

## Treatment of Vertebral Body Hemangiomas with Direct Ethanol Injection and Short Segment Stabilization: Description of Technique and Review of Literature

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### ABSTRACT

**Background:** Vertebral body (VH) hemangiomas with myelopathy are difficult to manage.

**Objective:** The authors describe their technique of symptomatic vertebral body hemangiomas (VH) with absolute alcohol (ethyl alcohol) describe the long-term outcomes and do a literature review

**Methods:** Surgery consisted of intra-operative bilateral pedicular absolute alcohol (<1% hydrated ethyl alcohol) injection, laminectomy and cord decompression at the level of pathology followed by a short segment instrumented fusion using pedicle screws. Patients treated included symptomatic VH with cord compression with myelopathy. The following were excluded: pathological fractures and/or deformity or multi-level pathologies.

**Results:** 38 patients (Mean 24.9+12.2, range: 10-68 years, 20 females). Clinical features included myelopathy all (5 paraplegic), sphincter involvement (13) and mid back/lower pain (7). Pre-operative American Spinal Injury Association (ASIA) scores: A (8), B (13), C (6), D (10) and E (1). Majority had single vertebral involvement (35), 3 multiple levels. Six underwent surgery earlier (1 alcohol embolization here). Mean surgical time: 122+38 min, average blood: 260+80 cc. Mean amount of absolute alcohol injected: 14+5.2 cc. (2 requiring 20 and 25 cc). Immediate embolization achieved in all, allowing laminectomy and soft-tissue hemangioma removal easily. Post-surgery, 1 patient had transient deterioration, rest all patients improved (sphincters improved in 9) at a follow up ranging 28-103 months (mean 47.6+22.3). Follow-up ASIA scores: E (28), D (6), B (3) and C (1). All patients showed evidence of bone sclerosis and relief of cord compression on follow-up imaging.

**Conclusion:** This is largest study in literature showing excellent improvement, low re-operation rates following ethanol embolization and short segment fixation.

**Keywords:** Vertebral hemangioma, Absolute alcohol, Ethanol, Pedicle screw fixation, Outcomes

### INTRODUCTION

Vertebral hemangiomas (VH) are among most common lesions of the vertebral column, but can become very challenging to treat when they start becoming symptomatic by causing cord compression [1-5]. They are more common in females with overall incidence of these lesions is about 10% in normal population [1-8]. Single vertebral involvement occurs most commonly, although two level involvements is not so uncommon even though involvement of more number of levels is exceedingly uncommon [1,3-7,9,10]. Till date, whatever surgical techniques described have been very difficult, let it either complete vertebrectomy [10-17], injection of various "cement" like material [18-48] and even radiotherapy [49-52]. Complete vertebrectomy is extremely difficult and associated with high morbidity and mortality due to blood loss and degree of surgical exposure. Likewise, injection of various embolizing and 'cement' like

material would only temporarily reduce the vascularity with obvious risk of recurrence.

Ethanol embolization [53-62] through a per-cutaneous route was shown to be effective but was associated with a high incidence of pathological fractures and also transient neurological deterioration. The authors demonstrated a unique technique in 2011 [63,64], which consists of intra-

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operative ethanol embolization combined with short segment fixation. This and subsequent publications [63-65] and have demonstrated high degree of safety, efficacy and feasibility of this procedure.

### CLINICAL MATERIALS AND METHODS

The main indications of this procedure include vertebral hemangiomas with myelopathy. We do not use it in cases with pathological fractures, deformity, Von Hippel disease or patients with severe systemic illnesses (e.g. hypertension or diabetes). The surgical technique has been described in details in the earlier papers [63-65]. However briefly, the technique consists of exposure of the affected vertebrae along with one level above and below. Instrumented fixation (pedicle screws) was then performed one level above and below. After this, absolute alcohol (1% ethyl alcohol) is injected into either pedicle (using fluoroscopy or neuronavigation) of the affected vertebrae using 14-16 gauges Jamshide needle. The presence of VH is confirmed by rapid oozing or gushing of venous blood from the cannulas. We generally prefer using 6-7 cc of absolute alcohol in either side. This is introduced with slow increments of 0.5 cc with careful monitoring of hemodynamic status.

### OUR RESULTS AND LITERATURE REVIEW

We treated till date a total of a total of 38 patients were treated from June 2006 till June 2017 with at least a follow up of 28 months and were included in this study. The mean age was 24.9+13.2 years, (range: 10-68 years, 20 females). Clinical features included myelopathy in all (5 paraplegic), sphincter involvement (13) and mid back/lower pain (7). The pre-operative American Spinal Injury Association (ASIA) scores were A in 8, B in 13, C in 6, D in 10 and E in 1 patient. Majority had single vertebral involvement (35), however 3 patients multiple level involvement. Six underwent surgery earlier. Of these, 1 underwent alcohol embolization at our hospital in 2012. The mean surgical time was 122+38 min, average blood loss being 260+80 cc. The mean amount of absolute alcohol injected was 14+5.2 cc. Two patients required 20 and 25 cc (case 28 and 22 respectively), both having multiple level hemangiomas. Immediate embolization achieved in all, allowing laminectomy and soft-tissue hemangioma removal easily. One patient had transient neurological deterioration. His power deteriorated to 1/5 in both lower limbs. Immediate CT scan showed pedicle screws in place. He was treated with steroids, and within 2 weeks improved to the pre-operative level. His power improved to near normal at 30 months of follow up. One patient had a transient hypotension during surgery. Following copious irrigation with saline, and watchful waiting, this improved. This however did not have any impact on the final clinical outcome.

All patients improved (sphincters also improved in all too various degrees) at a follow up ranging from 28-103 months

(mean 47.6+22.3). Follow-up ASIA scores were E in 28, D in 6, B in 5 and C in 1. All patients showed evidence of bone sclerosis and relief of spinal cord compression on follow-up imaging. The Nurick's grade were I (35 patients) and II (3 patients) at the last follow up. Five patients presented with paraplegia. Of these, one was is term pregnancy (30 weeks). Two improved to ASIA grade B, 2 to ASIA grade E and 1 to grade D. 13 had sphincter involvement, all improved to extent of becoming continent.

### DISCUSSION

Ethanol in earliest times was used to produce angioinfarction of kidneys for uncontrolled hypertension<sup>66</sup>. While it is a very effective embolizing agent but has the disadvantage of being highly nectotoxic and can have systemic hemodynamic side effects [56,61,62].

Pathologically VH are benign lesions of the bone, usually of dysembryogenetic origin or hamartomatous lesions [67-76]. They can be cavernous, capillary or a mixed type [75,77,78]. Arteriovenous shunting is rare and these have only low flow channels [75,77,78]. Such a pathological architecture provides a relatively safe situation for injection of embolizing agents like ethanol as it would prevent rapid shunting and systemic toxicity (if injected slowly). Presence of low flow fistulas in VH also would prevent rapid 'wash off' of ethanol, thus allowing its embolizing and sclerosing action to take place locally.

The current accepted strategies for surgical management of VH include vertebrectomy [10-17] (usually with embolization), injection of 'cement' like substances using either vertebroplasty or kyphoplasty [18-48] and radiotherapy [49-52]. The first technique is fraught with high risk, morbidity and mortality (upto 6% in some earlier series [8]). There are some cases described where this was performed even using total circulatory arrest [79]. In comparison, the latter 2 techniques even though providing much less risk have the short-coming of technically not eradicating the disease.

In 1994, Heiss et al. [54,80,81] published the first report of vertebral hemangiomas treated by percutaneous CT guided injection of absolute alcohol. While this was associated generally with good improvement but was associated with a reports of pathological fractures and transient neurological deterioration. Injection of absolute alcohol causes intralesional thrombosis and destruction of the endothelium that composes the hemangioma. Devascularisation is followed by shrinkage of the lesion and subsequent sclerosis which decompresses the cord and nerve roots [54,80].

VH ethanol embolization has the unique advantage of both providing instant embolization and also being tumoricidal [54-64,66]. This could have been perhaps the reason, why in some cases of per-cutaneous injection of ethanol, the patients developed pathological fractures [54,80,82]. This correlated with the volume of ethanol injected (>40 ml). In

such cases, possibly once the tumor was embolized and underwent necrosis by ethanol, the residual bony lattice unable to support the weight of the body collapsed. To counteract this shortcoming, the authors suggested a short segment instrumented fixation [11,63,64].

Systemic complications are another major concern of ethanol injection. Niemeier et al. [58] reported a case of Brown-Sequard syndrome following injection of alcohol for VH. This and the cases of transient deterioration described by others [59,82] may have been due to a retrograde leak, which cannot be detected during a percutaneous injection. Such manifestations have been also described in a case that had undergone endovascular embolization of VH83. Migration of microcoil into the sulco-commisural artery has been postulated as the reason for this. MRI done later, demonstrated spinal cord infarct. It is thus possible, that a rapid systemic 'run off' of ethanol into the perforators may have caused similar problems of neurological deterioration. The current series has one case of transient deterioration following surgery. The patient had developed severe weakness (1/5) following surgery, which improved to the pre-operative status after 2 weeks. There was another patient, where transient hemodynamic changes were noted during surgery. Apart from these 2 cases, there were no other long-term morbidities. All patients improved in their weakness as a rule. Even the patients with paraplegia improved significantly (3 to ASIA grades >D). In our experience, the incidence of recurrence has been low. Even if the recurrence did take place, a repeat ethanol injection seemed satisfactory in improving symptoms and controlling the disease. We of course cannot comment on longer-term outcomes (>10 years follow up) at this stage.

The mean amount of absolute alcohol injected was 14+5.2 cc. Two patients required 20 and 25 cc, both having multiple level hemangiomas. Interestingly, case 22, which had the maximum amount of ethanol, injected developed transient intraoperative hypotension. This was well within the limits of what has been recommended in the literature. Although it is difficult to comment, it would be safe to conclude that an amount up to 15 cc should be reasonably safe. We feel that more important would be the uses of small increments of 0.5 cc injections during the intra-operative period. We feel that in patients with multiple levels VH, the procedure may be staged.

MRI imaging performed at follow up showed relief of spinal cord compression in all cases. In addition, CT scan demonstrated bone sclerosis and new bone formation. This was a finding, which we found in only 2 cases in our pilot study, but have found consistently in all our cases in the current series. We have not found this finding described in any of the earlier studies even though it may be expected due to 2 reasons: 1) The sclerosing effect of ethanol itself; 2) Necrosis and disintegration of the tumor tissue which now leaves a large space within the bony lattice, providing same

for fresh osteogenesis to take place. However, whatever could be the reasons; ethanol embolization provides very good advantage in this aspect over other conventional embolizing agents. Lastly, but not least, it is a highly cost effective technique (\$1 for 100 cc of ethanol!). This definitely has had an impact on our patient profile as a significant number of our patients were economically challenged and not covered through insurance [83].

## CONCLUSION

Intra operative absolute alcohol (<1% hydrated ethanol) combined with surgical decompression of the cord and short segment instrumented fixation seems to be a useful (100% improvement in our series) technique in both single and multiple level vertebral hemangiomas with epidural soft tissue compression of the cord. It may provide the advantage of reducing the complications of ethanol by providing operative visualization, allowing immediate recovery due to surgical decompression and also preventing pathological fractures. In our series of 33 cases with a long term follow up, it has been demonstrated to be safe, effective, and associated with low morbidity. In addition, it has been shown to produce bony sclerosis over a period of time thus strengthening the bone quality. There has been only 1 recurrence in our series, which has been effectively treated with ethanol re-embolization. Based on this, we feel that ethanol embolization and short segment instrumented fixation may be currently one of the best alternatives for treatment of symptomatic vertebral hemangiomas.

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## DISCLAIMER

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

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