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Introduction

- The development and likelihood of recovery in spinal hematoma (SH) in various patient populations (pediatric, OB) has not been assessed in a single study.
- In this report, we investigated the factors for the occurrence of SH in the pediatric, obstetric, and adult non-OB populations.
- We analyzed the factors for SH after regional and interventional pain procedures in patients who were on anticoagulant(s) (ACs) and those without anticoagulants.
- We calculated the odds ratio for recovery based on the American Spinal Injury Association (ASIA) Impairment Scale at presentation.¹

Methods

- Our study was exempted from our local IRB.
- We searched PubMed using the search terms, “spinal hematoma” and “case reports”. We limited our search to papers written in English and published between 1954 and July 31, 2022.
- Patients on anticoagulants were subdivided according to etiology as spontaneous, related to trauma or surgery, or interventional pain procedure.
- We correlated recovery with the onset of symptoms and ASIA scale, as follows:¹ *Grade A*, complete neurological injury: no motor or sensory function; *Grade B*, incomplete neurological injury: sensory but no motor function is preserved below the neurological level; *Grade C*, incomplete neurological injury: motor function is preserved below neurological level and more than half of the key muscle groups have a muscle grade < 3; *Grade D*, incomplete neurological injury: motor function is preserved below the neurological level and at least half of the key muscle groups have a muscle grade ≥ 3; and, *Grade E*, sensory and motor function are normal.
- Treatment was classified as conservative or surgical decompression.
- We categorized the timing of surgery within 12 h, >12 to <36 hours, >36 to <48 hours, and > 48 hours after symptom onset.
- Neurological recovery after treatment was categorized as either “full recovery”, “partial recovery”, or “no recovery”.
- Generalized linear model with binomial distribution and logit link function was used to evaluate the relationship between complete versus partial/no recovery and no recovery versus complete/partial recovery by ASIA category.

Results

- Our PubMed search of articles showed 12,212 articles. Elimination of non-related articles resulted in a total of 939 case reports.
- There were 134 pediatric cases: 74 were spontaneous with no identifiable etiology, 28 had coagulation abnormality (hemophilia), 28 related to trauma, and 6 to neuraxial procedure (lumbar puncture).
- There were 39 obstetric cases; 23 were spontaneous; 16 were related to neuraxial injections. The trimester of occurrence was 1 in the second trimester, 18 in the third, 9 postpartum (it was not stated in 11 patients). Treatment was conservative in 8 (21%) and surgery in 31 (79%). Recovery (37 patients) was full in 21 (57%), partial in 15 (40%), none in 1 (3%).
- Details of non-OB adult cases in relation to AC use is in the Table.
- Cases in which clinicians did not adhere to ASRA regional guideline included epidural catheter or spinal drain removal during anticoagulation, anticoagulant initiated during epidural infusion, immediate heparinization after lumbar puncture or spinal anesthesia, or inadequate duration of AC discontinuation.
- Cases where the ASRA regional guideline were followed included patients in whom the AC was stopped but aspirin was continued, patients on subcutaneous heparin, or intraoperative heparin administration.
- Interventional procedures included ESI, SCS placement, vertebroplasty or kyphoplasty. The patients were either on aspirin, aspirin plus NSAID or clopidogrel, warfarin, heparin; or the stoppage was shorter than recommended.
- In cases where the ASRA pain medicine guideline was followed, the patients were on more than one AC.
- There were 504 non-OB patients not on ACs: spontaneous in 282 (56%), trauma in 93 (19%), related to neuraxial procedure in 62 (12%), interventional procedure in 36 (7%), and surgery in 31 (6%).
- In patients with focal deficits, the odds ratio for full recovery were lower for ASIA C compared to ASIA D.
- In terms of recovery, there was no association between the onset of symptoms, focal deficits, or paraplegia and the time interval to decompressive laminectomy.

Table. Cases of Adult Cases in Relation to Anticoagulant Use

Parameter	Number of cases
Adult non-OB patients	262
Spontaneous, chronic anticoagulation, single anticoagulant	104 (34 warfarin, 8 LMWH, 3 heparin, 5 P2Y12 inhibitor, 18 NOAC, 29 ASA, 7 NSAID)
Spontaneous, chronic anticoagulation, combination AC	68
Spontaneous, acute anticoagulation (MI, CVA, PE, cardiac procedure)	19
Related to trauma	6
Related to neuraxial procedure	37
Related to interventional procedure	22
Hematoma after surgery (aspirin)	6

Discussion and Conclusions

- We identified cases of SH where the ASRA guidelines were adhered to and instances when it was not followed.
- SH after SCS placement is secondary to several reinsertions of the electrode.
- SH after vertebroplasty is due to rupture of radiculomedullary veins, cement extravasation, or pedicle fracture.
- The time to surgery was not significantly associated with recovery. Our findings contradict recommendations of definite intervals between onset of symptoms, focal deficits, or paraplegia and timing of surgery.²⁻⁵

References

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