addresses all aspects of VTE prevention. There may be confounders that the survey does not adequately evaluate. For instance, institutions that invest in weekend mobility teams or PT/OT teams may also have other resources or cultural benefits that decrease rates of VTE. Future studies will need to better account for these confounders.

Conclusion

A trauma center's culture of VTE prevention likely plays an important role in achieving better patient outcomes. The focus of VTE prevention should include aggressive ambulatory goals and strict adherence to chemical thromboprophylaxis guidelines. In order to achieve this, the entire trauma center, (surgeons, specialists, nurses, pharmacy, PT/OT, and hospital administration), must be aligned and empowered to create this culture. Future studies should include these factors in VTE prevention as part of their process for outcomes.

Conflicts of interest

The Author does not have any financial conflicts of interest.

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Fig. 1. Comparison of the Survey Reported Times of initiation of VTE chemoprophylaxis versus the time documented in TQIP for patients with admission length of stay greater or equal to 4 days.

For the following figures, the cohort survey times were paired with the corresponding TQIP times. The red bar represents the time answered on the survey for when VTE chemoprophylaxis is initiated. The gray bar represents the times as reported by TQIP. The lower edge of the bar is the 25th percentile (time when 25% of patients have received TPX). The dark gray line is the 50th percentile time, if the 50th percentile time and 25th or 75th percentile were the same. The top line is the 75th percentile (time when 75% of the patients have received TPX). Bars denoted as PE were top performers in PE. Bars noted as DVT are top performers in DVT.

Figure 1a. Survey question = What time range is usual for your center to initiate Chemical VTE prophylaxis in the General Trauma Patient Compared to the TQIP times for the ALL Patient Cohort.

Figure 1b. Survey question = What time range is usual for your center to initiate Chemical VTE prophylaxis in the Elderly Trauma Patient Compared to the TQIP times for the Elderly Cohort.

Figure 1c. Survey question = What time range is usual for your center to initiate Chemical VTE prophylaxis in the Traumatic Brain Injury Patient Compared to the TQIP times for the Severe TBI Cohort.

Figure 1d. Survey question = What time range is usual for your center to initiate Chemical VTE prophylaxis in the Hemorrhagic Shock Patient Compared to the TQIP times for the Shock Cohort.

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