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Implementation of ROTEM-guided hemostatic resuscitation and evolution of transfusion practices: a 15-year population-level analysis in a Level I trauma center

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Abstract

Background

Hemostatic resuscitation guided by viscoelastic testing has changed the management of trauma-induced coagulopathy. We evaluated changes in blood products transfusion and procoagulant use after implementation of rotational thromboelastometry (ROTEM)-guided coagulation management in patients with severe trauma.

Methods

15-year retrospective population-level analysis (2009–2023) of patients with severe trauma admitted to a Level I trauma center. Three periods were defined according to major changes in coagulation management: pre ROTEM ('Reference' period), ROTEM-guided management ('ROTEM' period) and ROTEM-guided management with tranexamic acid ('ROTEM + tranexamic acid' period). Quarterly incidences of blood products transfusion (red blood cells [RBC], platelets, fresh frozen plasma [FFP]), procoagulant products use (fibrinogen concentrate [FC], prothrombin complex concentrate [PCC]) and mortality were compared.

Results

Among 4,205 patients, 48% had an Injury Severity Score ≥ 15. ROTEM was performed in 92% of the most severely injured. The incidence of RBC transfusion decreased by 27% during the 'ROTEM' period (incidence rate ratio [IRR], 0.73; 95% confidence interval [CI], 0.64–0.84) and by 35% during 'ROTEM + tranexamic acid' period (IRR, 0.65; 95% CI 0.54–0.78). FFP transfusion also decreased over time. FC use increased by 50% during the 'ROTEM' period (IRR, 1.50; 95% CI, 1.11–2.05) and by 153% during the 'ROTEM + tranexamic acid' period (IRR, 2.53; 95% CI, 1.83–3.53). The proportion of patients requiring massive transfusion decreased from 19% to 4% during these periods. Incidence of 24-hours and ICU mortality were similar.

Conclusion

ROTEM-guided coagulation management was associated with reduced RBC and FFP transfusion and increased FC use, without change in mortality.

BACKGROUND

Severe trauma remains a leading cause of death in young adults. Trauma-induced coagulopathy (TIC) occurs early after injury and is associated with increased bleeding, transfusion requirements, organ dysfunction and mortality[1–5]. Early identification and management of TIC are therefore critical components of trauma resuscitation.

Diagnosis of TIC at hospital admission remains challenging and relies on a combination of clinical assessment and laboratory testing, including conventional coagulation assays and viscoelastic hemostatic assays (VHA) such as rotational thromboelastometry (ROTEM)[6]. In routine clinical practice, these tests can be used alone or in combination, with fixed transfusion algorithms to guide the administration of blood products such as fresh frozen plasma (FFP), platelets and red blood cells (RBC), or procoagulant products such as fibrinogen concentrates (FC) and prothrombin complex concentrates (PCC). There is no consensus regarding their use, therefore coagulation management protocols are heterogeneous among trauma centers[7].

Over the past decade, the VHA-guided approach has been associated with increased use of targeted procoagulant therapies, particularly FC, and reduced reliance on plasma-based transfusion strategies[8, 9]. However, evidence remains uncertain and most studies evaluating VHA-guided strategies are limited by small sample sizes, short observation periods or low implementation rates[8–10].

In addition, few studies have assessed the long-term, system-level impact of implementing VHA-guided coagulation management within a mature trauma system, where both clinical practices and adjunctive therapies such as tranexamic acid have evolved over time. Understanding these real-world changes is essential to evaluate how hemostatic resuscitation strategies translate into clinical practice[11, 12].

In this context, we conducted a 15-year population-level analysis in a Level I trauma center to evaluate changes in transfusion practices and procoagulant use following the implementation of a ROTEM-guided coagulation management protocol. We hypothesized that the adoption of ROTEM-guided strategies would be associated with reduced blood products transfusion and increased use of targeted procoagulant therapies.

METHODS

Design and setting

We conducted a retrospective, population-level observational study in a French Level I trauma center between January 1, 2009, and December 31, 2023. The STROBE guideline was used to ensure proper reporting of methods, results and discussion (**Supplemental Digital Content [SDC] 1**)**.**

The study was performed within the Trauma System of the Northern French Alps (TRENAU), an integrated regional trauma network established in 2008 to optimize prehospital triage and in-hospital management of severely injured patients based on the on-scene gradation of trauma severity by an emergency physician adapted from the French Vittel triage criteria[13]. Patients are referred to the nearest and most suitable trauma center according to severity of trauma. Of note, the most severe cases are systematically referred to Level I trauma center. Upon hospital arrival, early trauma care is performed by dedicated trauma teams in dedicated emergency trauma rooms. Detailed information about TRENAU gradation and orientation of severe trauma patients has been previously published[14].

Participants

We included all consecutive adult patients (≥16 years) with severe trauma admitted directly from the trauma scene to the trauma center and subsequently hospitalized in the intensive care unit (ICU). Severe trauma was defined according to the TRENAU triage classification (grades A, B, or C), based on prehospital assessment by an emergency physician[13,14]. Patients who died within the first hour of hospital admission in the emergency trauma room were excluded. These exclusions concerned patients with prehospital cardiac arrest, early withdrawal of life-sustaining therapies or massive bleeding related to pre-existing anticoagulant therapy. Exclusion criteria were applied to ensure homogeneity in evaluating transfusion practices during resuscitation.

Study Periods and Coagulation Management Protocols

We predefined three consecutive periods corresponding to major changes in coagulation management:

'Reference' period

From January 1st , 2009, to September 1st , 2011, during which ROTEM (ROTEM® delta, manufactured by Werfen, Le Pré Saint Gervais, France) was not yet available and blood products transfusion was based solely on clinical judgement and conventional laboratory findings, according to European guidelines[15,16]. Hemoglobin target was 7-9 g/dL. In the most severe cases, excessive bleeding was managed empirically using an FFP:RBC ratio of at least 1:2 before coagulation test results became available. Thresholds for defining TIC were PTratio greater than 1.2, and/or fibrinogen level <1.5 g/L and/or platelet count < 50 000/mm^3.

'ROTEM' period

From September 2nd, 2011, to December 31st, 2013, ROTEM was performed to guide blood products transfusion in grade A and grade B trauma patients, without systematic administration of tranexamic acid prior to trauma-center admission. ROTEM was systematically performed in grade A and B patients and could be performed in grade C patients at the physician's discretion. ROTEM analyses were performed in a standardized fashion in the hemostasis laboratory and treated as priority emergencies. The results were available on the computer located in the trauma room within an average time of 10 minutes.

To guide administration of hemostatic products, an algorithm was developed and validated by all trauma physicians, considering presence or absence of hemorrhagic shock and results of ROTEM (CT EXTEM, A5 FIBTEM, A10 FIBTEM; **SDC 2**). Of note, FC was administered if there was evidence of fibrinogen deficit (based on A5 FIBTEM and/or A10 FIBTEM) or pre-emptively in case of hemorrhagic shock. PCC were administered only if there was severe bleeding with evidence of coagulation factors deficit (based on CT EXTEM). FFP were administered pre-emptively in case of hemorrhagic shock or as an alternative to PCC in case of documented coagulation factors deficit. Platelets were administered in case of

hemorrhagic shock or if there was severe bleeding with evidence of platelet dysfunction (based on A10 EXTEM and A10 FIBTEM). Hemoglobin target was ≥ 7 g/dL, platelet count target was ≥ 50 000/mm3 or ≥ 100 000/mm3 in case of traumatic brain injury and/or active bleeding.

'ROTEM + tranexamic acid' period

From January 1st, 2014, to December 31st, 2023, ROTEM continued to be performed as previously and early administration of tranexamic acid became recommended, according to the results of the CRASH-2 trial[17]. Patients were administered 1 gram of intravenous tranexamic acid during the first 3 hours following the injury, either in the prehospital phase of care or at emergency trauma room admission. After hospital admission, if necessary, an additional 1 g over an 8-h continuous infusion was administered. A new algorithm was developed and internally validated, considering presence or absence of hemorrhagic shock and the results of ROTEM (A10 FIBTEM, CT EXTEM, A10 EXTEM; **SDC 3**). The main difference compared to the 'ROTEM' period coagulation management protocol was the possibility of prophylactic administration of FC in case of abnormal FIBTEM and presence of one of the following conditions: to prevent secondary injuries threatening functional prognosis (intracranial or spinal cord injuries); in case of lesions associated with potentially significant blood loss (AAST grade ≥ 3 splenic and/or hepatic injuries, retroperitoneal injuries, vascular injuries, unstable pelvic fractures) or in case of urgent hemorrhagic surgery.

These periods were defined a priori to reflect stepwise implementation of hemostatic strategies rather than individual-level exposure.

Data sources

Data were obtained from multiple institutional and national databases and merged at the individual level using unique identifiers. Following data were extracted from the hospital database: age, sex, simplified acute physiology score (SAPS II), length of ICU stay (in days) and vital status upon ICU discharge. Type of injury, clinical presentation upon admission, grade (A, B, or C) and Injury severity score (ISS) were obtained from the TRENAU database (from 2009 to 2018). Data regarding use of ROTEM were obtained from the laboratory. Data regarding procoagulant products use were obtained from the in-hospital pharmacy, as follows: FC, in grams (Clottafact®, LFB, Les Ullis, France) and PCC, in international units (Kanokad®, LFB, Les Ullis, France; or Octaplex®, Octapharma, Boulogne Billancourt, France). Data were obtained from the blood bank (French Blood Establishment) for blood products use, as follows: RBC, in units; platelets, in units; and FFP, in units. These data sources provided exhaustive and prospectively recorded information on transfusion and procoagulant use throughout the study period.

Outcomes

Our main objective was to describe the trends in overall consumption in blood products and procoagulant products over the study period. Primary endpoints were the incidences in consumption of

RBC, FFP, platelets, FC and PCC. Incidence was defined, for each product, as the number of patients receiving at least one unit, per 100 trauma admissions. Incidences were reported per quarter.

Our secondary objectives were to describe evolutions of the following criteria: massive transfusion requirement (defined as transfusion of ≥10 units of RBC within the first 24 hours), uptake of ROTEM (in % of admissions), ICU length of stay (in days), 24-hour mortality and ICU mortality.

Statistical analyses

We conducted a longitudinal population-level analysis of quarterly incidence trends. For each outcome, we calculated incidence rates per 100 trauma admissions. Temporal trends were analyzed using Poisson regression models with a log link function and the number of trauma admissions as an offset. Models were adjusted for time (in quarters) to account for underlying temporal trends. Results were expressed as incidence rate ratios (IRR) with 95% confidence intervals (95%CI), comparing the 'ROTEM' and 'ROTEM + tranexamic acid' periods to the 'Reference' period. Given the ecological design of the study, analyses were not adjusted for individual-level confounders, and no causal inference can be drawn from the observed associations. No imputation was performed for missing data. In sensitivity analyses time was modelled using seasonal effects, and results are not presented as yielding similar results. All analyses were conducted using R software (version 4.3.2)[18].

RESULTS

Study population

Over the study period, 6111 patients were admitted to the trauma emergency room. Among those, 4325 patients aged 16 years old or older presented with severe trauma (grade A, B or C). After exclusion of 120 patients who died within the first hour of admission, a total of 4,205 patients were included in the analysis (**Figure 1**).

Characteristics

The median age was 39 years (interquartile range [IQR], 26–55), and 77% of patients were male (**Table 1**). Overall, 48% among patients with available ISS data had an ISS ≥15. Median SAPS II at 24 hours was 16 (IQR, 8–26). Across the entire study population, ROTEM was performed in 46%. Following implementation, ROTEM was performed in 53% of patients overall and in 92% among the most severely injured patients (Grade A).

Overall Transfusion and Procoagulant Use

Overall, 619 patients (15%) received at least one unit RBC, including 44 patients (7% of RBC-transfused patients) who underwent massive transfusion (**Table 2**). The proportion of massive transfusion decreased across periods, from 19% during the 'Reference' period to 11% during the 'ROTEM' period and 4% during the 'ROTEM + tranexamic acid' period. FFP was administered to 175 patients (4%), platelets to

109 patients (3%), FC to 474 patients (11%), and PCC to 77 patients (2%). Median ICU length of stay was 5 days (IQR, 1–12). Concerning mortality, 24-hour mortality was 2.0% overall (2.0% during the Reference period, 2.1% during the ROTEM period and 1.9% during the ROTEM + tranexamic acid period). ICU mortality was 6.9% overall, with no significant difference across study periods.

Temporal Trends in Transfusion and Procoagulant Use

There was a significant reduction in the incidence of RBC and FFP transfusion over time (**Table 3**). Compared with the 'Reference' period, the incidence of RBC transfusion decreased by 27% during the 'ROTEM' period (IRR, 0.73; 95% CI, 0.64-0.84) and by 35% during 'ROTEM + tranexamic acid' period (IRR, 0.65; 95% CI 0.54-0.78). FFP transfusion also decreased during the 'ROTEM' period (IRR, 0.76; 95% CI, 0.62-0.93) and during 'ROTEM + tranexamic acid' period (IRR, 0.55; 95% CI, 0.37-0.81).

In parallel, FC use increased by 50% during the 'ROTEM' period (IRR, 1.50; 95% CI, 1.11-2.05) and by 153% during the 'ROTEM + tranexamic acid' period (IRR, 2.53; 95% CI, 1.83 to 3.53). Platelet and PCC use were not significantly different across periods.

Graphical Analysis of Temporal Trends

Graphical representation of quarterly incidences (**Figure 2**) showed a progressive decline in RBC and FFP transfusion over time and a parallel increase in FC use. Notably, reductions in RBC and FFP transfusion appeared to begin prior to the implementation of ROTEM, while the increase in FC use coincided more closely with the introduction of ROTEM-guided management and subsequent protocol changes. No clear temporal trend was observed for platelet transfusion, PCC use, or ICU mortality.

DISCUSSION

In this 15-year population-level analysis of patients with severe trauma, the implementation of a VHA-guided coagulation management strategy was associated with a substantial reduction in RBC and FFP transfusion, alongside a marked increase in FC use, without detectable change in ICU mortality.

Over the past two decades, trauma resuscitation has undergone major changes, with a progressive shift from empiric, ratio-based transfusion strategies toward an individualized, goal-directed hemostatic management. These changes have been driven by improved understanding of TIC, earlier administration of tranexamic acid, and the adoption of damage control resuscitation principles[1, 5, 17, 19]. Large observational studies and reviews have documented a global reduction in blood products use over time, reflecting these evolving practices[19–21]. Our findings are consistent with this broader trend and suggest that the observed reduction in transfusion requirements likely reflects both the implementation of ROTEM-guided strategies and concurrent improvements in trauma care.

Notably, visual inspection of temporal trends in our study indicates that reductions in RBC and FFP transfusion began prior to ROTEM implementation, suggesting the presence of secular trends. This observation highlights the importance of interpreting before–after analyses with caution and reinforces

that the association between ROTEM implementation and reduced transfusion cannot be considered causal. However, the magnitude of the reduction of overall transfusion requirement, including massive transfusion, was remarkable and ROTEM should be viewed as one component of a broader evolution toward targeted hemostatic resuscitation. In fact, some guidelines have evolved from suggesting that VHA may be performed, in addition to conventional biology, to characterize TIC and guide hemostatic therapy, toward a grade 1C recommendation to use either VHA or conventional biology for repeated assessments of TIC[7, 16].

Viscoelastic hemostatic assays such as ROTEM have been proposed to improve the diagnosis and management of TIC by enabling rapid, point-of-care assessment of coagulation status[8, 9, 22]. Randomized and observational studies have reported mixed results regarding their clinical impact. In a pragmatic randomized trial, Gonzalez et al showed that VHA-guided resuscitation was associated with reduced mortality compared with conventional coagulation assays, although subsequent studies such as the ITACTIC trial did not demonstrate a clear benefit on major clinical outcomes[10, 22]. Moreover, multiple recent trials evaluating the empirical administration of procoagulant products without systematic diagnosis of TIC have failed to demonstrate significant improvements in clinical outcomes, suggesting that a one-size-fits-all approach may not be effective [23–25]. These conflicting results may reflect several methodological issues, including heterogeneous definitions of severe trauma, delayed administration of hemostatic interventions, and the inclusion of patients without confirmed coagulation abnormalities[3, 26, 27]. Administering fibrinogen or other procoagulant therapies to patients without documented hypofibrinogenemia or TIC may dilute a potential treatment effect among those who are most likely to benefit. This may partly explain the neutral results of trials such as CRYOSTAT-2, in which treatment was administered empirically rather than guided by systematic identification of a specific coagulation deficit[24]. In this context, the principal value of a ROTEM-guided strategy may lie not in reducing mortality across an unselected trauma population, but in improving treatment specificity by rapidly identifying the patients most likely to benefit from targeted hemostatic therapy. ROTEM may reduce unnecessary treatment exposure while enabling earlier, individualized intervention in those with a demonstrated coagulation deficit. Our findings, showing substantial changes in transfusion practices without a detectable reduction in mortality, are consistent with this interpretation. However, the decrease in blood products use is a meaningful goal, robust evidence pointing towards a consistent association of multiple organ failure with increasing amounts of blood products use[9, 28–30]. Moreover, sparing transfusion is a major healthcare issue.

Another key finding of our study is the marked increase in FC use, which paralleled the reduction in FFP transfusion. Fibrinogen is the first coagulation factor to decrease during major hemorrhage and plays a central role in clot formation. Its depletion is associated with poor outcomes, including increased mortality and need for massive transfusion [31, 32]. To allow a targeted correction of hypofibrinogenemia, FC provides the advantages of immediate availability for use, storage at room temperature, quick reconstitution in low volume and high concentration, with an interesting safety profile alone or in association with PCC[33]. Compared to cryoprecipitate, which is not available in France, it allows a faster fibrinogen replacement and seems as effective[34, 35].Targeted fibrinogen

supplementation guided by VHA has been proposed as an efficient alternative to FFP-based strategies, offering advantages in terms of rapid availability and standardized dosing[8, 9, 22]. Our results support the concept of a shift toward FC-centered resuscitation strategies in trauma care. Importantly, the increase in procoagulant use raises questions regarding safety, particularly the risk of thromboembolic complications[23, 36]. While some studies, including ancillary analyses of the PROCOAG trial, have suggested an increased risk of thrombotic events with PCC, data on FC safety remain reassuring but limited[33].

Finally, to overcome the previous methodological challenges, it seems important to promote large datasets from real-life settings and not only from randomized trials[37]. Large registry-based analyses, including those derived from the TraumaRegister DGU, have provided important insights into trauma care but remain limited by heterogeneity in clinical practices and variable uptake of VHA testing[11, 12]. Similarly, data from the American College of Surgeons Trauma Quality Improvement Program highlight substantial variability in transfusion practices across centers[38]. In contrast, our population-level approach in this context is interesting, providing a long-term evaluation within a single, mature trauma system with high VHA uptake, allowing for a more consistent assessment of practice evolution over time[14]

Our study has several limitations. First, its retrospective, single-center design limits causal inference and generalizability. Second, the exclusion of patients who died within the first hour after hospital admission may have introduced survivor bias and limits interpretation of mortality outcomes, particularly with respect to early hemorrhage-related mortality. Third, detailed injury severity and physiological variables were unavailable after 2018, resulting in substantial missing data for ISS, trauma grade, GCS score, and admission blood pressure. Consequently, changes in case mix throughout the entire study period could not be fully assessed or accounted for. The population-level design also precluded adjustment for individual-level confounders and evaluation of the direct effect of ROTEM-guided interventions at the patient level. In addition, we could not account for all concurrent changes in trauma care over the 15-year study period, including improvements in prehospital management, hemorrhage-control strategies, surgical and interventional radiology techniques, and critical care practices. Finally, thromboembolic complications and quality of life or other functional outcomes could not be assessed.

Despite these limitations, our study provides one of the largest longitudinal evaluations of ROTEM-guided hemostatic strategies in a real-life setting from a mature trauma system. Our findings support the concept that trauma resuscitation has evolved toward more targeted, individualized approaches, in line with the emerging paradigm of precision trauma care[25].

CONCLUSIONS

The implementation and high uptake of a VHA-guided coagulation management strategy was associated with a decrease in the consumption of labile blood products alongside a marked increase in fibrinogen concentrates use, without detectable changes in ICU-mortality.

Abbreviations

CI: confidence interval

FC: fibrinogen concentrate

FFP: fresh frozen plasma

ICU: intensive care unit

IRR: Incidence rate ratio

ISS: Injury severity score

MT: massive transfusion

PCC: prothrombin complex concentrate

PT: prothrombin time

RBC: red blood cell

ROTEM: rotational thromboelastometry

SAPS II: Simplified Acute Physiology Score II

TIC: Trauma-induced coagulopathy

TRENAU: Trauma system of the Northern French Alps

VHA: viscoelastic hemostatic assays

Declarations

Ethics approval and consent to participate:

In accordance with French regulations for retrospective observational studies, patients and their relatives were informed of the potential use of their data and their right to object. The requirement for written informed consent was waived. The study protocol was approved by an institutional review board (IRB 00010254-2025-056).

Consent for publication:

Notapplicable

Availability of data and materials:

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests:

The authors declare that they have no competing interests.

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Authors' contributions:

Conception and study design: EE, NZ, TD

Literature Review: EE, AL

Data acquisition: EE, JJ, EPB, CR, FBJ, MAD and FXA

Data analysis and interpretation: ML, MP, TD

Drafting of the manuscript: EE, NZ

Critical revision: EE, NZ, AL, FXA, TD, EPB, CR, FBJ, JJ, MAD, ML, MP

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Tables

TABLE 1. Characteristics of the study population at emergency trauma room admission, overall and per period.

Variable	N missing*	'Reference' N = 591	'ROTEM' N = 759	'ROTEM + Tranexamic acid' N = 2,855	Overall N = 4,205
Sex, male	0 (0)	453 / 591 (77%)	582 / 759 (77%)	2,207 / 2,855 (77%)	3,242 / 4,205 (77%)
Age, years	0 (0)	37 (26-52)	39 (26-53)	39 (26-55)	39 (26-55)
Type of injury	2,268 (54)				
Bicycle		15 / 483 (3%)	31 / 586 (5%)	38 / 868 (4%)	84 / 1,937 (4%)
Collision or impact with an object		20 / 483 (4%)	26 / 586 (4%)	49 / 868 (6%)	95 / 1,937 (5%)
High energy fall		107 / 483 (22%)	144 / 586 (25%)	230 / 868 (26%)	481 / 1,937 (25%)
Light vehicle, heavy goods vehicle and bus		111 / 483 (23%)	145 / 586 (25%)	226 / 868 (26%)	482 / 1,937 (25%)
Low energy fall		63 / 483 (13%)	76 / 586 (13%)	96 / 868 (11%)	235 / 1,937 (12%)
Motorcycle		72 / 483 (15%)	95 / 586 (16%)	137 / 868 (16%)	304 / 1,937 (16%)
Other		62 / 483 (13%)	34 / 586 (6%)	18 / 868 (2%)	114 / 1,937 (6%)
Pedestrian		16 / 483 (3%)	22 / 586 (4%)	44 / 868 (5%)	82 / 1,937 (4%)
Weapon or sharp object and firearm		17 / 483 (4%)	13 / 586 (2%)	30 / 868 (3%)	60 / 1,937 (3%)
Glasgow score	2,330 (55)	15 (15, 15)	15 (14, 15)	15 (14, 15)	15 (14, 15)
Systolic blood pressure (mmHg)	2,458 (58)	130 (117, 142)	125 (115, 140)	127 (113, 140)	127 (115, 140)
Grade	1,477 (35)				
A		49 / 480 (10%)	44 / 563 (8%)	323 / 1,685 (19%)	416 / 2,728 (15%)

Variable	N missing*	'Reference' N = 591	'ROTEM' N = 759	'ROTEM + Tranexamic acid' N = 2,855	Overall N = 4,205
B		173 / 480 (36%)	214 / 563 (38%)	591 / 1,685 (35%)	978 / 2,728 (36%)
C		258 / 480 (54%)	305 / 563 (54%)	771 / 1,685 (46%)	1,334 / 2,728 (49%)
ISS	2,269 (54)	14 (8, 25)	16 (8, 25)	13 (6, 25)	14 (8, 25)
ISS ≥ 15	2,269 (54)	231 / 489 (47%)	300 / 591 (51%)	402 / 856 (47%)	933 / 1,936 (48%)
AIS head and neck ≥3	2,258 (54)	118 / 489 (24%)	163 / 591 (28%)	267 / 867 (31%)	548 / 1,947 (28%)
ROTEM	0 (0)	0 / 591 (0%)	250 / 759 (33%)	1,668 / 2,855 (58%)	1,918 / 4,205 (46%)
SAPS-II	0 (0)	15 (9, 23)	15 (8, 26)	17 (8, 26)	16 (8, 26)

Legend: Values are shown as number (%) or median (Q1-Q3). ISS, Injury severity score; AIS, Abbreviated injury scale; ROTEM, Rotational thromboelastometry; SAPS II, Simplified acute physiology score.

* Missing data concerned patients admitted to our emergency-trauma room in 2019 and after.

TABLE 2. Overall hemostatic products consumption and outcomes of ICU stay

Variable	N missing	'Reference' N = 591	'ROTEM' N = 759	'ROTEM + Tranexamic acid' N = 2,855	Overall N = 4,205
Red Blood cells	0 (0)	94 / 591 (16%)	112 / 759 (15%)	413 / 2,855 (14%)	619 / 4,205 (15%)
Massive transfusion*	0 (0)	15 / 94 (19%)	11 / 112 (11%)	18 / 413 (4%)	44 / 619 (7%)
Fresh frozen plasma	0 (0)	54 / 591 (9%)	55 / 759 (7%)	66 / 2,855 (2%)	175 / 4,205 (4%)
Platelets	0 (0)	19 / 591 (3%)	19 / 759 (3%)	71 / 2,855 (2%)	109 / 4,205 (3%)
Fibrinogen concentrate	0 (0)	28 / 591 (5%)	64 / 759 (8%)	382 / 2,855 (13%)	474 / 4,205 (11%)
Prothrombin complex concentrate	0 (0)	7 / 591 (1%)	9 / 759 (1%)	61 / 2,855 (2%)	77 / 4,205 (2%)
Length of ICU stay (days)	0 (0)				
Median (Q1, Q3)		4 (1, 11)	6 (1, 14)	5 (2, 12)	5 (1, 12)
Mean (SD)		7.55 (9.49)	10.21 (12.88)	8.84 (11.77)	8.90 (11.71)
24-hour mortality	0 (0)	12 / 591 (2.0%)	16 / 759 (2.1%)	55 / 2,855 (1.9%)	83 / 4,205 (2.0%)
ICU mortality	0 (0)	43 / 591 (7.3%)	40 / 759 (5.3%)	206 / 2,855 (7.2%)	289 / 4,205 (6.9%)

Legend: Values are shown as number (%), median (Q1-Q3) or mean (SD). ICU, Intensive care unit.

*Massive transfusion was defined as receiving ≥ 10 RBC units within the first 24 hours.

TABLE 3. Incidence rate ratios of blood products transfusion, procoagulant products administration and ICU mortality over time.

Variable	Period	IRR	95% CI
Red Blood cells	*ROTEM*	0.73	0.64-0.84
	ROTEM + tranexamic acid	0.65	0.54-0.78
Fresh frozen plasma	*ROTEM*	0.76	0.62-0.93
	ROTEM + tranexamic acid	0.55	0.37-0.81
Platelets	*ROTEM*	0.93	0.54-1.60
	ROTEM + tranexamic acid	0.81	0.38-1.72
Fibrinogen concentrate	*ROTEM*	1.50	1.11-2.05
	ROTEM + tranexamic acid	2.53	1.83-3.53
Prothrombin complex concentrate	*ROTEM*	0.72	0.44-1.18
	ROTEM + tranexamic acid	0.77	0.44-1.36
ICU-mortality	*ROTEM*	0.81	0.52-1.27
	ROTEM + tranexamic acid	1.43	0.84-2.45

Legend: ICU, Intensive care unit; IRR, Incidence rate ratio; ROTEM, Rotational thromboelastometry; 95% CI, 95% confidence intervals.

Incidences rate ratios are reported for each variable, for the ‘ROTEM’ and ‘ROTEM + tranexamic acid’ periods, compared to the ‘Reference’ period.

Figures

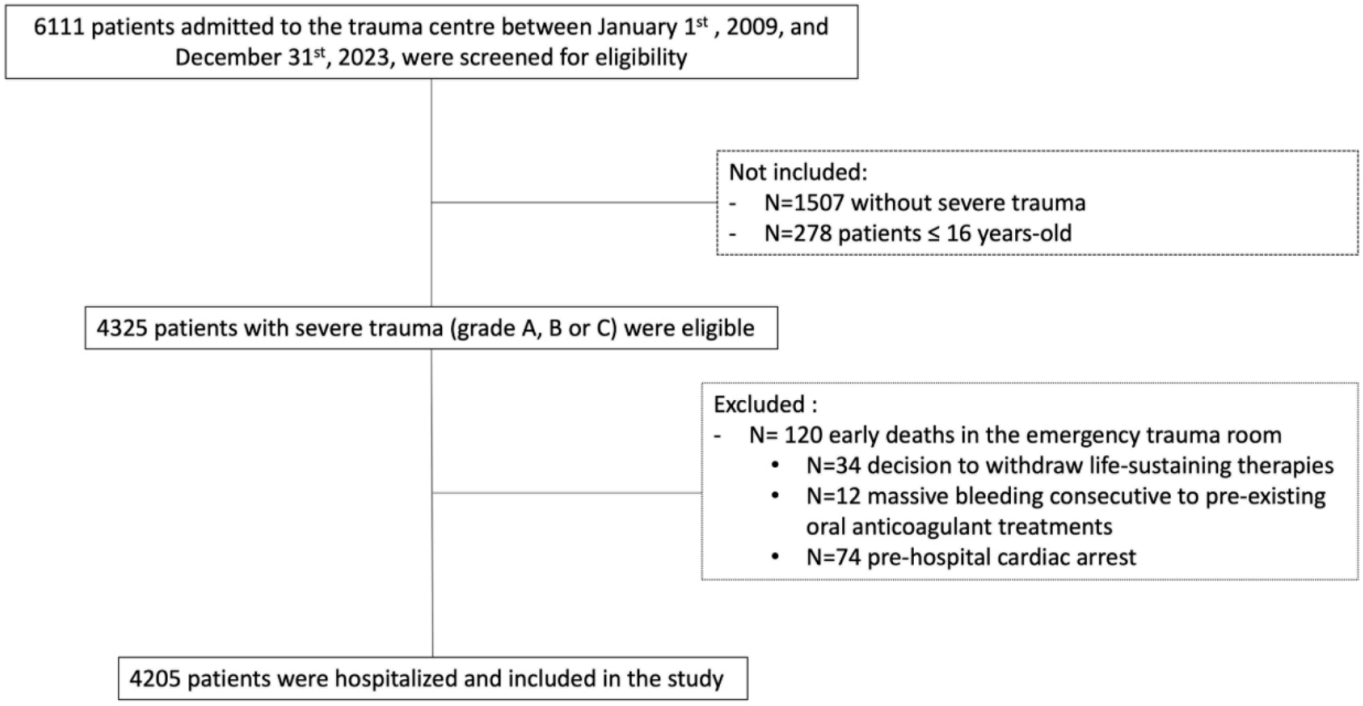

Figure 1

Flow chart of the study population

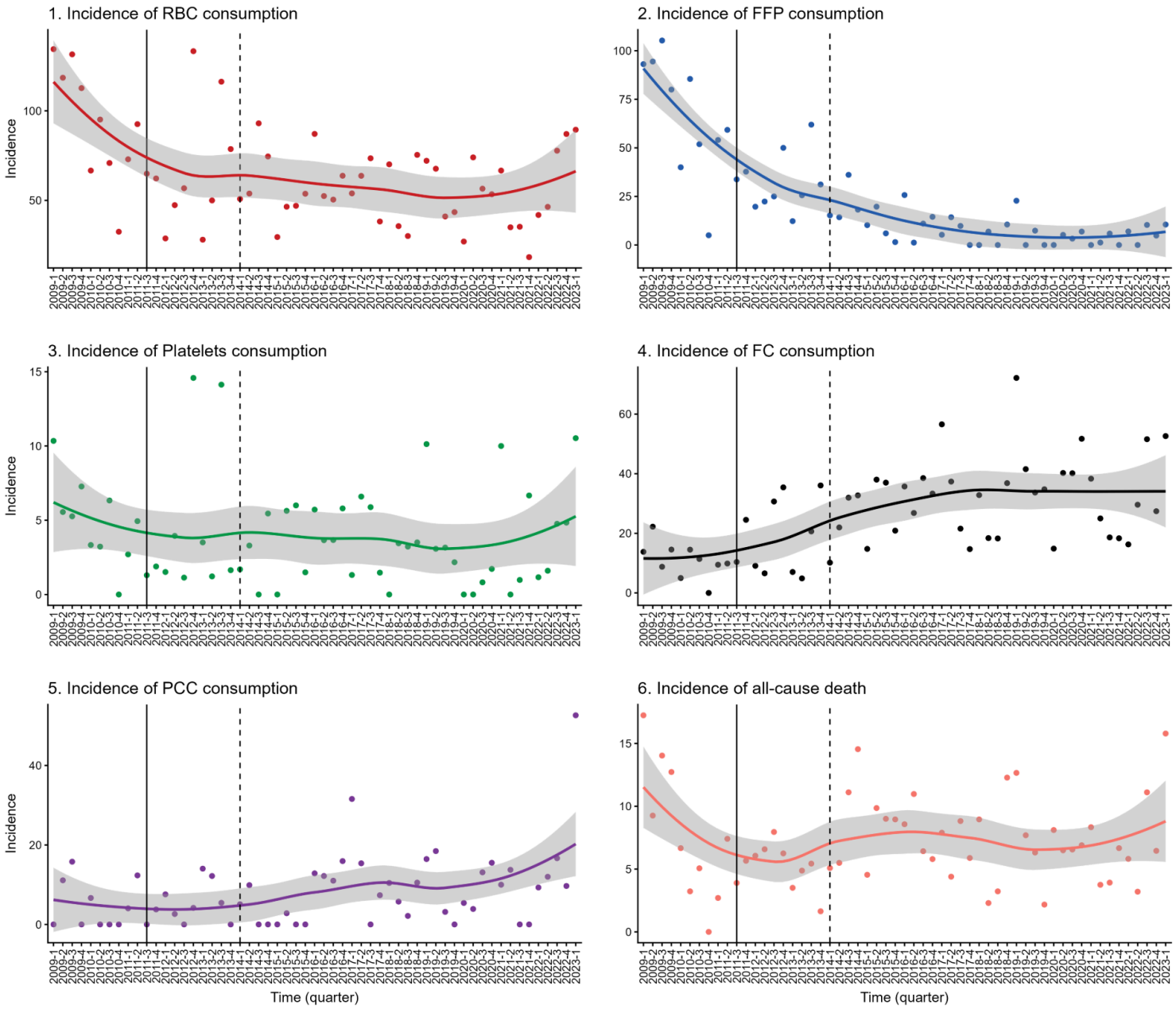

Figure 2

Evolution of incidence of blood products consumption, procoagulant products consumption and all-cause death over time.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SDC2AlgorithmROTEM.pdf
- SDC3AlgorithmROTEMAT1.pdf