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**Appendix:**

**1 - Is routine screening for DVT required in the pre-operative and/or post-operative period for patients undergoing spine procedures?**

**Search Terms:**

("Venous Thromboembolism"[Mesh] AND screening AND spine) OR ("Venous Thromboembolism"[Mesh] AND spinal surgery) OR ("routine screening" AND "deep vein" AND spine) OR (spine surgery[MeSH Terms] AND "Venous Thromboembolism"[Mesh]) OR (operative DVT screening[MeSH Terms] AND spinal)

((ultrasound[Text Word])) OR ("ultrasound screening"[Text Word])) OR ("venous compression ultrasound"[Text Word])) OR ("duplex ultrasonography"[Text Word])) OR ("doppler ultrasonography"[Text Word])) OR ("computed tomography"[Text Word])) OR (CT[Text Word])) OR ("magnetic resonance"[Text Word])) OR (MR[Text Word])) OR (MRI[Text Word])) OR (angiography[Text Word])) OR (venography[Text Word])) AND ("Venous Thrombosis"[Mesh] OR "deep vein thrombosis")) AND (((((((("spine procedure"[Text Word]) OR ("spinal surgery"[Text Word])) OR ("spine surgery"[Text Word])) OR ("vertebral surger\*"[Text Word])) OR ("spine fusion"[Text Word])) OR ("laminectomy"[Text Word])) OR ("scoliosis surgery"[Text Word])) OR ("lumbar spine surgery"[Text Word]))

**Total: 196 results**.

* Initially identified 🡪 primary screening on 102 papers
* 26 met the inclusion criteria.

***Inclusion Criteria:***

* Studies on spine procedure or spine surgery.
* Studies with VTE rates reported.
* Studies on patients with spine degeneration diseases.
* Both pediatric and adult series.
* At least one screening test described.
* Primary research.
* Original articles; randomized or nonrandomized controlled studies; and meta-analyses.
* English articles.

***Exclusion Criteria:***

* Paper on joint arthroplasty, regional anesthesia (spinal hematoma).
* Narrative review articles.
* Not in English.
* Duplicate reports, letters, and case reports.

**2 - Concerning VTE risk, which surgeries can be considered high-risk, and which surgeries can be considered low-risk in spine surgery?**

**Search Terms:**

("venous thromboembolism"[MeSH Terms] OR ("venous"[All Fields] AND "thromboembolism"[All Fields]) OR "venous thromboembolism"[All Fields] OR ("pulmonary embolism"[MeSH Terms] OR ("pulmonary"[All Fields] AND "embolism"[All Fields]) OR "pulmonary embolism"[All Fields]) OR ("venous thrombosis"[MeSH Terms] OR ("venous"[All Fields] AND "thrombosis"[All Fields]) OR "venous thrombosis"[All Fields] OR ("deep"[All Fields] AND "venous"[All Fields] AND "thrombosis"[All Fields]) OR "deep venous thrombosis"[All Fields])) AND (("spine"[MeSH Terms] OR "spine"[All Fields] OR "spines"[All Fields] OR "spine s"[All Fields]) AND ("surgery"[MeSH Subheading] OR "surgery"[All Fields] OR "surgical procedures, operative"[MeSH Terms] OR ("surgical"[All Fields] AND "procedures"[All Fields] AND "operative"[All Fields]) OR "operative surgical procedures"[All Fields] OR "general surgery"[MeSH Terms] OR ("general"[All Fields] AND "surgery"[All Fields]) OR "general surgery"[All Fields] OR "surgery s"[All Fields] OR "surgerys"[All Fields] OR "surgeries"[All Fields])) AND ("high-risk"[All Fields] OR "low-risk"[All Fields] OR (("major"[All Fields] OR "majored"[All Fields] OR "majoring"[All Fields] OR "majorities"[All Fields] OR "majority"[All Fields] OR "majors"[All Fields]) AND ("risk"[MeSH Terms] OR "risk"[All Fields])))

**Total: 190 results.**

***Inclusion Criteria:***

* Spine surgery
* Venous thromboembolism rates reported
* Stratification by procedure type and/or other operative variables
* Primary research
* English articles.

***Exclusion Criteria:***

* Narrative review articles
* Non-English articles
* Non-spine surgery.

**3 - Does the concern for epidural hematoma influence the choice for VTE prophylaxis after spine surgery?**

**Search Terms:**

(epidural hematoma, spinal [MeSH Terms] OR hematoma[Title/Abstract]) AND (venous thromboembolism[MeSH Terms] OR pulmonary embolism[MeSH Terms] OR deep venous thrombosis[MeSH Terms] OR thromboembolism[Title/Abstract])

**Total: 1,121 search results** (start of database until 2021).

**Databases Searched:** Pubmed, EMBASE, Cochrane Library.

**Filters:** Language: English, Dutch.

***Inclusion Criteria:***

* Both clinical and preclinical studies with any level of evidence
* Published in peer-reviewed journals in English or Dutch
* Investigated spinal epidural hematomas and (chemo)prophylaxis
* References of included studies were checked
* Studies were not excluded if they did not clearly report venous thromboembolism (VTE) or the method of VTE screening.

***Exclusion Criteria:***

* Studies in which spinal epidural hematoma data was not accessible or no rate was provided
* Those without an available full-text article
* Abstracts, case reports, case series, conference presentations, reviews, editorials, and expert opinions.

**4 - When can VTE chemoprophylaxis, if to be used, be started following spine procedures?**

**Search Terms:**

* Chemoprophylaxis timing
* VTE
* Thromboembolism
* Spine Surgery
* PE
* Pulmonary Embolism
* Chemoprophylaxis
* Deep Vein Thrombosis
* Epidural Hematoma
* Chemical Prophylaxis
* Venous Thromboembolism.

***Inclusion Criteria:***

* Spine surgery
* VTE prophylaxis options compared
* Study population grouped by single-/multi-level, anatomic location, or surgical approach

***Exclusion Criteria:***

* Personal opinion articles
* Individual case reports
* Not in English.

**5 - If VTE prophylaxis is to be administered, does the number of levels, and/or the anatomical location, and/or surgical approach (i.e., minimally invasive) influence the choice of VTE prophylaxis for patients undergoing spinal surgery?**

**Search Terms:**

((venous thromboembolism[MeSH] OR (Embolism and Thrombosis[Mesh]) OR pulmonary embolism[Mesh])) AND (prevent OR prophylaxis OR chemoprophylaxis[MeSH Terms])

AND ((spinal surgery) OR (spine surgery) AND ((approach) OR (level)) OR (cervical[Title/Abstract]) OR (lumbar[Title/Abstract]) OR (thoracolumbar[Title/Abstract]))

**Total: 21 results** (Initial search query identified 467 results, which were included or excluded as described below. Additional relevant articles found in references were also included.

***Inclusion Criteria:***

* Spine surgery
* VTE incidence reported
* VTE prophylaxis options compared
* Study population grouped by single-/multi-level, anatomic location, or surgical approach

***Exclusion Criteria:***

* Personal opinion articles
* Individual case reports
* Not in English.

**6 - Is aspirin a viable chemoprophylaxis for VTE in patients undergoing spine surgery?**

**Search Terms:**

((Aspirin[MeSH Terms]) OR (Aspirin[Title/Abstract]) OR (Aspirin)) AND ("Venous Thromboembolism"[Mesh] OR "Venous Thrombosis"[Mesh] OR "pulmonary embolism" OR "deep vein thrombosis") AND ((Prevention and Control[MeSH Subheading]) OR (prevention[Title/Abstract]) OR (prevent\*[Title/Abstract]) OR (prophylaxis[tw])) AND ((Spinal Surgery) OR (Spine Surgery) OR (Vertebral column Surgery))

**Total: 27 results.**

***Inclusion Criteria:***

* Orthopaedic procedures
* Venous thromboembolism rates reported
* Aspirin chemoprophylaxis use reported

***Exclusion Criteria:***

* Personal opinion articles
* Not in English.

**7 - What is the optimal protocol for management of patients who are on aspirin for a non-spine related disorder prior to spine surgery?**

**Search Terms:**

**Search Database(s):** Medline/Pubmed, and, Google Scholar

**(MeSH Terms):**

((“Spine/surgery”[Mesh] OR “Spinal Diseases/surgery”[Mesh] OR “Spinal Fusion”[Mesh] OR “Diskectomy”[Mesh] OR “Laminectomy”[Mesh] OR “Spinal Nerves/surgery”[Mesh] OR “Spinal Cord/surgery”[Mesh] OR “Spinal Cord Diseases/surgery”[Mesh] OR spine surgery[title] OR spinal surgery[title] AND ((Humans[Mesh]) AND (English[lang]))) NOT (“Spinal Cord Injuries/surgery”[Mesh] OR “Spinal Cord Neoplasms/surgery”[Mesh] OR “Spinal Neoplasms/surgery”[Mesh] OR “Spinal Injuries/surgery”[Mesh]) AND ((Humans[Mesh]) AND (English[lang]))) AND ((((“Thrombolytic Therapy”[Mesh] OR “Chemoprevention”[Mesh:noexp]) OR (“Thrombosis/drug therapy”[Mesh] OR “Thrombosis/ prevention and control”[Mesh] OR “Thrombosis/therapy”[Mesh])) OR (“Anticoagulants”[Mesh] OR “Anticoagulants “[Pharmacological Action])) OR (“Fibrinolytic Agents”[Mesh] OR “Fibrinolytic Agents “[Pharmacological Action] OR anticoagulation[title] OR antithrombotic[title] OR chemoprophylaxis[title]) AND (“humans”[MeSH Terms] AND English[lang]))

**Key words and Results:**

“Anticoagulation or anticoagulants” and “Continuation” and “Spine surgery” (Results: Pubmed 55, Google Scholar 19,400)

“Anticoagulation or anticoagulants” and “discontinuation” and “Spine surgery” (Results: Pubmed 28, Google Scholar 19,800)

“Anticoagulation or anticoagulants” and “perioperative” and “Spine surgery” (Results: Pubmed 69, Google Scholar 25,100)

“Antiplatelet agents” and “Spine surgery” (Results: Pubmed 234, Google Scholar 21,300)

**Selection Criteria:**

**Filters:**

Results per year: 1990-Present (all articles)

Results per year: pre-1990 (RCT only)

Species: Humans

Language: English.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Database**  | **Date searched** | **Limits** | **Primary Hits (type number of search results)** | **Notes** |
| Medline/ PubMed | 05/30/2021 | English / Humans | 252 |  |
| Google Scholar | 05/30/2021 | Same  | 3,050 |  |

***Inclusion Criteria:***

* Spine Surgery
* Perioperative management of anticoagulation, therapeutic anticoagulation use
* Prospective/retrospective/review articles presenting associations guidelines (NASS, ASRA, etc.)
* Pharmacologic literature on anticoagulation agents highlighting pharmacokinetics and half-lives.

***Exclusion Criteria:***

* Data not relatable to spine surgery (but still including non-spine orthopedic level 1 studies pertaining to epidural catheter placement-removal)
* Data not including preoperative anticoagulation use
* Case reports.

**8 - What is the optimal protocol for management of patients who are being treated with warfarin for a non-spine related disorder prior to spine surgery?**

**Search Terms:**

**Search Database(s):** Medline/Pubmed, and, Google Scholar

**(MeSH Terms):**

((“Spine/surgery”[Mesh] OR “Spinal Diseases/surgery”[Mesh] OR “Spinal Fusion”[Mesh] OR “Diskectomy”[Mesh] OR “Laminectomy”[Mesh] OR “Spinal Nerves/surgery”[Mesh] OR “Spinal Cord/surgery”[Mesh] OR “Spinal Cord Diseases/surgery”[Mesh] OR spine surgery[title] OR spinal surgery[title] AND ((Humans[Mesh]) AND (English[lang]))) NOT (“Spinal Cord Injuries/surgery”[Mesh] OR “Spinal Cord Neoplasms/surgery”[Mesh] OR “Spinal Neoplasms/surgery”[Mesh] OR “Spinal Injuries/surgery”[Mesh]) AND ((Humans[Mesh]) AND (English[lang]))) AND ((((“Thrombolytic Therapy”[Mesh] OR “Chemoprevention”[Mesh:noexp]) OR (“Thrombosis/drug therapy”[Mesh] OR “Thrombosis/ prevention and control”[Mesh] OR “Thrombosis/therapy”[Mesh])) OR (“Anticoagulants”[Mesh] OR “Anticoagulants “[Pharmacological Action])) OR (“Fibrinolytic Agents”[Mesh] OR “Fibrinolytic Agents “[Pharmacological Action] OR anticoagulation[title] OR antithrombotic[title] OR chemoprophylaxis[title]) AND (“humans”[MeSH Terms] AND English[lang]))

**Key words and Results:**

“Anticoagulation or anticoagulants” and “Continuation” and “Spine surgery” (Results: Pubmed 55, Google Scholar 19,400)

“Anticoagulation or anticoagulants” and “discontinuation” and “Spine surgery” (Results: Pubmed 28, Google Scholar 19,800)

“Anticoagulation or anticoagulants” and “perioperative” and “Spine surgery” (Results: Pubmed 69, Google Scholar 25,100)

“Antiplatelet agents” and “Spine surgery” (Results: Pubmed 234, Google Scholar 21,300)

**Selection Criteria:**

**Filters:**

Results per year: 1990-Present (all articles)

Results per year: pre-1990 (RCT only)

Species: Humans

Language: English.

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| --- | --- | --- | --- | --- |
| **Database**  | **Date searched** | **Limits** | **Primary Hits (type number of search results)** | **Notes** |
| Medline/ PubMed | 05/30/2021 | English / Humans | 252 |  |
| Google Scholar | 05/30/2021 | Same  | 3,050 |  |

***Inclusion Criteria:***

* Spine Surgery
* Perioperative management of anticoagulation, therapeutic anticoagulation use
* Prospective/retrospective/review articles presenting associations guidelines (NASS, ASRA, etc.)
* Pharmacologic literature on anticoagulation agents highlighting pharmacokinetics and half-lives.

***Exclusion Criteria:***

* Data not relatable to spine surgery (but still including non-spine orthopedic level 1 studies pertaining to epidural catheter placement-removal)
* Data not including preoperative anticoagulation use
* Case reports.

**9 - In patients on anticoagulants for a non-spine disorder, is perioperative bridging therapy necessary following cessation of anticoagulation prior to spine surgery?**

**Search Terms:**

**Search Database(s):** Medline/Pubmed, and, Google Scholar

**(MeSH Terms):**

((“Spine/surgery”[Mesh] OR “Spinal Diseases/surgery”[Mesh] OR “Spinal Fusion”[Mesh] OR “Diskectomy”[Mesh] OR “Laminectomy”[Mesh] OR “Spinal Nerves/surgery”[Mesh] OR “Spinal Cord/surgery”[Mesh] OR “Spinal Cord Diseases/surgery”[Mesh] OR spine surgery[title] OR spinal surgery[title] AND ((Humans[Mesh]) AND (English[lang]))) NOT (“Spinal Cord Injuries/surgery”[Mesh] OR “Spinal Cord Neoplasms/surgery”[Mesh] OR “Spinal Neoplasms/surgery”[Mesh] OR “Spinal Injuries/surgery”[Mesh]) AND ((Humans[Mesh]) AND (English[lang]))) AND ((((“Thrombolytic Therapy”[Mesh] OR “Chemoprevention”[Mesh:noexp]) OR (“Thrombosis/drug therapy”[Mesh] OR “Thrombosis/ prevention and control”[Mesh] OR “Thrombosis/therapy”[Mesh])) OR (“Anticoagulants”[Mesh] OR “Anticoagulants “[Pharmacological Action])) OR (“Fibrinolytic Agents”[Mesh] OR “Fibrinolytic Agents “[Pharmacological Action] OR anticoagulation[title] OR antithrombotic[title] OR chemoprophylaxis[title]) AND (“humans”[MeSH Terms] AND English[lang]))

**Key words and Results:**

“Anticoagulation or anticoagulants” and “Continuation” and “Spine surgery” (Results: Pubmed 55, Google Scholar 19,400)

“Anticoagulation or anticoagulants” and “discontinuation” and “Spine surgery” (Results: Pubmed 28, Google Scholar 19,800)

“Anticoagulation or anticoagulants” and “perioperative” and “Spine surgery” (Results: Pubmed 69, Google Scholar 25,100)

“Antiplatelet agents” and “Spine surgery” (Results: Pubmed 234, Google Scholar 21,300)

**Selection Criteria:**

**Filters:**

Results per year: 1990-Present (all articles)

Results per year: pre-1990 (RCT only)

Species: Humans

Language: English.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Database**  | **Date searched** | **Limits** | **Primary Hits (type number of search results)** | **Notes** |
| Medline/ PubMed | 05/30/2021 | English / Humans | 252 |  |
| Google Scholar | 05/30/2021 | Same  | 3,050 |  |

***Inclusion Criteria:***

* Spine Surgery
* Perioperative management of anticoagulation, therapeutic anticoagulation use
* Prospective/retrospective/review articles presenting associations guidelines (NASS, ASRA, etc.)
* Pharmacologic literature on anticoagulation agents highlighting pharmacokinetics and half-lives.

***Exclusion Criteria:***

* Data not relatable to spine surgery (but still including non-spine orthopedic level 1 studies pertaining to epidural catheter placement-removal)
* Data not including preoperative anticoagulation use
* Case reports.

**10 - Do patients with spine trauma require routine VTE prophylaxis before and after surgery?**

**Search Terms:**

(((((((postoperative procedure[MeSH Terms]) OR (postoperative procedures[MeSH Terms])) OR ("postoperative prophylaxis"[Text Word])) OR (postoperative care[MeSH Terms])) OR ((((care, preoperative[MeSH Terms]) OR (preoperative procedure[MeSH Terms])) OR ("preoperative prophylaxis"[Text Word])) OR ("before surgery"[Text Word]))) OR ((((orthopedic procedure[MeSH Terms]) OR (orthopedic procedures[MeSH Terms]) OR (orthopedic procedure) OR (orthopedic procedures) OR (orthopaedic procedures) OR (orthopaedic procedure))) OR ((("spinal cord surgery"[Text Word]) OR ("spinal cord"[Text Word])) OR ("spine surgery"[Text Word])))) AND (((("spine trauma"[Text Word]) OR ("spinal cord trauma"[Text Word])) OR ("spinal injury"[Text Word])) OR ("spine injury"[Text Word]))) AND ((((Prevention and Control[MeSH Subheading]) OR (prevention[Title/Abstract])) OR (prevent\*[Title/Abstract]) OR (prophylaxis[tw])) AND ("Venous Thromboembolism"[Mesh] OR "Venous Thrombosis"[Mesh] OR "pulmonary embolism" OR "deep vein thrombosis"))

**Databases Searched:** Pubmed.

Language: English.

***Inclusion Criteria:***

* Both clinical and preclinical studies with any level of evidence
* Published in peer-reviewed journals in English
* Investigated the use of VTE prophylaxis before and after surgery in preventing thromboembolic events in spine trauma patients.

***Exclusion Criteria:***

* Data was not accessible or missing
* Those without an available full-text article
* Duplicates and studies with poor scientific methodology as per risk of bias assessment
* Abstracts, case reports, conference presentations, reviews, editorials, and expert opinions.

**11 - Does the presence of a dural tear influence the choice for VTE prophylaxis after spine surgery?**

**Search Terms:**

((((((("dural tear"[tw]) OR ("dural leak"[tw])) OR ("dural injury"[tw])) OR ("dural laceration"[tw])) OR (incidental durotomy OR incidental dural tear OR incidental dural leak OR incidental dural injury OR incidental dural laceration)) OR (accidental durotomy OR accidental dural tear OR accidental dural leak OR accidental dural injury OR accidental dural laceration)) OR (iatrogenic durotomy OR iatrogenic dural tear OR iatrogenic dural leak OR iatrogenic dural injury OR iatrogenic dural laceration)) AND ((((((((((((((("Venous Thromboembolism"[Mesh]) OR ("Venous Thrombosis"[Mesh])) OR ("Pulmonary Embolism"[Mesh])) OR (pulmonary embolism OR pulmonary embolus OR pulmonary thromboembolism)) OR (Venous Thrombosis OR Venous Thromboses OR Venous Thromboembolism)) OR (Deep Venous Thrombosis OR Deep Venous Thromboses OR Deep Vein Thrombosis OR Deep Vein Thromboses)) OR (PE OR VTE OR DVT OR Blood Clot OR Blood Clots)) OR ((VTE Prophylaxis OR Thromboprophylaxis)) OR ("Anticoagulants"[Mesh] OR Anticoagulants OR Anticoagulant OR anticoagulation OR anti-coagulation OR Antithrombins OR Factor Xa Inhibitor OR Factor Xa Inhibitors)) OR ("Anticoagulants"[Mesh] OR "Platelet Aggregation Inhibitors"[Mesh] OR "Fibrinolytic Agents"[Mesh]) OR ( "LMWH"[tw] OR "low molecular weight heparin "[tw] OR "aspirin"[tw] OR "antithrombotics"[tw] OR "antiplatelet"[tw] OR " Vitamin K antagonists" [tw] OR "Factor Xa Inhibitors" [tw] OR "Adenosine diphosphate receptor antagonist"[tw] OR "ADP receptor antagonist"[tw] OR "Cyclooxygenase Inhibitor"[tw] OR "Prostaglandin"[tw] OR "Prostacyclin"[tw] OR "Glycoprotein IIb/IIIa antagonist"[tw] OR "Glycoprotein IIb/IIIa inhibitor"[tw] OR "Heparinoids"[tw] OR "Fibrinolytic"[tw] OR "Thrombin inhibitors"[tw])) OR (Adenosine-diphosphate ADP receptor antagonist)) OR (Thrombin Inhibitor OR Thrombin Inhibitors)) OR ("Heparin"[Mesh] OR Heparin OR Dalteparin OR Enoxaparin OR Nadroparin OR Tinzaparin)) OR ("Warfarin"[Mesh] OR Warfarin OR Coumadine OR Coumadin)) OR ("Aspirin"[Mesh] OR Aspirin))) NOT ("obstetric"[tw] OR "postpartum"[tw] OR "post-partum"[tw])

**Total: 66 results.**

***Inclusion Criteria:***

* Patients ≥ 18 years of age who underwent spine surgery
* Dural tear rates reported
* Venous thromboembolism rates reported
* At least one chemoprophylactic agent described
* Primary research
* English articles

***Exclusion Criteria:***

* Patients < 18 years of age
* Prior fusion, trauma injuries, revisions, infection, intended durotomies, and/or oncologic diagnosis
* Non-spine surgery patients
* Narrative review articles
* Non-English articles.

**12 - Should pediatric patients undergoing major spine procedures require routine VTE prophylaxis?**

**Search Terms:**

((spine procedure [MeSH Terms]) OR (spine surgery))) AND ((Pediatric [Mesh Terms]) AND ((Venous Thrombosis[Mesh Terms]) OR (venous thromboembolism[MeSH Terms]) OR (pulmonary embolism) OR (deep vein thrombosis) AND (thromboprophylaxis)

Total: 3,693 search results (years 2000-2021)

**Databases Searched:** PubMed, CINAHL, Cochrane Library

**Filters:**

Language: English

***Inclusion Criteria:***

* Both clinical and preclinical studies with any level of evidence
* Published in peer-reviewed journals in English
* Evaluate the thromboprophylaxis in pediatric spine surgeries.

***Exclusion Criteria:***

* Studies without accessible data or missing
* Those that we were unable to find full-text article
* All duplicate articles
* Articles with weak scientific methodology as per risk of bias assessment
* Abstracts, case reports, conference presentations, reviews, editorials, and expert opinions.