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Original Research Article

Assessment of vitamin C supplementation as an adjuvant analgesic therapy and evaluating its efficacy in terms of clinical and functional outcomes in post-operative patients undergoing surgical decompression for prolapsed intervertebral lumbar disc

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ABSTRACT

Background: Post-operative pain is one of the most debilitating condition following lumbar spine surgery, which negates the clinical and functional outcomes. Vitamin C (ascorbic acid) due to its anti-oxidant, neuroprotective and neuromodulating properties; was evaluated to have adjuvant analgesic effects in these patients.
Methods: This prospective study included 50 patients undergoing single level lumbar disectomy; randomly divided into group A (vitamin supplementation, n=25) and group B (no supplementation, n=25). Both the groups were evaluated on the follow ups for the clinical outcomes (visual analog scale-VAS score), functional outcomes (Oswestry disability index-ODI score) and total analgesia consumed.
Results: Both the groups showed statistically significant improvements in clinical and functional outcomes with respect to pre-operative status. Group A showed statistically significant ($p<0.05$) improvement in VAS and ODI scores as compared to group B at 4th, 6th and 8th week follow up, however at 2nd and 12th week follow up the difference was found to be insignificant. Total analgesia consumed by group A patients was statistically lower than that consumed by group B patients.
Conclusions: Vitamin C has analgesic effects in certain clinical conditions, thus reducing post-operative pain and improving the overall satisfaction and outcome of the surgery. It helps in bringing about the improvement in clinical as well as the functional outcome of the spine surgery and has an effective dose-sparing and adjuvant effect on the post-operative analgesia.

Keywords: Vitamin C, Ascorbic acid, Visual analog scale, Oswestry disability index

INTRODUCTION

Post-operative pain is one of the most challenging obstacles for the surgeon.[1,2] Despite advancements in the pain management field, this particular problem negates the postoperative clinical and functional outcomes; hampering the overall satisfaction of the patient, leading to longer post-operative stay and longer rehabilitation thus burdening the health care expenditure as well as the quality of life.[3-6] Commonly used analgesics like NSAIDs and opioids when used at higher doses have their own set of side effects like nausea, vomiting, respiratory depression, and gastric ulceration.[7,8] The main aim of post-operative pain management is to provide analgesic relief with minimal doses so as to lessen the side effects.[9]

One of the most common causes of patient dissatisfaction in the case of spine surgeries is inappropriate post-operative pain management. Many medications like gabapentin have been used postoperatively but have mixed reviews.[10]

Vitamin C also known as ascorbic acid, is a water-soluble vitamin that plays an important role in normal growth and development. It has an anti-oxidant, neuroprotective, and neuromodulating properties.[11,12] This very property of vitamin C has been considered to cause pain relief in post-operative patients in adjuvant with primary analgesics.[12] It has been used to reduce pain in patients with hip and knee osteoarthritis, and chronic regional pain syndrome after wrist, foot, and ankle surgeries.[13,14] It has also been shown to reduce post-operative pain in patients undergoing laparoscopic cholecystectomy.[12]

Aims and objectives

The objective of this study was to evaluate the efficacy of vitamin C as an adjuvant in improving the clinical and functional outcomes and overall analgesic requirements in patients undergoing single level lumbar spine decompression surgery (discectomy without instrumentation).

METHODS

The present study was a prospective study conducted in the Department of Orthopaedics in Bharat Ratna Doctor Babasaheb Ambedkar Municipal Hospital, Mumbai from July 2021 to July 2023, with prior approval taken from the institutional ethical committee. The study population consisted of patients coming with low back ache due to prolapsed intervertebral disc (PIVD) at single lumbar level needing surgical decompression.

A total of 50 patients were enrolled in the study, after taking the written informed consent. These patients were randomly divided into two groups; Group A with those receiving vitamin C supplementation and Group B with those not receiving supplementation. Randomization was done by a random number table. All the patients were followed up at 2nd, 4th, 6th, 8th and 12th weeks.

Inclusion criteria

Patients aged between 25-60 years of age with radiculopathy symptoms without neuro deficits; with X-rays showing disc space reduction and magnetic resonance imaging (MRI) showing prolapsed intervertebral disc compressing the roots with minimal degenerative changes were included in the study.

Exclusion criteria

Patients with pathological spine diseases such as spondylolisthesis, spondylolysis, tumors (primary or secondary), and inflammatory or infective conditions; multilevel PIVD or gross degenerative changes seen on MRI needing instrumentation; or having a previous history of spine interventions including surgery or injections (transforaminal, epidural, facetal) for pain relief were excluded from the study. Also patients receiving any sort of pain modulation therapy like transcutaneous electrical nerve stimulation were excluded from the study.

Patients meeting the criteria underwent single-level open disectomy, performed by the same team of spine surgeons. All the patients were then followed up onthe 2nd, 4th, 6th, 8^{th,} and 12th weeks and were evaluated clinically for pain intensity by visual analog scale (VAS) score and functionally by Oswestry disability index (ODI) score pre-operatively and at post-operative follow-ups.

All the patients were given IV analgesics consisting of tramadol and diclofenac sodium for the first 3 days followed by an oral dose of diclofenac sodium 75 mg twice daily for the next 5 days and then as and when needed. Group A patients were additionally supplemented with oral vitamin C in a dose of 1000 mg/day for 3 months till the last follow-up. All the patients were asked to keep a record of the total number of diclofenac sodium tablets consumed for pain relief for 3 months and then excluding the initial doses (3 days of IV and 5 days of oral analgesia) that were common to both the groups; total amount consumed was calculated. Initial doses of IV for 3 days and oral for 5 days were not included in the calculations to eliminate the confounding.

Statistical analysis

All the data was collected in a Microsoft excel spreadsheet. The nominal data (such as gender, smoker, hypertensive, diabetic, and surgical level) was expressed as a number. The continuous data (such as age, body mass index, VAS scores, ODI scores, and the total dose of analgesia consumed) was expressed as mean, standard deviation, and range. Comparison for significance was done by student t-test (paired for intra-group and unpaired for inter-group). A p value of <0.05 was considered statistically significant.

RESULTS

The study after getting approval from the institutional ethical committee, included a total of 50 patients needing surgical decompression for PIVD, who were randomly divided into two groups: group A with those receiving post-operative supplementation of vitamin C, and group B with those not receiving any supplementation.

The average age of the population in group A was 45.92±8.6 years while in group B was 47.08±7.5 years. The difference of the two means was found to be statistically insignificant. In our study, we had a total of 18 male patients (36%) and 32 female patients (64%). Group A had 8 males and 17 female patients, while group B had 10 male and 15 female patients.

The average BMI of patients in group A was 26.16±2.33 kg/m^2 while that in group B was 27.06±2.02 kg/m^2. The difference was found to be statistically insignificant. Group A had 8 smokers while group B had 7 smokers. 12 patients in group A were diabetic, while group B had 11 diabetic patients. Group A had 10 patients suffering from hypertension, while group B had 11 hypertensive patients.

Group A had 3 patients (12%) operate on the L2-3 disc, 4 patients (16%) operate on the L3-4 disc, 8 patients (32%) patients operate on the L4-5 disc, and 10 patients (40%) operate on the L5-S1 disc. Group B had 2 patients (8%) operated on the L2-3 disc, 3 patients (12%) operated on the L3-4 disc, and 10 patients each (40%) operated on the L4-5 and L5-S1 disc.

No statistical differences were observed between any of the demographic variables between the two populations like age, sex, BMI, co-morbidities like diabetes and hypertension, smoking status, and surgical level (Table 1). This negates any confounding between the two groups with respect to demographic distribution and surgical levels.

Table 1: Depicts demographic variables of the two study groups.

Demographic data	Group A	Group B
Cases	25	25
Age (years)	45.92±8.6	47.08±7.5
Sex (male/female)	8 males/17 females	10 males/15 females
Body mass index (BMI) (kg/m^2)	26.16±2.33	27.06±2.02
Smoker (%)	8 (32)	7 (28)
Diabetic (%)	12 (48)	11 (44)
Hypertensive (%)	10 (40)	11 (44)
Surgical level (%)		
L2-3	3 (12)	2 (8)
L3-4	4 (16)	3 (12)
L4-5	8 (32)	10 (40)
L5-S1	10 (40)	10 (40)

Both the groups showed statistically significant improvements in clinical outcome (VAS score) and functional outcome (ODI score) with respect to pre-operative status.

The mean preoperative VAS score of group A was 7.82±0.5, while that of group B was 7.88±0.6. The difference of the two means was found to be insignificant (p>0.05). The mean VAS scores at every follow-up (2nd, 4th, 6th, 8^{th,} and 12th post-operative week) of both groups are depicted in Table 2. The difference of the means of the two groups was found to be statistically significant (p<0.05) at the 4th, 6^{th,} and 8th week follow-up; while it was found to be statistically insignificant (p>0.05) at the 2nd and 12th week follow-up.

Table 2: Mean VAS scores at each follow up in either group.

Time frames	Group A	Group B	P value
Pre-operative	7.82±0.5	7.88±0.6	>0.05
Post-operative (week)			
2nd	3.84±0.4	4.06±0.5	>0.05
4th	1.86±0.37	2.12±0.42	<0.05
6th	1.02±0.28	1.24±0.46	<0.05
8th	0.62±0.26	0.8±0.25	<0.05
12th	0.48±0.34	0.5±0.41	>0.05

The mean preoperative ODI score of group A was 43.4±5.15, while that of group B was 44.2±5.9. The difference of the two means was found to be insignificant (p>0.05). The mean ODI scores at every follow-up (2nd, 4th, 6th, 8^{th,} and 12thpost-operative week) of both groups are depicted in Table 3. The difference of the means of the two groups was found to be statistically significant (p<0.05) at the 4th, 6^{th,} and 8th week follow-up; while it was found to be statistically insignificant (p>0.05) at the 2nd and 12th week follow-up.

Table 3: Mean ODI scores at each follow up in either group.

Time frames	Group A	Group B	P value
Pre-operative	43.4±5.15	44.2±5.9	>0.05
Post-operative (week)			
2nd	21.6±3.5	21.8±4.06	>0.05
4th	17±2.5	19±4.08	<0.05
6th	14.4±3.63	16.4±3.07	<0.05
8th	10.8±2.8	12.8±3.25	<0.05
12th	9.6±3.2	10.2±3.95	>0.05

The mean amount of analgesia consumed by group A patients was 5.8±0.68 grams, while that of group B patients was 6.23±0.65 grams (Figure 1). The difference between the two means was found to be statistically significant (p<0.05).

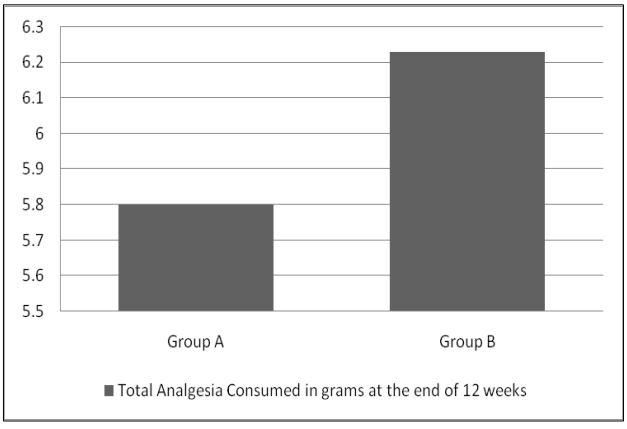

Figure 1: Mean analgesia consumed in grams in either group at the end of 12 weeks.

There were 5 patients in group A and 4 patients in group B who had superficial wound infections which were treated with daily dressings and antibiotics with no further complications. 2 patients in each group had dural tears intraoperatively which were managed with fat pad patch and surgical patch with no further complications. No neurological deficits post-surgery was encountered in any of the patients. No drug-related complications or side effects were encountered.

DISCUSSION

Postoperative pain is one of the most challenging obstacles for the surgeon.[1,2] Despite advancements in the pain management field, this particular problem negates the post-operative clinical and functional outcomes; hampering the overall satisfaction of the patient, leading to longer post-operative stay and longer rehabilitation thus burdening the health care expenditure as well as the quality of life.[3-6]

Vitamin C (ascorbic acid) is an organic acid required for normal growth and development and a number of biochemical reactions in the body. It is important for the synthesis of the extracellular matrix containing collagen in the bone, soft tissues, and endothelium. Vitamin C has also been shown to have neuro-modulating and neuro-protective properties.[11,12] Vitamin C also plays an important role in the synthesis of various neurotransmitters like dopamine, epinephrine, and serotonin; which are involved in various cholinergic and GABAnergic neural transmissions.[15,16] These very neurotransmitters are involved in pain inhibitory pathways.[17] Some clinical reports have shown vitamin C to improve the functions in cases of damaged nerves.[18-22] In a study by Long et al, plasma levels of vitamin C following trauma and infection were found to decrease.[23] Apart from this, it is one of the most important antioxidants and ROS (reactive oxygen species) scavengers in the body.[19,24-27] This very property of vitamin C has been considered to alleviate pain in post-operative patients; as literature has shown these ROS and other oxygen radicals to be the main culprits behind post-operative pain. These antioxidants, neuro-protective, and neuro-modulating properties of vitamin C formed the base of our study to supplement vitamin C in post-operative patients and look for its clinical and functional improvements over non-supplemented patients.[11,12]

In our study the mean VAS scores were significantly lower in patients receiving vitamin C supplementation at the 4th, 6^{th,} and 8th week follow-up; however, the differences were equivocal at the 2nd and 12th week follow-up. The same results were observed with respect to ODI scores. Pre-operative scores in both groups were comparable and the demographic and surgical level confounders were equal in both groups. These findings suggest vitamin C to be an effective adjuvant in decreasing post-operative pain. The total amount of analgesia consumed by the non-supplemented group was found to be significantly more than the supplemented group at the end of 12 weeks. Though the clinical (VAS score) and functional (ODI score) outcomes at the end of 12 weeks were comparable between the two groups it was found to be at the expense of higher analgesia consumed over the period of 12 weeks by a non-supplemented group. These findings were similar to the study conducted by Mahajan et al; in which they concluded a significant difference in VAS scores between the 2 groups at 2nd and 4th-week follow-ups, but the difference was insignificant at 1st and 6th-week follow-ups. They also concluded significantly higher consumption of analgesia in a non-supplemented group; which is similar to our conclusion.[28] In a study conducted by Gun Woo Lee et al; they included 123 patients undergoing single-level posterior lumbar interbody fusion and evaluated the efficacy of vitamin C on clinical outcome (VAS score), functional outcome (ODI score), and fusion rates. They concluded the difference between the two groups to be insignificant at all follow-ups, except in 3rd month the ODI score in the supplemented group was significantly lower than the non-supplemented group.[29] These findings are contrary to our findings. Their study involved posterior lumbar interbody fusion contrary to our discectomy; which could be the reason for this difference in the results.

Previous studies have shown vitamin C to decrease pain at doses of 0.5-3 grams/day.[13,30,31] Thus, we chose a dose of 1gram/day dose for the period of 12 weeks. There has been little literature suggesting some adverse effects with long-term supplementation of vitamin C like gastric comfort and ulcers.[14,26] However, in our study, the period of administration was 12 weeks and thus no side effects were encountered.

The current study had few limitations. First, the sample size was small and the follow-up period was limited to only 12 weeks. Second, we did not consider other factors that would influence post-operative pain like psychological and social status and stress. However, there were some strengths in our study. First, all the patients included in the study were followed up to 12 weeks with no patient loss by the same team who were blinded regarding the supplementation as were the patients. Thus this study was a double-blinded one. Second, due to the lack of previous studies in establishing the effective adjuvant role of vitamin C in post-operative spine patients; this study can be a cornerstone for further such research. Future studies with a larger sample and longer follow-ups with a concentration on the proper mode of administration (i.e.; parenteral or enteral), measuring the pre-operative, post-operative, and last follow-up vitamin C concentration in the blood; would help in better understanding the adjuvant role of vitamin C in alleviating the post-operative pain in spine surgeries.

CONCLUSION

Vitamin C has analgesic effects in certain clinical conditions, thus reducing post-operative pain and improving the overall satisfaction and outcome of the

surgery. It helps in bringing about the improvement in clinical as well as the functional outcome of the spine surgery, thus decreasing the overall financial burden on the patient. It has an effective dose-sparing and adjuvant effect on the post-operative analgesia consumed. However, future high-quality studies with larger samples and longer follow-ups with a concentration on the proper mode of administration, and measurement of the pre-operative, post-operative, and last follow-up vitamin C concentration in the blood; would help in better understanding the adjuvant role of vitamin C in alleviating the post-operative pain in spine surgeries.

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