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ORIGINAL STUDY

Symptomatic venous thromboembolism after trauma surgery : a study on 56.884 procedures

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Patients undergoing trauma surgery are at significant risk for developing thromboembolism. Venous thromboembolism rates, especially after less common surgical procedures are unknown. The purpose of this study is to establish data on the incidence of venous thromboembolism in trauma practice following a surgical procedure.

All surgical trauma procedures between 2006 and 2011 were identified within the Achmea Health Database. This database records medical care to persons insured at the Achmea health insurance company. This is the largest health insurance company in the Netherlands. In the year following the surgical procedure we analyzed if a claim was filed concerning a deep venous thrombosis or pulmonary embolism.

56.884 surgical trauma procedures were included in the analysis and followed for one year thereafter. Venous thromboembolism development was raised most markedly until 100 days after the surgical procedure. Relatively high incidences of venous thromboembolism were found after surgical lower extremity and pelvic procedures.

The present large database study provides a comprehensive view on the epidemiology of venous thromboembolism after different traumatic injuries requiring a surgical procedure.

Keywords: Trauma surgery ; thromboembolism.

INTRODUCTION

After trauma surgery there is a significant risk for the development of deep vein thrombosis (DVT) and pulmonary embolism (PE) *(12,6)*. PE is the third most common cause of death in patients that survive the first 24 hours after trauma *(4,5,11)*. Furthermore, post-thrombotic syndrome is a long term complication of DVT and accounts for 25% of leg ulcers *(10)*.

The actual risk of venous thromboembolism (VTE) after trauma surgery might be dependent on the fracture type. Although the incidence of VTE after some common fractures such as femoral neck fractures is well documented, little is known about the incidence of VTE after less common fracture types *(3,14)*. Because the trauma itself seems to be a major risk factor for the development of VTE, a better understanding of the risk for VTE after specific fractures can be used to better identify patients that might benefit from thromboprophylaxis. For a reliable estimate of thromboembolic events large numbers of patients are needed. This paper

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aims to establish data on the incidence of venous thromboembolism in the skeletal trauma practice following a surgical procedure from a large population based database.

MATERIALS AND METHODS

The retrospective cohort consisted of 3.7 million persons insured between 2006 and 2012 with ’Achmea’, the largest health care insurance company in the Netherlands. Every resident of the Netherlands is compulsorily insured. All claims are routinely recorded in a database, the Achmea Health Database. Background information on those insured like age and death are also recorded in the database.

Third parties can request anonymized data for scientific research in accordance with the Dutch privacy legislation.

We identified patients to be eligible based on insurance claims for a surgical procedure related to a fracture, ligament injury, dislocation or other trauma. In the Netherlands these claims are filed according to a national diagnosis-treatment classification (DTC) system based on a combination of the hospital registration of diagnosis (international classification of diseases, 9th revision, clinical modification (ICD-9-CM) codes) and applied therapeutic interventions. Patients were only included if they were insured with Achmea for a 365-day period from surgery. In the year following the fracture we analyzed if a claim was filed concerning a deep venous thrombosis or pulmonary embolism.

Data was retrospectively extracted from the Achmea database to IBM SPSS statistics version 21 (SPSS Inc, Chicago, Illinois, USA) and then analyzed for frequency, percentage and 95% confidence intervals.

RESULTS

56.884 surgical procedures performed between 2006 and 2011 were included in the analysis and followed for 1 year thereafter. (Fig 1) The mean age of the patient was 55 (SD 25.5) years at the time of the procedure. 6815 patients were 17 years and younger.

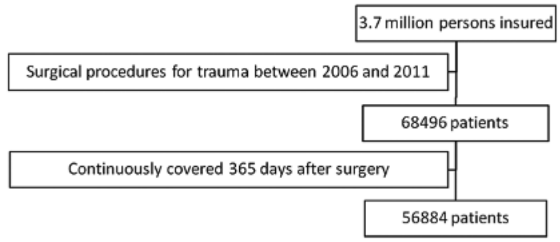

Fig. 1. — Flow chart of eligible subjects

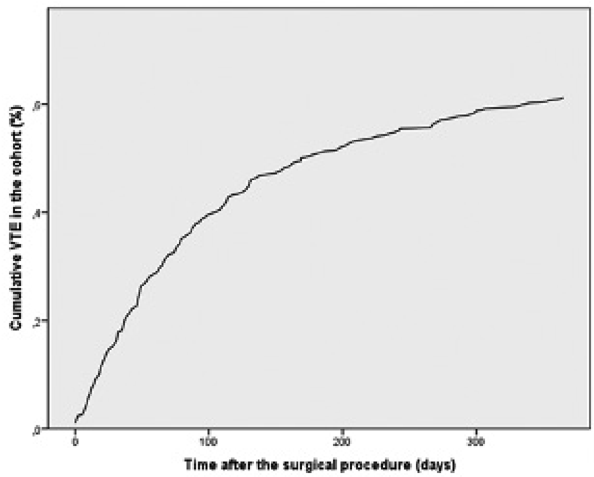

Fig. 2. — Cumulative percentage VTE in the cohort, in the year after surgery.

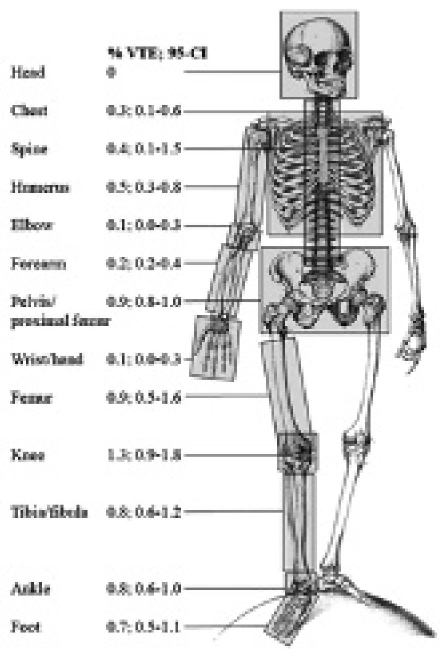

Fig. 3. — Venous thrombotic event rate following injury requiring a surgical procedure, injuries are grouped to anatomical region.

Table I. — Venous thrombotic event rates following injury requiring a surgical procedure

	No. of surgical procedures	No. of VTE (%; 95 CI)		No. of DVT (%; 95% CI)		No. of PE (%; 95% CI)	
PELVIS/PROXIMAL FEMUR	17005	149	(0.9;0.8-1.0)	75	(0.4;0.4-0.6)	74	(0.4;0.4-0.6)
Femur proximal and neck fracture	16653	147	(0.8;0.7-1.0)	74	(0.4;0.3-0.6)	73	(0.4;0.3-0.5)
Pelvic fracture	242	2	(0.8;-0.3-2.0)	1	(0.4;-0.4-1.2)	1	(0.4;-0.4-1.2)
Hip traumatic dislocation	12	0		0		0	
Acetabulum fracture	98	0		0		0	
FEMUR FRACTURE (DIAPHYSEAL/DISTAL)	2010	21	(0.9;0.5-1.6)	8	(0.4;0.1-0.7)	13	(0.6;0.3-1.0)
KNEE	2308	29	(1.3;0.9-1.8)	10	(0.4;0.2-0.8)	19	(0.8;0.5-1.3)
Knee ligament rupture	138	6	(4.3;0.9-7.8)	1	(0.7;-0.7-2.2)	5	(3.6;0.5-6.8)
Patella fracture	670	8	(1.2;0.4-2.0)	1	(0.1;-0.1-0.4)	7	(1.0;0.3-1.8)
Tibial plateau fracture	1334	14	(1.0;0.5-1.6)	7	(0.5;0.1-0.9)	7	(0.5;0.1-0.9)
Patella disclocation	127	1	(0.8;-0.8-2.4)	1	(0.8;-0.8-2.4)	0	
Knee dislocation	39	0		0		0	
TIBIA (DIAPHYSEAL)	3204	26	(0.8;0.6-1.2)	14	(0.4;0.3-0.7)	12	(0.4;0.2-0.7)
Tibia fracture	3137	26	(0.8;0.5-1.2)	14	(0.4;0.2-0.7)	12	(0.4;0.2-0.7)
Fibula fracture	67	0		0		0	
ANKLE FRACTURE	7300	58	(0.8;0.6-1.0)	35	(0.5;0.3-0.6)	25	(0.3;0.2-0.5)
FOOT	2517	18	(0.7;0.5-1.1)	15	(0.6;0.4-1.0)	3	(0.1;0.0-0.4)
Achilles tendon rupture	758	11	(1.5;0.6-2.3)	10	(1.3;0.5-2.1)	1	(0.1;-0.1-0.4)
Tarsus fracture	157	1	(0.6;-0.6-1.9)	1	(0.6;-0.6-1.9)	0	
Phalanx fracture	410	2	(0.5;-0.2-1.2)	1	(0.2;-0.2-0.7)	1	(0.2;-0.2-0.7)
Metatarsus fracture	628	3	(0.5;-0.0-1.0)	3	(0.5;-0.0-1.0)	0	
Calcaneus fracture	437	1	(0.2;-0.2-0.7)	0		1	(0.2;-0.2-0.7)
Talus fracture	88	0		0		0	
Ankle/Foot Luxation	28	0		0		0	
Toe luxation	11	0		0		0	
HUMERUS	3573	18	(0.5;0.3-0.8)	8	(0.2;0.1-0.4)	10	(0.3;0.2-0.5)
Biceps tendon rupture	64	1	(1.6;-1.6-4.7)	0		1	(1.6;-1.6-4.7)
Humerus proximal and shaft fracture	3364	17	(0.5;0.3-0.8)	8	(0.2;0.1-0.4)	9	(0.3;0.1-0.4)
Shoulder luxation	145	0		0		0	
ELBOW	4558	6	(0.1;0.0-0.3)	6	(0.1-0.0-0.3)	0	
Humerus; distal, (epi)condyle fracture	2014	4	(0.2;0.0-0.4)	4	(0.2;0.0-0.4)	0	
Olecranon fracture	1777	2	(0.1;0.0-0.2)	2	(0.1;0.0-0.2)	0	
Radial head fracture	715	0		0		0	
Elbow luxation	52	0		0		0	

FOREARM (DIAPHYSEAL/ DISTAL)	7580	18 (0.2;0.2-0.4)	5 (0.0;0.0-0.2)	13 (0.2;0.1-0.3)
Distal radius fracture	4862	16 (0.3;0.2-0.5)	4 (0.1;0.0-0.2)	12 (0.2;0.1-0.4)
Forearm fracture	2718	2 (0.1;0.0-0.2)	1 (0.0;0.0-0.1)	1 (0.0;0.0-0.1)
WRIST/HAND	4270	5 (0.1;0.0-0.3)	3 (0.0;0.0-0.2)	2 (0.0-0.0-0.2)
Phalax fracture	2319	4 (0.2;0.0-0.3)	3 (0.1;0.0-0.4)	1 (0.0;0.0-0.1)
Metacarpal fracture	1541	1 (0.1;0.0-0.2)	0	1 (0.1;0.0-0.2)
Carpusfracture	279	0	0	0
Phalanx incl MCP luxation	62	0	0	0
Mallet finger	43	0	0	0
Wrist; rad-ulna and carpus luxation	26	0	0	0
CHEST	2022	5 (0.3;0.1-0.6)	3 (0.2;0.0-0.4)	2 (0.1;0.0-0.4)
AC+SC luxation	98	2 (2.0;-0.8-4.9)	0	2 (2.0;-0.8-4.9)
Scapula fracture	114	1 (0.9;-0.9-2.6)	1 (0.9;-0.9-2.6)	0
Clavicula fracture	1722	2 (0.1;0.0-0.3)	2 (0.1;0.0-0.3)	0
Sternum/rib fracture	88	0	0	0
SPINE	476	2 (0.4;0.1-1.5)	0	2 (0.4;0.1-1.5)
Spinal fracture with spinal cord injury	33	2 (6.1;-2.5-14.7)	0	2 (6.1;-2.5-14.7)
Spinal fracture	443	0	0	0
HEAD	61	0	0	0
Maxillo facial fracture	52	0	0	0
Skull fracture	9	0	0	0

Abbreviations : VTE, venous tromboembolism ; DVT, deep venous thrombosis ; PE, pulmonary embolism ; CI, confidence interval ; MCP, metacarpalphalangeal ; AC, Acromioclavicular ; SC, sternoclavicular.

A total of 178 DVT and 179 LE was recorded in the year following surgery. The median time in days for DVT and LE to develop was 72 and 59 days respectively. The 25th percentile was at 30 and 24 days, the 75th percentile was at 149 and 130 days. Overall VTE development seemed to decrease around 100 days after trauma but afterwards still one third of the VTE's occurred (Fig 2).

Both LE and DVT occurred in 7 patients. Table I represents a comprehensive list of DVT and PE following different procedures. In Figure 3 thromboembolic events are presented with injuries grouped to anatomical region.

VTE incidence rate is higher after lower extremity and pelvic trauma requiring a surgical procedure compared to upper extremity trauma (chi-square $P < 0.05$).

DISCUSSION

The present large database study provides a comprehensive view on the epidemiology of VTE after different traumatic injuries requiring a surgical procedure. We found the largest risk for the development of VTE after trauma to the pelvis, spine and lower extremity. The relatively high risk occurs despite many of these patients receiving some form of pharmacological thromboprophylaxis *(2)*.

The main strength of our study is that we were able to analyze a very large group of patients contributing to more accurate results. Also no recent, comparable data is available in the literature. Potential limitations of our study include the fact that the data were collected for administrative (reimbursement) purposes, rather that scientific research. Also because of changes in the reimbursement system in 2006 and 2012, our dataset was restricted to this time period. Because 17% of patients were not continuously covered after surgery for 1 year they were "lost to follow up" and excluded from the study. The database lacks detail in terms of the diagnosis, not accounting for ; concomitant injury, extent of soft tissue damage and trauma mechanism. Also, treatment information regarding thromboprophylaxis, anesthesia, hospital stay and weight bearing were not available. It is therefore, impossible to define very specific high risk groups for the development of VTE from this study. However, registration of the data is complete, accurate, subject to extensive control and comprehensive auditing because of the economic function of the data *(13)*. Finally despite the very large cohort of patients the absolute number of procedures for some specific traumatic injuries remains low and the accuracy of these data accordingly. Grouping of surgical procedures to anatomical region is debatable but it allows for more reliable event rates and subsequently better shows the regions are at risk.

An observational study on 45.968 orthopedic procedures between 1996 and 2005 with a relatively short follow up of six weeks after internal fixation of proximal femur fractures and hemiarthroplasty surgery following hip fracture found VTE incidence rates of 1.1% (95% CI, 0.9-1.4) and 0.9% (95% CI, 0.4-2.0) respectively. Thromboprophylaxis (not further specified) was used for 7-10 days *(9)*. We found the VTE rate of 0.8% (95% CI, 0.7-1.0) after proximal femur and neck fracture surgery to be slightly lower, although follow up was 1 year and we found that the thromboembolic risk to persists well after 6 weeks. These finding can be explained through an increasing emphasis on early mobilization of patients in recent years and advances in surgical technique. Furthermore, Dutch national guideline advised 4-5 weeks thromboprophylaxis after hip fracture surgery in this time period and adherence to this guideline has been shown to be very high *(1,2)*. Our results are also in line with a recent large randomized trial which compared standard of care thromboprophylaxis with rivaroxaban after major orthopedic surgery (elective total hip and knee arthroplasty). The standard of care thromboprophylaxis showed a symptomatic venous thromboembolic event rate of 1.02% in 8.635 patients *(14)*. Furthermore, we found our data to be comparable to a large recent study including 57.619 patients, determining symptomatic venous thromboembolism after surgery for a lower leg fracture ; they found an overall event rate of 1.0% *(15)*. We found that the risk after spinal cord injury is high and this is confirmed in several studies *(3)*. Development of VTE after upper extremity fracture surgery was relatively uncommon. A study to internal fixation of upper limb fractures or dislocation also found a low incidence of VTE, 1 in 637 procedures *(7)*. The comparable rates of VTE of these selected fractures in other studies support the reliability of the database used for this study and provide further evidence for the reliability of the reported incidences of VTE for the less documented trauma procedures.

There was no documentation available on how VTE was diagnosed. The applicable Dutch guideline advised compressive ultrasound for diagnosing DVT and Multidetector Computed Tomography (CT) angiography for pulmonary embolism if indicated after clinical analyses. This is in line with accepted international guidelines *(3,8)*.

To the best of our knowledge the present database study provides the largest and most recent analysis of the epidemiology of VTE after trauma surgery to the human body. Consensus statement advice is usually based on well-studied trauma procedures and it is often hard to extrapolate such advice to less well studied traumatic injuries. This study at least provides an indication for the rates of VTE after very common and less common procedures and therefore can be a valuable aid in deciding for thromboprophylaxis in specific patients and aid in the extrapolation of consensus statement advice to specific procedures. Furthermore it may provide a base for the need of further research for the need of thromboprophylaxis after traumatic injuries.

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