Hypercoagulable patients in the perioperative period

J.J. van Veen & P. Toth

STH/CRH

Agenda

- To prevent TE and minimise bleeding risk in the peri-operative period
- Thromboprophylaxis (P.Toth 20 mins)
- Bridging (J.J.van Veen 20 mins)

Virchow‘s triad :

- venous stasis
- endothelial injury
- hypercoagulability

Periprocedural haemostasis

BLEEDING

Patient related

Procedure related

THROMBOSIS

Patient related

Procedure related

Patient related risk factors for VTE

Box 1. Risk factors for VTE

- Active cancer or cancer treatment
- Age over 60 years
- Critical care admission
- Dehydration
- Known thrombophilias
- Obesity (BMI over 30 kg/m^2)
- One or more significant medical comorbidities (such as heart disease, metabolic, endocrine or respiratory pathologies, acute infectious diseases or inflammatory conditions)
- Personal history or a first degree relative with a history of VTE
- Use of hormone replacement therapy
- Use of oestrogen-containing contraceptive therapy
- Varicose veins with phlebitis.

For women who are pregnant or have given birth within the previous 6 weeks see Chapter 30 (Pregnancy and up to 6 weeks post partum).

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Risk of VTE in non-surgical patients

Table 5-19: Risk of DVT and symptomatic PE, by medical condition, from the nil arm of RCTs

	Number of patients with an event	*Sample Size*	*Incidence*	*Incidence Lower 95% CL*	*Incidence Upper 95% CL*
DVT					
General Medical Patients[121,141,191,579]	106	827	13%	11%	15%
Stroke [157,167,240,434,435,520,538,540,581]	195	384	50%	45%	55%
Acute Coronary Syndromes[42,209,251,252,338,522,672,709]	76	372	21%	17%	25%
All	377	1583	24%		
Symptomatic Pulmonary Embolism					
General Medical Patients[121,394,579]	24	2400	0.9%	0.6%	1.3%
Stroke [157,520]	2	54	3%	0%	9%
Acute Coronary Syndromes[42,251,445,709]	5	156	4%	2%	8%
All	17	2638	1%		

NICE 2010

Patient related risk factors for bleeding

Box 2. Bleeding Risk Factors

- Active bleeding
- Acquired bleeding disorders (such as acute liver failure)
- Concurrent use of anticoagulants known to increase the risk of bleeding (such as warfarin with INR higher than 2)
- Lumbar puncture/epidural/spinal anaesthesia expected within the next 12 hours
- Lumbar puncture/epidural/spinal anaesthesia within the previous 4 hours
- Acute stroke
- Thrombocytopenia (platelets less than 75 x 10^9/l)
- Uncontrolled systolic hypertension (230/120 mmHg or higher)
- Untreated inherited bleeding disorders (such as haemophilia and von Willebrand's disease)

NICE 2010

Risk of major bleeding in non-surgical patients

	Number of patients with an event	*Sample Size*	*Incidence*	*Incidence Lower 95% CL*	*Incidence Upper 95% CL*
Major Bleeding					
General Medical Patients[121,191,394,579]	11	2629	0.4%	0.2%	0.7%
Stroke[167,540,581]	4	107	4%	1%	9%
Acute Coronary Syndromes[70]	0	14	Not Estimable		
All	15	2750	0.6%		

NICE 2010

Pre op haemostasis tests NICE guideline

- No paper compared the health outcomes for patients who had preoperative haemostasis tests with patients who did not.
- There is some evidence that the value of preoperative haemostasis tests may increase with comorbidity.

NICE guideline

CODE	DEFINITION
	INAPPROPRIATE
No[1]	'No' indicates a consensus in both groups that the test is considered **INAPPROPRIATE**
No[2]	'No' indicates a consensus in both groups that the test is considered **INAPPROPRIATE**
	UNCERTAIN
a	(a) ONE group reached consensus that the test is APPROPRIATE, but the other group was UNCERTAIN
b	(b) ONE group reached consensus that the test is NOT APPROPRIATE, but the other group was UNCERTAIN
c	(c) BOTH groups were UNCERTAIN
d	(d) BOTH group reached consensus, but ONE group agreed it was APPROPRIATE and ONE group agreed it was INAPPROPRIATE
	APPROPRIATE
Yes[2]	'Yes' indicates a consensus in both groups that the test is considered **APPROPRIATE**
Yes[1]	'Yes' indicates a consensus in both groups that the test is considered **APPROPRIATE**

1 indicates the top level of consensus – 100% consensus in both groups.

2 indicates the secondary level of consensus – consensus was reached in BOTH groups but was only 75% in at least ONE group.

NICE guideline

TABLE 5.23 Haemostasis tests for ASA grade 1 children and adults

	AGE CATEGORIES (YEARS)								
Grade of surgery	<6 months	6 to <12 months	1 to <5	5 to <12	12 to <16	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[2]	No[2]	No[2]	No[2]	No[2]	No[1]	No[1]	No[1]	No[1]
2	No[2]	No[2]	No[2]	No[2]	No[2]	No[1]	No[1]	No[1]	No[1]
3	No[2]	No[2]	No[2]	No[2]	No[2]	No[2]	No[2]	No[2]	No[2]
4	No[2]	No[2]	No[2]	No[2]	No[2]	b	b	b	b
Neurosurgery	d	d	d	d	d	d	d	d	d
Cardiac surgery	a	a	a	a	a	d	d	d	d

NICE guideline

TABLE 5.26 Haemostasis tests for ASA grade 2 adults with comorbidity from respiratory disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[1]	No[1]	No[1]	No[1]
2	No[1]	No[1]	No[1]	No[1]
3	No[1]	No[1]	No[1]	No[1]
4	b	b	b	b

TABLE 5.24 Haemostasis tests for ASA grade 2 adults with CVD comorbidity

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[1]	No[1]	No[1]	No[1]
2	No[1]	No[1]	No[1]	No[1]
3	No[2]	No[2]	No[2]	No[2]
4	d	d	d	d

TABLE 5.28 Haemostasis tests for ASA grade 2 adults with comorbidity from renal disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[2]	No[2]	No[2]	No[2]
2	No[2]	No[2]	No[2]	No[2]
3	c	c	c	c
4	c	a	a	a

TABLE 5.27 Haemostasis tests for ASA grade 3 adults with comorbidity from respiratory disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[1]	No[1]	No[1]	No[1]
2	No[1]	No[1]	No[1]	No[1]
3	No[1]	No[1]	No[1]	No[1]
4	b	b	b	b

TABLE 5.25 Haemostasis tests for ASA grade 3 adults with CVD comorbidity

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	No[1]	No[1]	No[1]	No[1]
2	No[1]	No[1]	No[1]	No[1]
3	b	b	b	b
4	d	d	d	d

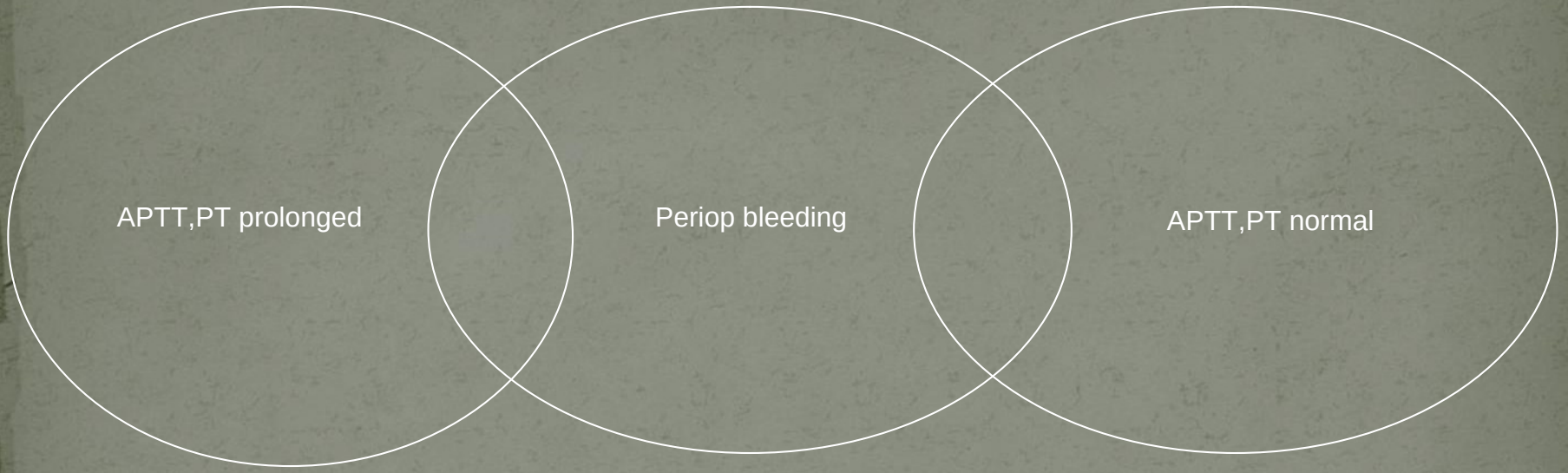
TABLE 5.29 Haemostasis tests for ASA grade 2 adults with comorbidity from renal disease

	AGE CATEGORIES (YEARS)			
Grade of surgery	≥16 to <40	≥40 to <60	≥60 to <80	≥80
1	b	b	b	b
2	b	b	b	b
3	c	c	c	c
4	a	a	a	a

Pre op haemostasis tests BCSH guideline

- Based on 9 observational studies (3 prospective) that contained enough data to allow the calculation of the predictive value and likelihood ratios of tests for perioperative bleeding
- The positive predictive value (0.03–0.22) and likelihood ratio (0.94–5.1) for coagulation tests indicate that they are poor predictors of bleeding.

Guidelines on the assessment of bleeding risk prior to surgery or invasive procedures
British Committee for Standards in Haematology
Y. L. Chee, J. C. Crawford, H. G. Watson and M. Greaves
British Journal of Haematology 2008,140, 496–504



Biological variation 2.5%
Artefact due to sampling
Irrelevant disorders:
LA:1.2-3.8%
FXII:2.3%
HMWK,prekallikrein

VWD 1:10000
Haem A 1:5000 male
Haem B 1:30000 male
F I,II,V,VII,X
1:300000 -1:2000000
Acquired disorders

Mild/masked VWD,Haem A
FXIII
Alpha 2 antiplasmin

Routine preoperative coagulation tests: an outdated practice?
J. J. van Veen1, D. R. Spahn2 and M. Makris 1
British Journal of Anaesthesia 106 (1): 1–3 (2011)

BCSH guideline

- Indiscriminate coagulation screening prior to surgery or other invasive procedures to predict postoperative bleeding in unselected patients is not recommended. (Grade B, Level III)

- A bleeding history including detail of family history, previous excessive post-traumatic or postsurgical bleeding and use of anti-thrombotic drugs should be taken in all patients preoperatively and prior to invasive procedures. (Grade C, Level IV)

Guidelines on the assessment of bleeding risk prior to surgery or invasive procedures
British Committee for Standards in Haematology
Y. L. Chee, J. C. Crawford, H. G. Watson and M. Greaves
British Journal of Haematology 2008,140, 496–504

BCSH guideline

- If the bleeding history is negative, no further coagulation testing is indicated. (Grade C, Level IV)

- If the bleeding history is positive or there is a clear clinical indication (e.g. liver disease), a comprehensive assessment, guided by the clinical features is required.
  (Grade C,Level IV)

Guidelines on the assessment of bleeding risk prior to surgery or invasive procedures
British Committee for Standards in Haematology
Y. L. Chee, J. C. Crawford, H. G. Watson and M. Greaves
British Journal of Haematology 2008,140, 496–504

Risk of VTE in hospitalised patients without thromboprophylaxis

Table 4—*Approximate Risks of DVT in Hospitalized Patients (Section 1.2)

Patient Group	DVT Prevalence, %
Medical patients	10–20
General surgery	15–40
Major gynecologic surgery	15–40
Major urologic surgery	15–40
Neurosurgery	15–40
Stroke	20–50
Hip or knee arthroplasty, HFS	40–60
Major trauma	40–80
SCI	60–80
Critical care patients	10–80

*Rates based on objective diagnostic screening for asymptomatic DVT in patients not receiving thromboprophylaxis.

From ACCP Guidelines on prevention of VTE Chest 2008

Procedure related VTE risk
HES Registry

Table 5-18: Incidence of symptomatic VTE estimated from HES 2003/4

	Number of patients with an event	*Sample Size*	*Incidence*
Femoral head	237	23538	1.01%
Knee replacement	493	52535	0.94%
Vascular	1186	169218	0.70%
Adult cardiac	208	40180	0.52%
Hip replacement	293	57899	0.51%
Transplantation	11	2375	0.46%
Thoracic	117	26002	0.45%
Lower gastrointestinal (GI)	428	95968	0.45%
Renal replacement	140	39733	0.35%
Upper gastrointestinal (GI)	356	110562	0.32%
Fractures	555	181346	0.31%
Intensive Therapy Unit (ITU)	1215	448253	0.27%
Oncology	1311	529069	0.25%
Radiology cardiovascular	404	221317	0.18%
Endoscopic and percutaneous	2383	1376236	0.17%
Joints other	29	17553	0.17%
Spine	76	56559	0.13%
Orthopaedic (other)	254	219116	0.12%
Neurosurgery not spine	229	215533	0.11%
Plastic	259	314817	0.08%
Urology	121	164362	0.07%
Hernia	72	115703	0.06%
Gynaecological	179	443529	0.04%
Arthroscopy	34	112123	0.03%
Anus and piles	26	86671	0.03%
Breast	22	78547	0.03%
Ear, Nose and Throat (ENT)	51	209680	0.02%
Head and neck	16	80258	0.02%
Max facial dental	34	184784	0.02%
Eyes	69	457382	0.02%

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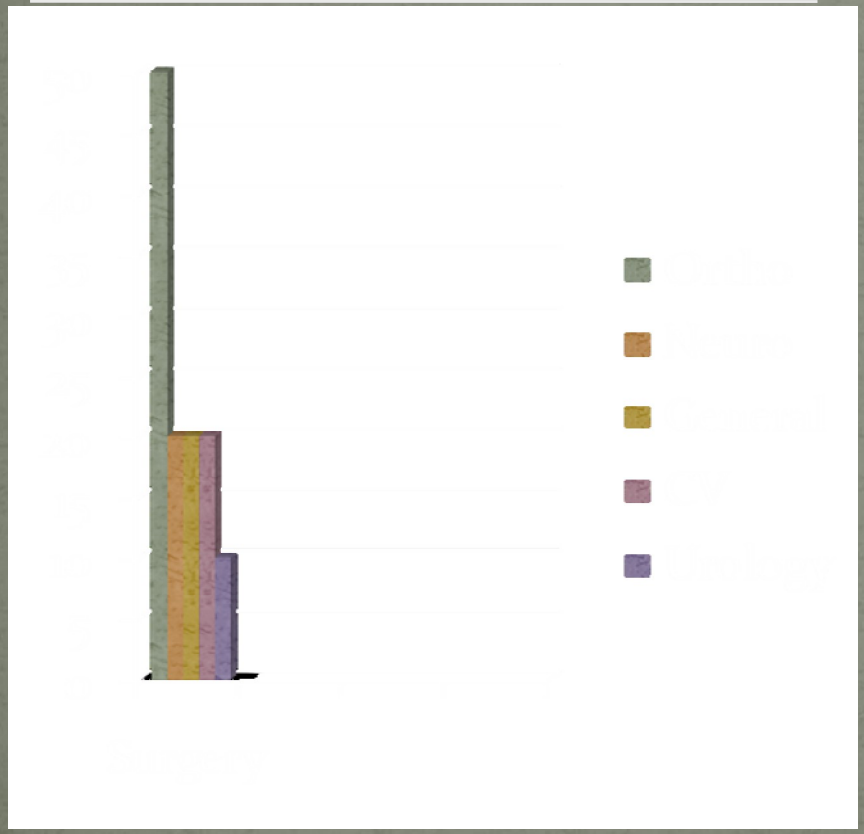
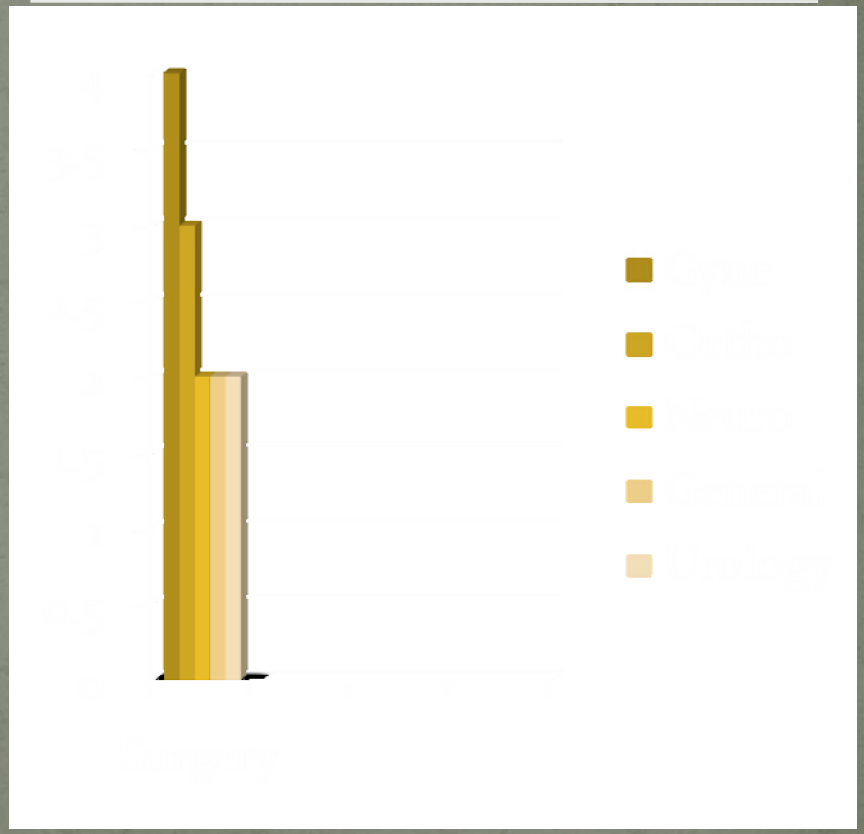
Procedure related thrombotic & bleeding risk without thromboprophylaxis

DVT incidence (%) without TP



Incidence of major bleeding without TP (%)



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Assessing procedure related bleeding risk

Table 2. Procedural bleeding risks[7,26,27,65]

High (2-day risk of major bleed 2%-4%)
Heart valve replacement
Coronary artery bypass
Abdominal aortic aneurysm repair
Neurosurgical/urologic/head and neck/abdominal/breast cancer surgery
Bilateral knee replacement
Laminectomy
Transurethral prostate resection
Kidney biopsy
Polypectomy, variceal treatment, biliary sphincterectomy, pneumatic dilatation
PEG placement
Endoscopically guided fine-needle aspiration
Multiple tooth extractions
Vascular and general surgery
Any major operation (procedure duration > 45 minutes)
Low (2-day risk of major bleed 0%-2%)
Cholecystectomy
Abdominal hysterectomy
Gastrointestinal endoscopy ± biopsy, enteroscopy, biliary/pancreatic stent without sphincterotomy, endonosonography without fine-needle aspiration
Pacemaker and cardiac defribillator insertion and electrophysiologic testing
Simple dental extractions
Carpal tunnel repair
Knee/hip replacement and shoulder/foot/hand surgery and arthroscopy
Dilatation and curettage
Skin cancer excision
Abdominal hernia repair
Hemorrhoidal surgery
Axillary node dissection
Hydrocele repair
Cataract and noncataract eye surgery
Noncoronary angiography
Bronchoscopy ± biopsy
Central venous catheter removal
Cutaneous and bladder/prostate/thyroid/breast/lymph node biopsies

This table is based on definitions derived from surgical/subspecialty societies in anticoagulant bridging or anticoagulant bridging management studies.

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Bleeding risk associated with surgery

Bleeding risk associated with surgery

Very high risk[1]	High risk	Low risk[2]	On warfarin possible[3]
• Cardiac surgery	• major orthopaedic surgery	Minor procedures as specified by treating surgeon/physician	• Diagnostic GI endoscopic procedures ± biopsy(Veitch *et al*, 2008)
• neurosurgery	• major vascular surgery		
• Spinal surgery	• Major gynaecological and urological surgery		• Biliary or pancreatic stenting (Veitch *et al*, 2008)
• radical prostatectomy	• Major cancer surgery • Other major abdominal and thoracic surgery		• Diagnostic EUS (Veitch *et al*, 2008) • minor dermatological surgery (Douketis *et al*, 2008)
	• renal biopsy		• Minor dental surgery (Perry *et al*, 2007) • Minor ophthalmological surgery (cataract extraction) (Douketis *et al*, 2008)

Risk assessment scores-Rogers score

Table 6—*Risk Assessment Model From the Patient Safety in Surgery Study*

Risk Factor	Risk Score Points
Operation type other than endocrine	
Respiratory and hernic	9
Thoracoabdominal aneurysm, embolectomy/thrombectomy, venous reconstruction, and endovascular repair	7
Aneurysm	4
Mouth, palate	4
Stomach, intestines	4
Integument	3
Hernia	2
ASA physical status classification	
3, 4, or 5	2
2	1
Female sex	1
Work RVU	
> 17	3
10-17	2
Two points for each of these conditions	2
Disseminated cancer	
Chemotherapy for malignancy within 30 d of operation	
Preoperative serum sodium > 145 mmol/L	
Transfusion > 4 units packed RBCs in 72 h before operation	
Ventilator dependant	
One point for each of the conditions	1
Wound class (clean/contaminated)	
Preoperative hematocrit level ≤ 38%	
Preoperative bilirubin level > 1.0 mg/dL	
Dyspnea	
Albumin level ≤ 3.5 mg/dL	
Emergency	
Zero points for each of these conditions	0
ASA physical status class 1	
Work RVU < 10	
Male sex	

ASA = American Society of Anesthesiologists; RVU = relative value unit. Republished with permission from Rogers et al.[82]

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Risk assessment scores- Caprini score

Table 7—*Caprini Risk Assessment Model*

1 Point	2 Points	3 Points	5 Points
Age 41-60 y	Age 61-74 y	Age ≥ 75 y	Stroke (< 1 mo)
Minor surgery	Arthroscopic surgery	History of VTE	Elective arthroplasty
BMI > 25 kg/m^2	Major open surgery (> 45 min)	Family history of VTE	Hip, pelvis, or leg fracture
Swollen legs	Laparoscopic surgery (> 45 min)	Factor V Leiden	Acute spinal cord injury (< 1 mo)
Varicose veins	Malignancy	Prothrombin 20210A	
Pregnancy or postpartum	Confined to bed (> 72 h)	Lupus anticoagulant	
History of unexplained or recurrent spontaneous abortion	Immobilizing plaster cast	Anticardiolipin antibodies	
Oral contraceptives or hormone replacement	Central venous access	Elevated serum homocysteine	
Sepsis (< 1 mo)		Heparin-induced thrombocytopenia	
Serious lung disease, including pneumonia (< 1 mo)		Other congenital or acquired thrombophilia	
Abnormal pulmonary function			
Acute myocardial infarction			
Congestive heart failure (< 1 mo)			
History of inflammatory bowel disease			
Medical patient at bed rest			

Assessing perioperative thrombotic risk

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Table 5—*Risk Stratification for VTE in General, Abdominal-Pelvic, Bariatric, Vascular, and Plastic and Reconstructive Surgery*

	Patient Population							
	Patients Undergoing Major General, Thoracic, or Vascular Surgery		Patients Undergoing General Surgery, Including GI, Urological, Vascular, Breast, and Thyroid Procedures		Patients Undergoing Plastic and Reconstructive Surgery			
AT9 VTE Risk Category	Rogers Score	Observed Risk of Symptomatic VTE, %	Caprini Score	Observed Risk of Symptomatic VTE, %	Caprini Score	Observed Risk of VTE, %	Other Surgical Populations in Risk Category	Estimated Baseline Risk in the Absence of Pharmacologic or Mechanical Prophylaxis, %
Very low	< 7	0.1	0	0	0-2	NA	Most outpatient or same-day surgery	< 0.5
Low	7-10	0.4	1-2	0.7	3-4	0.6	Spinal surgery for nonmalignant disease	1.5
Moderate	> 10	1.5	3-4	1.0	5-6	1.3	Gynecologic noncancer surgery Cardiac surgery Most thoracic surgery Spinal surgery for malignant disease	3.0
High	NA	NA	≥ 5	1.9	7-8	2.7	Bariatric surgery Gynecologic cancer surgery Pneumonectomy Craniotomy Traumatic brain injury Spinal cord injury Other major trauma	6.0

AT9 = Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines.

Assessing perioperative bleeding risk

Table 8—*Risk Factors for Major Bleeding Complications*

General risk factors
Active bleeding
Previous major bleeding
Known, untreated bleeding disorder
Severe renal or hepatic failure
Thrombocytopenia
Acute stroke
Uncontrolled systemic hypertension
Lumbar puncture, epidural, or spinal anesthesia within previous 4 h or next 12 h
Concomitant use of anticoagulants, antiplatelet therapy, or thrombolytic drugs
Procedure-specific risk factors
Abdominal surgery
Male sex, preoperative hemoglobin level < 13 g/dL, malignancy, and complex surgery defined as two or more procedures, difficult dissection, or more than one anastamosis[89]
Pancreaticoduodenectomy
Sepsis, pancreatic leak, sentinel bleed[87]
Hepatic resection
Number of segments, concomitant extrahepatic organ resection, primary liver malignancy, lower preoperative hemoglobin level, and platelet counts[88]
Cardiac surgery
Use of aspirin[90]
Use of clopidogrel within 3 d before surgery[91]
BMI > 25 kg/m^2, nonelective surgery, placement of five or more grafts, older age[92]
Older age, renal insufficiency, operation other than CABG, longer bypass time[93]
Thoracic surgery
Pneumonectomy or extended resection[94]
Procedures in which bleeding complications may have especially severe consequences
Craniotomy
Spinal surgery
Spinal trauma
Reconstructive procedures involving free flap

CABG = coronary artery bypass graft.

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Complex preoperative assessment and recommendations for thrombosis prophylaxis

Table 23—*Recommendations for Thromboprophylaxis in Various Risk Groups*

	Risk and Consequences of Major Bleeding Complications	
Risk of Symptomatic VTE	Average Risk (~1%)	High Risk (~2%) or Severe Consequences
Very low (< 0.5%)	No specific prophylaxis	
Low (~1.5%)	Mechanical prophylaxis, preferably with IPC	
Moderate (~3.0%)	LDUH, LMWH, *or* mechanical prophylaxis, preferably with IPC	Mechanical prophylaxis, preferably with IPC
High (~6.0%)	LDUH *or* LMWH *plus* mechanical prophylaxis with ES *or* IPC	Mechanical prophylaxis, preferably with IPC, until risk of bleeding diminishes and pharmacologic prophylaxis can be added
High-risk cancer surgery	LDUH *or* LMWH *plus* mechanical prophylaxis with ES *or* IPC *and* extended-duration prophylaxis with LMWH postdischarge	Mechanical prophylaxis, preferably with IPC, until risk of bleeding diminishes and pharmacologic prophylaxis can be added
High risk, LDUH and LMWH contraindicated or not available	Fondaparinux *or* low-dose aspirin (160 mg); mechanical prophylaxis, preferably with IPC; or both	Mechanical prophylaxis, preferably with IPC, until risk of bleeding diminishes and pharmacologic prophylaxis can be added

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Timing of thrombosis prophylaxis

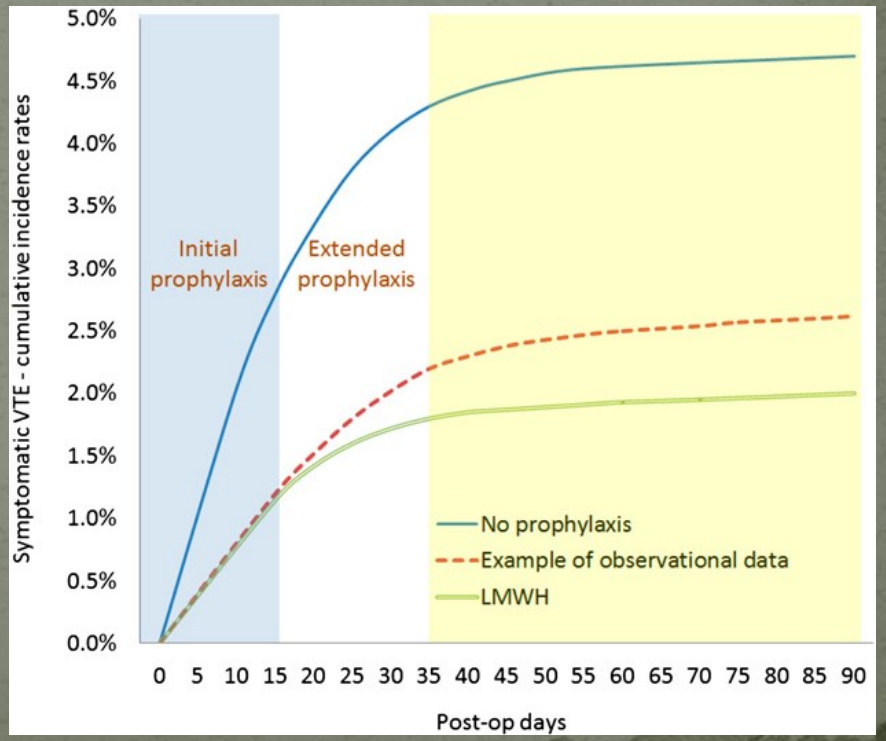
- Pre/postop vs periop

  For patients undergoing major orthopedic surgery (THA, TKA, HFS) and receiving LMWH as thromboprophylaxis, we recommend starting either 12 h or more preoperatively or 12 h or more postoperatively rather than within 4 h or less preoperatively or 4 h or less postoperatively (Grade 1B) . Major bleeding 5-7% vs 1-3% *ACCP 2012*

- Extended thromboprophylaxis

7-12 wks 10-50x VTE risk

Hip-knee surgery,major abdominal/pelvic cancer surgery



Baseline risk without thromboprophylaxis

Peri-op VTE

- DVT 20-80%
- PE 1-7.9%

- PE fatality rate 6-31%
- 5 yrs PTS rate 15-25%
- 2 yrs CTEPH rate 0.75%

Peri-op major bleed

- Major bleed 1.4-3.2%

- Fatality rate 0.8%
- Re-operation rate 13-21%
- Chr. morbidity 3%

NICE 2010

Thromboprophylaxis

Peri-op VTE

- Mechanical methods
  30-60% DVT reduction
- Pharmacological
  50-70% DVT reduction

Peri-op complication

- 3-4x skin lesions
  4-5% vs 1.3%
- 50% increase in major bleeding