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THE PREVENTION OF DEEP VENOUS THROMBOSIS IN NEUROSURGERY: AN UPDATE FROM OUR INSTITUTION

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ABSTRACT

Prophylactic low weight molecular subcutaneous heparin combined with mechanical devices and elastic stockings has already been correlated to a low incidence of deep venous thrombosis. However, there is still concern with the use of heparin in the neurosurgical field due to the potential hemorrhagic risks. We would like to update this topic with new data coming from a larger cohort of patients operated on at our Department in the last 8 years both for cranial and spinal procedures. We collected information on 5347 patients: 1497 were cranial and 3850 were spinal cases. We recorded 35 clinically symptomatic DVTs (0.6%) and 18 cases (0.3%) of hemorrhagic complications and no cases of pulmonary embolus. It is our opinion that the protocol we have implemented in our Unit for the prevention of deep venous thrombosis and pulmonary embolus is safe and effective and does not seem to increase the incidence of hemorrhagic complications.

1. Introduction

Deep venous thrombosis (DVT) and pulmonary embolism (PE) are possible life-threatening complications which can happen in any surgical patient especially if prolonged bed rested. This is particular true when we consider neurosurgical patients either with cranial or spinal pathologies. In this group population the use of subcutaneous low molecular weight heparin (LMWH) may carry an increased bleeding risk especially for cranial surgical cases. On the other hand, this is exactly the group of patients with the longer operation and bed rest time and therefore the one who could benefit more from some kind of DVT prevention. Apart from the length of the operative time and the bed rest immobilization other well known risk factors for developing DVT and PE are surgery for cranial tumors like meningiomas (which are correlated with a releasing of a prothrombotic factor), high grade gliomas, lymphomas and metastasis as well as the use of specific medical therapies like mannitol and steroid. Patient related risk factors are increased age, presence of congestive heart failure, body mass index > 30, previous history of neoplasia or DVT, pregnancy, smoking, hypercoagulability disorder, use of the pill and presence of sepsis [1-4]. The utility of using mechanical and pharmacological prophylaxis has been described since the report of Agnelli in 1998 when a reduction of venous thromboembolism rate had been correlated with the use of such devices [5].

Despite also other papers have shown a lower incidence of DVT and consequently of PE with the use of LMWH prophylaxis in the neurosurgical community there is still concern with its use [6]. Since 2007, we have implemented a protocol, in our department where we are using for any patient undergoing surgery elastic stocking, perioperative mechanical sequential compression and postoperative LWMH. In a previous report we have already identified our protocol to be useful in reducing the risk of DVT and PE in operated cranial patients without observing a significative increasing of post-operative hemorrhagic complications [7]. This report is intended to confirm the safety and efficacy of our protocol with a larger series of patients admitted to our Department from January 2009 to December 2016 and operated on for both cranial and spinal pathologies.

2. Material and methods

In the study period we admitted to our Department 5,834 patients of whom 5347 underwent neurosurgical procedures. We prospectively collected patient age, sex, site of operation (cranial versus spinal), clinical evidences of DVT or PE of all these 5,347 operated patients. There were 1,497 cranial (27.9%) and 3,850 spinal (72.1%) surgeries.

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Among cranial surgeries we performed 1,153 elective (77%) and 344 emergent (23%) procedures while among spinal cases we performed 3196 elective (83%) and 654 emergent (17%) procedures. Nine-hundred and nineteen (61.3%) were cranial major surgeries and 1,851 (48%) were major spinal operations. There were 2,563 men (48%) and 2,784 women (52%); with a male to female ratio of 0.9 : 1. The overall mean age was 59.4 years (range 18-98 years). The follow up was at 3 and 6 months with outpatient visits. All the patients followed our standard protocol already described in a previous report [7] which can be summarized in the following way:

- pre and postoperative elastic permanent stockings for all patients (from the day of admission until discharge or to complete mobilization)
- perioperative mechanical sequential full leg compression (for higher risk patient this device is continued for 48 hours postoperatively or at least until LWMH is started)
- LWMH is given according to the patient weight, generally once a day, started 24-48 hours post-surgery

Moreover, in high risk patients the LWMH is started a few days before the operation, according to the necessity to withdraw antiplatelet or oral anticoagulant treatment. The heparin is than stopped the day before surgery and started again after the procedure and it is continued until a complete mobilization is achieved. High risk patients are considered those with long bed immobilization or positive history for previous episodes of DVT or PE, obese one, patients harboring malignancy or meningiomas, patients who undergo an operation longer than 4 hours of operative time, patients in treatment with contraceptives who could not stop the medication in advance, pregnant women and case of post-partum. In all patients with clinical symptoms suspicious for DVT (leg swelling, calf pain, redness along the leg) we performed a lower limbs ultrasound and in case of PE suspect the patient underwent a chest CT scan as well. Routinely, all patients had a pre and post-operative blood testing which included partial thromboplastin time (PTT), activated partial thromboplastin time (aPTT), fibrinogen, antithrombin III and platelet count. Five days and two weeks postoperatively, a platelet counts were repeated in order to detect a thrombocytopenia due to the use of heparin. All cranial patients underwent a routine cranial CT scan 24-48 hours from the surgery and at any time in case of neurological deterioration. Spinal patients underwent RX or CT scan only in the case the operation was spinal hardware implant procedure. Moreover, in case of neurological deterioration we always performed a spinal MRI to detect any possible complication.

3. Results

In the study period we recorded 35 proved cases of DVT with an overall incidence of 0.6%. Twenty-three DVTs occurred in the spinal group (0.5%) and twelve in the cranial group (0.8%). Among these, more than 70% occurred in the major surgical procedure. We did not experience any cases of PE in this study period. Other 10 patients, with a high clinical suspects of PE underwent a chest perfusion CT scan but in all cases, the result was negative. The overall number of hemorrhagic clinically important complications were 18 cases with an incidence of 0.3%. Seven were in the spinal group (0.18%) and eleven in the cranial group (0.7%). However the hematomas which required surgical intervention were 6 out 5347 cases (0.11%). Two were in the spinal group and four in the cranial one. The overall number of complications in this series were 53 cases (0.9%) (Table 1). The number of DVTs were higher in all cases operated as emergency but this result, however, did not reach a statistical significance.

		n	%
Patients	**total**	**5,347**	
	cranial	1,497 - 919 major surgery - 344 emergent cases	28 61.3 23
	spinal	3,850 - 1,851 major surgery - 654 emergent cases	72 48 17
N. DVTs	**total**	**35**	**0.6**
	cranial	12	0.8
	spinal	23	0.5
Hemorrages	**total**	**18**	**0.3**
	cranial	11	0,7
	spinal	7	0.1

Table 1 - Distribution of the study sample

4. Discussion

It is well recognized that any surgical procedure carries the risk, for the patient, of developing DVT and potentially PE. Among different specialties, neurosurgical patients are at higher risk for developing such complications when compared with other surgical and medical population [1,8-10]. According to the literature, cranial neurosurgical and traumatic patients have a reported risk of DVP ranging from 1 to 25% [5-7], whereas the incidence of PE is between 1.5 and 3% [5,11,12]. Thirty-four per cent in a control untreated group of patients from a paper by Cerrato [13]; 13.7% according to Smith who used a weekly "screening" evaluation [14]; 7.2% according to Hoefnagel who focused the attention to DVT in patient with intracranial meningiomas [15] and 9.7% in Serrone's paper who studied the incidence of DVT in patients with subarachnoid hemorrhage [16]. Whereas, in spinal neurosurgical patients a lower incidence of DVT have been reported: 1.1% according to Wang [17], 0.8% to Moayer [18] and Piper [19]. When we consider the various risk factors connected with DVT and PE, apart the one we have already mentioned we have to keep in mind also the use of steroid therapies, tobacco, hypercoagulability disorders, postoperative urinary infection, blood transfusion and high quantity of blood loss during surgery [1-4,20]. Many papers have been published over the years on different methods for preventing DVT and the use of prophylactic heparin is probably the most effective and easy to be applied as well as a cheaper one. Among different types of subcutaneous Heparin the low molecular weight is without any doubt the preferred one. It has a longer duration of action and a greater bioavailability which makes its use easy and safer.

Many recent studies as well as the one by Chibbaro and Tacconi in 2008 [7] stressed the importance of starting the treatment either pharmacological and mechanical before surgery. As matter of fact in their study they showed an acceptable rate of complications included DVT and PE starting LWMH before surgery. However, other studies have shown the effectiveness of starting the pharmacologic prevention also after surgery with less risk of complications [5,21-23]. According to Moussa [24] hemodiluition in addition to low molecular weight heparin can have further protective effect in these patients. In his cornerstone manuscript in 1998, a study of surveillance identified an incidence of 23% of DVT in hospitalized non symptomatic neurosurgical patients. The same authors identified a risk for DVT of 41.4% in patients receiving only mechanical prophylaxis and of 16.7% in patients receiving both mechanical and pharmacological prophylaxis. None of the patients had symptoms related to PE [25] and the heparin use didn't appear to be related with hemorrhagic complications. Henwood identified a 9.7% of DVT discovered as a surveillance protocol in neurosurgical, mainly cranial, patients receiving a protocol of unfractioned heparin (UFH) 5000 twice a day and leg pneumatic compression sleeves [26]. However, the optimal prophylactic treatment is still debated, both in cranial and in spinal surgery [1,2,6,27-30]. In a previous report from our Department, we studied the safety of our internal protocol on 746 patients undergoing cranial surgery and we recorded 3 cases (0,4%) of DVT; one patients died 2 months after surgery due to PE. There were 8 cases (1,07%) of significant hemorrhages. We concluded that our protocol was safe, effective with a negligible risk of postoperative bleeding [7]. In the present study our goal was to discuss the results and complications of a much larger series along a eight years period, after the established use of our protocol for both cranial and spinal surgeries. The overall incidence of DVT was of 0.6 %: 0.5 % in the spinal group and 0.8 % in the cranial group. We were also able to confirm that the greatest incidence of DVT were related to brain surgery as well as to major types of operation. We also confirmed a very low incidence of post-operative bleeding with only a 0,3 % of hemorrhagic complications and requiring intervention only 6 out of 18 cases. The present series is quite large but we acknowledge it has got two main limitations: first of all it is not a prospectic randomized study and second we did not perform an ultrasound study on all patients but only in those cases who were clearly symptomatic or when there was a high index of suspicion for DVT. Therefore it is possible we might have underestimated some cases with DVT but clinically asymptomatic and this could be the explanation of the lower rate of DVT incidence we have found compared to the other published studies in which a pre and post-operative screening leg ultrasound test was used. However, the fact we have followed up these patients for six months and we have encountered only 8 cases of late onset of DVT and no PE cases, it might signify that all the potentially missed cases were completely asymptomatic or minimal symptomatic and therefore they could have been considered irrelevant from a clinical point of view.

5. Conclusions

Although some report raised the possibility of potential high risk for using heparin in neurosurgical patients and suggested to start it after the operation we think that our protocol consistent with elastic stockings, intermittent sequential compression devices and pharmacological prophylaxis with LWMH decreases the incidence of DVT/PE with an acceptable risk of postoperative surgical site bleeding.

References

1. Bryson DJ, Uzoigwe CE, Braybrooke J. Thromboprophylaxis in spinal surgery: a survey. Journal of Orthopaedic Surgery and Research [Internet]. 2012;7(1):14. Available from: http://www.josr-online.com/content/7/1/14

2. Rolston JD, Han SJ, Bloch O, Parsa AT. What clinical factors predict the incidence of deep venous thrombosis and pulmonary embolism in neurosurgical patients? Journal of Neurosurgery [Internet]. 2014;121(4):908–18. Available from: http://thejns.org/doi/10.3171/2014.6.JNS131419

3. Lieber BA, Han J, Appelboom G, Taylor BES, Han BJ, Agarwal N, et al. Association of Steroid Use with Deep Venous Thrombosis and Pulmonary Embolism in Neurosurgical Patients: A National Database Analysis. World Neurosurgery [Internet]. 2016;89:126–32. Available from: http://dx.doi.org/10.1016/j.wneu.2016.01.033

4. Bekelis K, Labropoulos N, Coy S. Risk of Venous Thromboembolism and Operative Duration in Patients Undergoing Neurosurgical Procedures. Neurosurgery [Internet]. 2017;80(5):787–92. Available from: https://academic.oup.com/neurosurgery/article-lookup/doi/10.1093/neuros/nyw129

5. Agnelli G, Piovella F, Buoncristiani P, Severi P, Pini M, D'Angelo A, et al. Enoxaparin plus Compression Stockings Compared with Compression Stockings Alone in the Prevention of Venous Thromboembolism after Elective Neurosurgery. New England Journal of Medicine [Internet]. 1998;339(2):80–5. Available from: http://www.nejm.org/doi/abs/10.1056/NEJM199807093390204

6. Wang X, Zhou Y-C, Zhu W-D, Sun Y, Fu P, Lei D-Q, et al. The risk of postoperative hemorrhage and efficacy of heparin for preventing deep vein thrombosis and pulmonary embolism in adult patients undergoing neurosurgery: a systematic review and meta-analysis. Journal of Investigative Medicine [Internet]. 2017;65(8):1136–46. Available from: http://jim.bmj.com/lookup/doi/10.1136/jim-2016-000235

7. Chibbaro S, Tacconi L. Safety of deep venous thrombosis prophylaxis with low-molecular-weight heparin in brain surgery. Prospective study on 746 patients. Surgical Neurology. 2008;70(2):117–21.

8. Bostrom S, Holmgren E, Jonsson O et al. Post-operative thromboembolism in neurosurgery: a study on the prophylactic effect of calf muscle stimulation plus dextram compared to low-dose heparin. Acta Neurochir (Wien) 1986; 80:83-9

9. Hamilton MG, Hull RD, Pineo GF. Venous trhomboembolism in neurosurgery and neurology patients: a review. Neurosurgery 1994; 34:280-96

10. Macdonald RL, Amidei C, Lin G, et al. Safety of perioperative subcutaneous heparin for prophylaxis of venous thromboembolism in patients undergoing craniotomy. Neurosurgery 1999; 45: 245-52

11. Clagett GP, Reisch JS. Prevention of venous thromboembolism in general surgical patients, results of meta-analysis. Ann Surg 1988; 208: 227-40

12. Collins R, Scrimgeour A, Yusuf S et al. Reduction in fatal pulmonary embolism and venous thrombosis by preoperative administration of subcutaneous heparine: overview of resultsof randomized trials in general, orthopedic, and urological surgery. N Engl. J Med 1988; 318:1162-73

13. Cerrato D, Ariano C, Fiacchino F. Deep vein thrombosis and low-dose heparin prophylaxis in neurosurgical patients. Journal of neurosurgery. 1978;49(3):378–81.

14. Smith TR, Nanney AD, Lall RR, Graham RB, McClendon J, Lall RR, et al. Development of venous thromboembolism (VTE) in patients undergoing surgery for brain tumors: Results from a single center over a 10 year period. Journal of Clinical Neuroscience [Internet]. 2015;22(3):519–25. Available from: http://dx.doi.org/10.1016/j.jocn.2014.10.003

15. Hoefnagel D, Kwee LE, Van Putten EHP, Kros JM, Dirven CMF, Dammers R. The incidence of postoperative thromboembolic complications following surgical resection of intracranial meningioma. A retrospective study of a large single center patient cohort. Clinical Neurology and Neurosurgery [Internet]. 2014;123:150–4. Available from: http://dx.doi.org/10.1016/j.clineuro.2014.06.001

16. Serrone JC, Wash EM, Hartings JA, Andaluz N, Zuccarello M. Venous Thromboembolism in Subarachnoid Hemorrhage. World Neurosurgery [Internet]. 2013;80(6):859–63. Available from: http://dx.doi.org/10.1016/j.wneu.2013.01.012

17. Wang TY, Sakamoto JT, Nayar G, Suresh V, Loriaux DB, Desai R, et al. Independent Predictors of 30-day Perioperative Deep Vein Thrombosis in 1346 Consecutive Patients After Spine Surgery. World Neurosurgery [Internet]. 2015;84(6):1605–12. Available from: http://dx.doi.org/10.1016/j.wneu.2015.07.008

18. Moayer AF, Mohebali N, Razmkon A. Incidence of Deep Vein Thrombosis in Patients Undergoing Degenerative Spine Surgery on Prophylactic Dalteparin; A Single Center Report. Bull Emerg Trauma. 2016;4(1):38–42.

19. Piper K, Algattas H, Deandrea-Lazarus IA, Kimmell KT, Li YM, Walter KA, et al. Risk factors associated with venous thromboembolism in patients undergoing spine surgery. J Neurosurg Spine. 2017;26:90–6

20.Natsumeda M, Uzuka T, Watanabe J, Fukuda M, Akaiwa Y, Hanzawa K, et al. High incidence of deep vein thrombosis in the perioperative period of neurosurgical patients. World Neurosurgery [Internet]. 2018;doi: 10.1016/j.wneu.2017.12.139. Available from: http://linkinghub.elsevier.com/retrieve/pii/S1878875017322556

21. Frim DM, Barker II FG, Poletti CE, et al. Postoperative low-dose heparin decreases thromboembolic complications in neurosurgical patients. neurosurgery 1992; 30: 830-3

22. Iorio A, Agnelli G. Low -molecular-weight and unfractionated heparin for prevention of venous thromboembolism in neurosurgery: a meta-analysis. Arch. Intern. Med. 2000; 160:2327-32

23. Raabe A, Gerlach R, Zimmermann M et al. Practice of perioperative thromboembolic prophylaxys in neurosurgery: results of a German survey. [in german]Zentralbl Neurochir 2000; 61: 103-10

24. Moussa WMM, Mohamed MAA. Prophylactic use of anticoagulation and hemodilution for the prevention of venous thromboembolic events following meningioma surgery. Clinical Neurology and Neurosurgery [Internet]. 2016;144:1–6. Available from: http://dx.doi.org/10.1016/j.clineuro.2016.02.040

25. Dermody M, Alessi-Chinetti J, Iafrati MD, Estes JM. The utility of screening for deep venous thrombosis in asymptomatic, non-ambulatory neurosurgical patients. Journal of Vascular Surgery [Internet]. 2011;53(5):1309–15. Available from: http://dx.doi.org/10.1016/j.jvs.2010.10.115

26. Henwood PC, Kennedy TM, Thomson L, et al. The incidence of deep vein thrombosis detected by routine surveillance ultrasound in neurosurgery patients receiving dual modality prophylaxis. Journal of Thrombosis and Thrombolysis. 2011;32(2):209–14.

27.Bikdeli B, Sharif-Kashani B. Prophylaxis for venous thromboembolism: A Great Global Divide between Expert Guidelines and Clinical Practice? Seminars in Thrombosis and Hemostasis. 2012;38(2):144–55.

28. Cheng JS, Arnold PM, Anderson PA, Fischer D, Dettori JR. Anticoagulation risk in spine surgery. Spine. 2010;35(SUPPL. 9S):117–24.

29. Khan NR, Patel PG, Sharpe JP, Lee SL, Sorenson J. Chemical venous thromboembolism prophylaxis in neurosurgical patients: an updated systematic review and meta-analysis. Journal of neurosurgery. 2017;DOI: 10.3171/2017.2.JNS162040

30. Koo KH, Choi JS, Ahn JH, Kwon JH, Cho KT. Comparison of Clinical and Physiological Efficacies of Different Intermittent Sequential Pneumatic Compression Devices in Preventing Deep Vein Thrombosis: A Prospective Randomized Study. Clinics in Orthopedic Surgery. 2014;6(4):468–75.

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