

제315회 대한결핵 및 호흡기학회 심포지엄
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Perioperative Management of DOACs
for Respiratory Procedure/Surgery
in Patients with VTE
- Lung cancer surgery & VATS biopsy -

2026. 05. 27.

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Contents

- Key Question & Search Strategy
- Search Results & Key Evidence
- Considerations & Next Steps

Key Questions

➤ In **patients with VTE receiving DOACs**, who undergo elective **lung cancer surgery** or **diagnostic VATS biopsy**, what is the optimal perioperative DOAC management strategy?

*1. Should DOACs be **interrupted** for 1-2 days before surgery vs. earlier?*

*2. Should perioperative **bridging** be given vs. could be omitted?*

*3. Should DOACs be **resumed** within 24 hours vs. >24 hours after the procedure?*

PICOs

Population	Venous thromboembolism (mainly PE & DVT) AND DOACs (Rivaroxaban, Apixaban, Edoxaban, Dabigatran etexilate) AND [Lung cancer surgery OR VATS biopsy (lung/pleura)]
Intervention	Interruption (of DOACs) Perioperative bridging (with Heparins) Resumption (of DOACs)
Comparison	Refer to Intervention
Outcome	VTE (recurrent/breakthrough) Bleeding (major bleeding, clinically relevant non-major bleeding, minor bleeding)

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Search Criteria and Databases

- **Search criteria**

- Species: Humans only.
- Sex/Age: All / Adults only.
- Publication type: No restriction.
- Language: English, Korean.



Search strategy: "P" only

"VTE" AND "DOAC" AND "Procedure"

(Lung cancer/Lung/Pleura)

+ (Surgery/Biopsy/VATS)

- **Database:** PubMed (MEDLINE), Embase, Cochrane Library, [KoreaMed](#)

- **Search period:** August 1, 2021 ~ (2026. 05. 11.)

Search Strategy: VTE

text	MeSH	Emtree
"lung embolism*":ti,ab	Pulmonary Embolism	'lung embolism'/exp
"pulmonary embolism*":ti,ab	Pulmonary Embolism	'lung embolism'/exp
"pulmonary thrombo embolism*":ti,ab	Pulmonary Embolism	'lung embolism'/exp
"pulmonary thromboembolism*":ti,ab	Pulmonary Embolism	'lung embolism'/exp
"lung thromboembolism*":ti,ab	없음	'lung embolism'/exp
"venous thrombo embolism*":ti,ab	Venous Thromboembolism	'venous thromboembolism'/exp
"venous thromboembolism*":ti,ab	Venous Thromboembolism	'venous thromboembolism'/exp
"vein thromboembolism*":ti,ab	없음	'venous thromboembolism'/exp
DVT:ti,ab	없음	'deep vein thrombosis'/exp
"deep vein thrombos*":ti,ab	Venous Thrombosis	'deep vein thrombosis'/exp
"deep venous thrombos*":ti,ab	Venous Thrombosis	'deep vein thrombosis'/exp
"vein thrombos*":ti,ab	Venous Thrombosis	'vein thrombosis'/exp
"venous thrombos*":ti,ab	Venous Thrombosis	'vein thrombosis'/exp
phlebothrombos*:ti,ab	Venous Thrombosis	'vein thrombosis'/exp
"lung thrombos*":ti,ab	없음	'pulmonary thrombosis'/exp
"pulmonary thrombos*":ti,ab	없음	'pulmonary thrombosis'/exp
"vein embolism*":ti,ab	없음	'vein embolism'/exp
"venous embolism*":ti,ab	없음	'vein embolism'/exp
VTE:ti,ab	없음	없음

Search Strategy: DOACs

text	MeSH	Emtree
apixaban*:ti,ab	apixaban [Supplementary Concept]	'apixaban'/exp
eliquis:ti,ab	apixaban [Supplementary Concept]	'apixaban'/exp
pradaxa:ti,ab	Dabigatran	'dabigatran etexilate'/exp
dabigatran*:ti,ab	Dabigatran	'dabigatran'/exp
edoxaban:ti,ab	edoxaban [Supplementary Concept]	'edoxaban'/exp
"Factor Xa Inhibitor*":ti,ab	Factor Xa Inhibitors	'blood clotting factor 10a inhibitor'/exp
"direct oral anticoagula*":ti,ab	Factor Xa Inhibitors	'direct oral anticoagulant'/exp [candidate term]
rivaroxaban*:ti,ab	Rivaroxaban	'rivaroxaban'/exp
xarelto*:ti,ab	Rivaroxaban	'rivaroxaban'/exp
antithrombin*:ti,ab	Antithrombins	'antithrombin'/exp
"direct thrombin inhibitor*":ti,ab	Antithrombins	'thrombin inhibitor'/exp
"thrombin inhibitor*":ti,ab	없음	'thrombin inhibitor'/exp
anticoagula*:ti,ab	Anticoagulants	'anticoagulant agent'/exp
"oral anticoagula*":ti,ab	없음	'anticoagulant agent'/exp
oralanticoagula*:ti,ab	없음	'anticoagulant agent'/exp
DOAC*:ti,ab	없음	없음
DTI:ti,ab	없음	없음

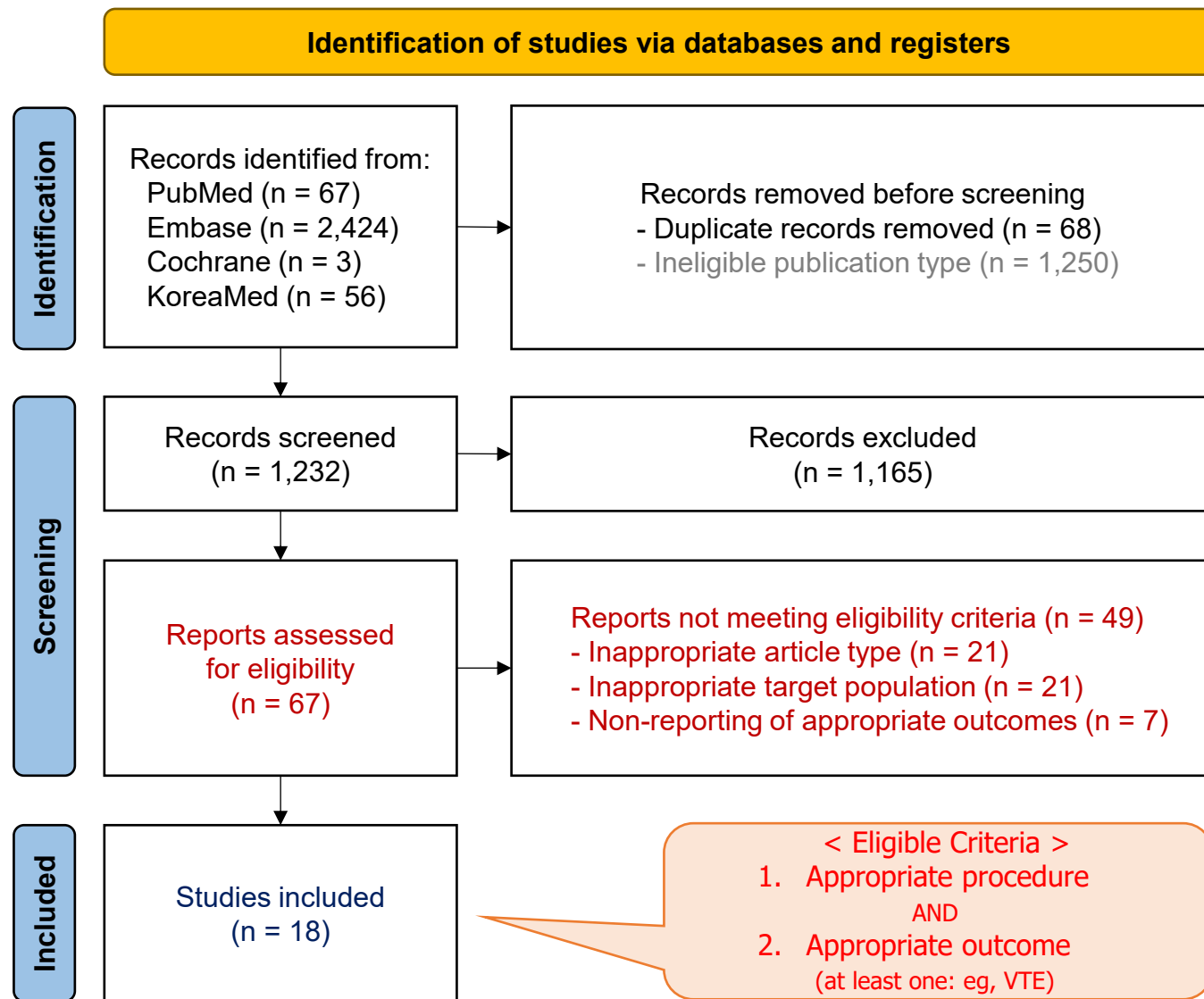
Search Strategy: Procedure (1)

text	MeSH	Emtree
lung*:ti,ab	Lung	'lung'/exp
pleura*:ti,ab	Pleura	'pleura'/exp
"adenocarcinoma of lung*":ti,ab	Adenocarcinoma of Lung	'lung adenocarcinoma'/exp
"lung adenocarcinoma*":ti,ab	Adenocarcinoma of Lung	'lung adenocarcinoma'/exp
"pulmonary adenocarcinoma*":ti,ab	Adenocarcinoma of Lung	'lung adenocarcinoma'/exp
"pulmonary tumo*":ti,ab	없음	'lung tumor'/exp
"lung neoplasm*":ti,ab	Lung Neoplasms	'lung tumor'/exp
"lung tumo*":ti,ab	Lung Neoplasms	'lung tumor'/exp
"pulmonary neoplasm*":ti,ab	Lung Neoplasms	'lung tumor'/exp
"lung cancer*":ti,ab	Lung Neoplasms	'lung cancer'/exp
"lung malignanc*":ti,ab	Lung Neoplasms	'lung cancer'/exp
"pulmonary cancer*":ti,ab	Lung Neoplasms	'lung cancer'/exp
"pulmonary malignanc*":ti,ab	없음	'lung cancer'/exp
"bronchial neoplasm*":ti,ab	Bronchial Neoplasms	'bronchus tumor'/exp
"bronchial tumo*":ti,ab	Bronchial Neoplasms	'bronchus tumor'/exp
"bronchial malignanc*":ti,ab	없음	'bronchus cancer'/exp
"bronchogenic cancer*":ti,ab	없음	'bronchus cancer'/exp
"bronchial cancer*":ti,ab	Carcinoma, Bronchogenic	'bronchus cancer'/exp
"bronchial carcinoma*":ti,ab	Carcinoma, Bronchogenic	'lung carcinoma'/exp
"lung carcinoma*":ti,ab	없음	'lung carcinoma'/exp
"pulmonary carcinoma*":ti,ab	없음	'lung carcinoma'/exp
"bronchial adenocarcinoma*":ti,ab	없음	'bronchial adenocarcinoma'/exp [candidate term]

Search Strategy: Procedure (2)

text	MeSH	Emtree
biops*:ti,ab	Biopsy	'biopsy'/exp
surg*:ti,ab	Surgical Procedures, Operative	'surgery'/exp
operat*:ti,ab	Surgical Procedures, Operative	'surgery'/exp
lobectom*:ti,ab	Pneumonectomy	'lobectomy'/exp
"lung volume reduction*":ti,ab	Pneumonectomy	'pneumonectomy'/exp
pneumonectom*:ti,ab	Pneumonectomy	'pneumonectomy'/exp
"robotic surg*":ti,ab	Robotic Surgical Procedures	'robot assisted surgery'/exp
"video assisted thoracoscopic surg*":ti,ab	Thoracic Surgery, Video-Assisted	'video assisted thoracoscopic surgery'/exp
VATS*:ti,ab	Thoracic Surgery, Video-Assisted	'video assisted thoracoscopic surgery'/exp
"video-assisted surg*":ti,ab	Video-Assisted Surgery	'video assisted surgery'/exp
"lobar resection*":ti,ab	없음	'lobar resection'/exp [candidate term]
segmentectom*:ti,ab	없음	'segmentectomy'/exp
"sublobar resection*":ti,ab	없음	'sublobar resection'/exp [candidate term]
"wedge resection*":ti,ab	없음	'wedge resection'/exp
RATS:ti,ab	없음	없음

Search Results



► Among 18 studies...

Procedures

- Lung cancer surgery (n=17)
- VATS Bx. for ILD (n=1)

Intervention/Comparator

- Heparin bridging (n=1)**
- Thromboprophylaxis
(n=6; LMWH 5, DOAC 1)

Reporting outcome (heterogenous)

- VTE, PE, DVT, CRT... (n=18)
- Bleeding (n=6)

Study region

- East Asia (n=10): China (n=9)
- Non-East Asia (n=8)

> VTE (heterogenous): 1.3~27.5%

Key Results (1)

- **P:** Lung cancer patients undergoing lung resection, who received DOAC or VKA 90 days before admission and 1 day before surgery.
- **I:** Heparin bridging
- **C:** No heparin bridging
- **O:** Postoperative VTE & bleeding (0~14d)
- Retrospective cohort study with PSM (N=2,416 → PSM: 750 vs. 750)
- Japanese nationwide DPC database (Apr 2014 – Mar 2018)

	All patients			Propensity-score matched patients		
	HB (n=1068)	NHB (n=1348)	p value	HB (n=750)	NHB (n=750)	p value
Sex (male), n (%)	793 (74.3)	965 (71.6)	0.144*	515 (68.7)	540 (72.0)	0.158*
Age, mean (SD)	73.11 (7.1)	73.47 (7.1)	0.300**	73.41 (6.9)	72.36 (7.2)	0.941**
BMI, mean (SD)	23.30 (3.5)	23.30(3.4)	0.796**	23.25 (3.6)	23.17 (3.5)	0.764**
Indications for anticoagulation, n (%)						
Atrial fibrillation	407 (38.1)	618 (45.9)	< 0.001*	329 (43.9)	319 (42.5)	0.602*
Mechanical valve or VT	84 (7.9)	100 (7.4)	0.681*	46 (6.1)	61 (8.1)	0.132*
Unknown	584 (54.7)	636 (47.2)	< 0.001*	380 (50.7)	373 (49.7)	0.718*
Anticoagulation, n (%)						
Warfarin	588 (55.1)	289 (21.4)	< 0.001*	281 (37.5)	281 (37.5)	1.000*
DOAC	480 (44.9)	1059 (78.6)	< 0.001*	469 (62.5)	469 (62.5)	1.000*

Key Results (1)

Postoperative outcome of all and the propensity score-matched patients with and without heparin bridging

	All patients			Propensity-score matched patients		
	HB (n = 1068)	NHB (n = 1348)	<i>p</i> value	HB (n = 750)	NHB (n = 750)	<i>p</i> value
All complications, <i>n</i> (%)	246 (23.0)	297 (22.0)	0.558*	179 (23.9)	161 (21.5)	0.267*
Thromboembolism, <i>n</i> (%)	14 (1.3)	10 (0.7)	0.161*	11 (1.5)	7 (0.9)	0.343*
Bleeding, <i>n</i> (%)	64 (6.0)	68 (5.0)	0.309*	44 (5.9)	31 (4.0)	0.124*
IP or ARDS, <i>n</i> (%)	10 (0.9)	10 (0.7)	0.600*	6 (0.8)	7 (0.9)	0.781*
Atelectasis, <i>n</i> (%)	67 (6.3)	76 (5.6)	0.511*	49 (6.5)	46 (6.1)	0.750*
Empyema, <i>n</i> (%)	9 (0.8)	16 (1.2)	0.406*	6 (0.8)	8 (1.1)	0.591*
Pneumonia or Other infection, <i>n</i> (%)	111 (10.4)	150 (11.1)	0.564*	80 (10.7)	82 (10.9)	0.86*
Operative mortality, <i>n</i> (%)	12 (1.2)	7 (0.5)	0.095*	7 (0.93)	5 (0.67)	0.562*
Length of stay, median, day (IQR)	17 (13–22)	13 (10–18)	<0.001**	16 (12–22)	14 (10–19)	<0.001**

- The incidence of postoperative **thromboembolism** was NOT significantly reduced and the frequency of postoperative **bleeding** was NOT statistically increased with HB.

Key Results (2)

- **P:** Lung cancer patients (Caprini score ≥ 5) undergoing anatomic lobectomy or segmentectomy
- **I:** Rivaroxaban 10mg QD (initiated 12-24h postop., until discharge)
- **C:** Nadroparin, weight-based dosing, SC (initiated 12-24h postop., until discharge)
- **O:** VTE (30-day), Bleeding (on-treatment)

- Single-blind, randomized, noninferiority trial (N=403)
- Single-center, Shanghai, China; Mar 2021 – Jul 2022

Key Results (2)

TABLE 2 Incidence of efficacy event (intention-to-treat population).

Outcomes	Overall (n = 403)	Rivaroxaban (n = 200)		Nadroparin (n = 203)		ARR ^a (95% CI)
		No. (%)	95% CI	No. (%)	95% CI	
Primary efficacy outcome	61 (15.1)	25 (12.5)	7.9-17.1	36 (17.7)	12.5-23.0	-5.2 (-12.2-1.7)
Secondary efficacy outcomes						
Major VTE	2 (0.5)	1 (0.5)	-0.5-1.5	1 (0.5)	-0.5-1.5	-
Deep-vein thrombosis	60 (14.9)	25 (12.5)	7.9-17.1	35 (17.2)	12.0-22.4	-4.7 (-11.7-2.2)
Proximal DVT	1 (0.2)	1 (0.5)	-0.5-1.5	0	-	0.5 (-0.5-1.5)
Distal DVT only	59 (14.6)	24 (12.0)	7.5-16.5	35 (17.2)	12.0-22.4	-5.2 (-12.1-1.6)
Bilateral	22 (5.5)	8 (4.0)	1.3-6.7	14 (6.9)	3.4-10.4	-2.9 (-7.3-1.5)
Unilateral	37 (9.2)	16 (8.0)	4.2-11.8	21 (10.3)	6.2-14.5	-2.3 (-8.0-3.3)
Symptomatic VTE						
During treatment	48 (11.9)	21 (10.5)	6.3-14.7	27 (13.3)	8.6-18.0	-2.8 (-9.1-3.5)
During follow-up	35 (8.7)	15 (7.5)	3.8-11.2	20 (9.9)	5.8-14.0	-2.4 (-7.8-3.1)

Primary efficacy outcome = a composite of any DVT or nonfatal PE

Major VTE = a composite of proximal DVT or nonfatal PE

Symptomatic VTE = any symptomatic DVT (proximal or distal) and nonfatal/fatal symptomatic PE

Key Results (2)

TABLE 3 Adverse events (safety analysis population).

Outcomes	Overall (n = 397)	Rivaroxaban (n = 196)		Nadroparin (n = 201)		RR ^a (95% CI)	p [*]
		No. (%)	95% CI	No. (%)	95% CI		
Any on-treatment bleeding events	38 (9.6)	24 (12.2)	7.7-16.8	14 (7.0)	3.4-10.5	1.9 (0.9- 3.7)	0.08
Major bleeding	32 (8.1)	19 (9.7)	5.6-13.8	13 (6.5)	3.1-9.9	1.6 (0.7- 3.2)	0.24
Causing a fall in hemoglobin level of ≥20 g/L	23 (5.8)	13 (6.6)	3.1-10.1	10 (5.0)	2.0-8.0	1.4 (0.6- 3.2)	0.48
Causing a transfusion of ≥2 units of whole blood or red cells	9 (2.3)	6 (3.1)	0.6-5.5	3 (1.5)	-0.2-3.2	2.1 (0.5- 8.5)	0.30
Non-major bleeding	6 (1.5)	5 (2.6)	0.3-4.8	1 (0.5)	-0.5-1.5	5.2 (0.6- 45.2)	0.13
Surgical site bleeding causing discontinuation of the study drug	5 (1.3)	4 (2.0)	0.1-4.0	1 (0.5)	-0.5-1.5	4.2 (0.5- 37.6)	0.20
Leading to transfusion of <2 units of blood	1 (0.3)	1 (0.5)		-	-	-	0.99

On-treatment bleeding events: beginning after the initiation and up to 2 days after the last dose of the study drug.

RR (logistic-regression model): for patients receiving rivaroxaban, as compared with those receiving nadroparin.

Considerations

TABLE 1] Suggested Risk Stratification for Patient-specific Periprocedural Thromboembolism^{13,14,25,a}

Risk Category	Mechanical Heart Valve	Atrial Fibrillation	VTE
High (> 10%/y risk of ATE or > 10%/mo risk of VTE)	Mitral valve <i>with</i> major risk factors for stroke ^b Caged ball or tilting-disc valve in mitral/aortic position Recent (< 3 mo) stroke or TIA	CHA ₂ DS ₂ VASc score ≥ 7 or CHADS ₂ score of 5 or 6 Recent (< 3 mo) stroke or TIA Rheumatic valvular heart disease	Recent (< 3 mo and especially 1 mo) VTE Severe thrombophilia (deficiency of protein C, protein S or antithrombin; homozygous factor V Leiden or prothrombin gene G20210A mutation or double heterozygous for each mutation, multiple thrombophilias) Antiphospholipid antibodies Active cancer associated with high VTE risk ^c
Moderate (4%-10%/y risk of ATE or 4%-10%/mo risk of VTE)	Mitral valve <i>without</i> major risk factors for stroke ^b Bileaflet AVR <i>with</i> major risk factors for stroke ^b	CHA ₂ DS ₂ VASc score of 5 or 6 or CHADS ₂ score of 3 or 4	VTE within past 3-12 mo Recurrent VTE Non-severe thrombophilia (heterozygous factor V Leiden or prothrombin gene G20210A mutation) Active cancer or recent history of cancer
Low (< 4%/y risk of ATE or < 2%/mo risk of VTE)	Bileaflet AVR <i>without</i> major risk factors for stroke ^b	CHA ₂ DS ₂ VASc score of 1-4 or CHADS ₂ score of 0-2 (and no prior stroke or TIA)	VTE > 12 mo ago

✓ **The time before resuming** anticoagulation postoperatively depends more on **the balance of VTE risks relative to bleeding.**

Douketis JD et al. Chest. 2022 Nov;162(5):e207-e243.
Berry J et al. J Thromb Haemost. 2023 Apr;21(4):780-786.

Considerations

TABLE 2] Suggested Risk Stratification for **Procedural Bleed Risk**, Based on ISTH Guidance Statements²⁵

<p>High-bleed-risk surgery/procedure^a (30-d risk of major bleed \geq 2%)</p>	<p>Major surgery with extensive tissue injury Cancer surgery, especially solid tumor resection (lung, esophagus, gastric, colon, hepatobiliary, pancreatic) Major orthopedic surgery, including shoulder replacement surgery Reconstructive plastic surgery Major thoracic surgery Urologic or GI surgery, especially anastomosis surgery Transurethral prostate resection, bladder resection, or tumor ablation Nephrectomy, kidney biopsy Colonic polyp resection Bowel resection Percutaneous endoscopic gastrostomy placement, endoscopic retrograde cholangiopancreatography Surgery in highly vascular organs (kidneys, liver, spleen) Cardiac, intracranial, or spinal surgery Any major operation (procedure duration > 45 min) Neuraxial anesthesia^b Epidural injections</p>
<p>Low-to-moderate-bleed-risk surgery/procedure^c (30-d risk of major bleed 0%-2%)</p>	<p>Arthroscopy Cutaneous/lymph node biopsies Foot/hand surgery Coronary angiography^d GI endoscopy \pm biopsy Colonoscopy \pm biopsy Abdominal hysterectomy Laparoscopic cholecystectomy Abdominal hernia repair Hemorrhoidal surgery Bronchoscopy \pm biopsy</p>
<p>Minimal-bleed-risk surgery/procedure^e (30-d risk of major bleed approximately 0%)</p>	<p>Minor dermatologic procedures (excision of basal and squamous cell skin cancers, actinic keratoses, and premalignant or cancerous skin nevi) Ophthalmologic (cataract) procedures Minor dental procedures (dental extractions, restorations, prosthetics, endodontics), dental cleanings, fillings Pacemaker or cardioverter-defibrillator device implantation</p>

✓ **How early to stop** anticoagulation is primarily influenced by pharmacokinetics of the drugs, and urgency/**bleeding risks** of surgery.

ISTH = International Society on Thrombosis and Haemostasis.

^aMinimal to no residual anticoagulant effect at time of procedure (ie, four to five drug half-life interruptions pre-procedure).

Next Steps?

➤ 서울아산병원 의학도서관에 문헌검색 최종신청 예정.

1. P = VTE on DOAC + Lung cancer, etc.

이미 **well-known VTE high-risk population**. (폐암이 아닌 VATS Bx.인 경우라도)

반면, patient VTE risk에 비해 **procedure/surgery별 출혈 관련 문헌은 상대적으로 적음.**

▶ **검색식을 procedure & bleeding 위주로 다시 작성**하여 추가 검색을 진행해볼지?

2. 검색기간 (기존)

2022 ACCP guideline **이후부터 2025년도까지**의 문헌만 추가로 검색하여 updat하고자 함.

해당 가이드라인 확인 시 개별 procedur에 대한 문헌확인 은 자세하게 하지 않음.

▶ 필요 시 **검색기간(시작일/종료일)을 확장**해볼지?

Thank You for Your Attention