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Calcium, Zinc and Copper Levels in Clavicles of Human Foetuses.

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ABSTRACT

Background: Calcium, zinc and copper are essential minerals for growth. **Methods:** Twenty five human foetuses were divided into five groups i.e. group I (<17 wks), group II (17-20 wks), group III (21-25 wks), group IV (26-30 wks), group V (> 30 wks) having 5 foetuses each. **Results:** Fifty clavicles obtained after dissection were used to determine concentration of aforementioned minerals in each clavicle separately. Except a significant rise of calcium level in group II clavicles compared to group I ones, its deposition kept pace with matrix formation in clavicles of rest of the groups. **Conclusion:** Uniform concentration of zinc and copper and their constant ratio throughout in developing clavicles were unique observations.

Keywords: Calcium, Clavicle, Copper, Zinc.

INTRODUCTION

Minerals play immense role in normal foetal development.[1] Calcium is the most abundant mineral of foetal body store. Previous literature regarding bodily calcium are based on studies in lower mammals.[2-4] Most of human studies on bone calcium contents are based on information in postnatal life.[5-7] Its concentration in human foetal tissue will have merit if considered in different stages of development. Copper and zinc are trace elements,[1,8,9] if deficient can lead to reduced embryonic development.[1,10,11] Data regarding concentrations of aforementioned elements in tissues of developing foetuses are based on studies on lower mammals.[12,13] Givens and Macy gave a detailed account of total calcium in developing human foetal bodies.[14] Tabrizi and Pakdel reported levels of Ca,[15] Cu and Zn in sacrum of women during three trimesters and their newborns. Such studies highlighted the nutritional status of foetus instead of developmental aspects. Scanty reports are available showing the levels of minerals in particular bone emphasizing their concentration in different stages of developing human foetuses. Clavicle being an atypical long bone was chosen for this purpose.[15] Previous literature has measured only calcium in developing human bone.[16] We have taken into consideration copper and zinc also in addition to calcium to further enhance the scope of study.

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MATERIALS AND METHODS

Twenty five human foetuses were collected from museum of Department of Anatomy, Jawaharlal Nehru Medical College, Aligarh, U.P. Research works on these foetuses are already in progress for which permission was granted by Ethical Committee of Institution to post graduate students of Department of Anatomy. The foetuses were divided into five groups [Table 1] i.e. group I (<17 wks), group II (17-20 wks), group III (21-25 wks), group IV (26-30 wks), group V (> 30 wks) having 5 foetuses each. Clavicles were dissected out and disarticulated to remove them, obtaining ten clavicles from each group. Each clavicle was cut into three pieces to determine three minerals i.e. calcium, copper and zinc. Each clavicular piece was weighed and dissolved in 5ml concentrated nitric acid. Solutions thus obtained were filtered through Whatmann number I filter paper. Solutions were used to measure calcium by the method of Henry and Dryer 17 and zinc and copper by Atomic Absorption Spectrophotometry.[18,19] Data

were analyzed by using one way ANOVA followed by post hoc Bonferroni test.

RESULTS

[Table 2] shows detailed clavicular mineral levels in different groups. Levels of calcium in clavicle in group I was 1.38 mg/g of bone while in groups II, III, IV and V, these were 2.8, 3.12, 2.87 and 3.13 mg/g respectively. There was no statistically significant difference among last four groups. Most interestingly , the calcium concentration was significantly low in group I foetuses. Values of zinc ranged from 1.55ppm to 2.15 ppm and those of copper from 0.17 ppm to 0.20 ppm but none showed statistically significant variation when compared with rest of the groups.

Table 1: Subgrouping of human fetuses.

Groups	Age (wks)	Number of clavicles		
		Right	Left	Total
I	<17 wks	5	5	10
II	17-20	5	5	10
III	21-25	5	5	10
IV	26-30	5	5	10
V	>30	5	5	10
Total no. of clavicles		25	25	50

Table 2: Comparison of levels of calcium (mg/g dry bone), zinc (ppm) and copper (ppm) in developing human foetal clavicles between five groups of gestational ages.

Minerals	Group I (n= 10) Mean ± SD	Group II (n= 10) Mean ± SD	Group III (n= 10) Mean ± SD	Group IV (n= 10) Mean ± SD	Group V (n= 10) Mean ± SD
Calcium	# f % ^ 1.38 ± 0.17	*2.80 ± 0.65	*3.12 ± 0.38	*2.87 ± 0.96	*3.13 ± 0.26
Zinc	1.55 ± 0.58	1.94 ± 0.27	2.15 ± 0.36	1.94 ± 0.27	2.15 ± 0.36
Copper	0.17 ± 0.02	0.20 ± 0.03	0.19 ± 0.04	0.20 ± 0.03	0.19 ± 0.04

Data were presented as mean ± standard deviation. Analysis was done using one – way ANOVA followed by post hoc Bonferroni test. The * depicts comparison with Group I,# depicts comparison with Group II, f depicts comparison with Group III, % depicts comparison with Group IV,^ depicts comparison with Group V */# / f / % /^ = < 0.05 (Significant)

DISCUSSION & CONCLUSION

To provide strength to bone, both inorganic component i.e. calcium and organic matrix matter. The former makes it hard and rigid while latter imparts resilience.[20] Clavicle is first bone to ossify and ossification centre can be seen as early 6 wks of intrauterine life.[21] This is responsible for rise of calcium level with great rate making the reading 2.8 mg/g in group II compared to 1.38 mg/g in group I. It is interesting to note that the calcium concentration in clavicles of rest of groups showed no change. This clearly indicates that calcium deposition kept pace with matrix formation to maintain a constant strength in rest of groups.

High concentration of zinc in foetal bone compared to soft tissue is clear indicator of its importance in growth of hard tissue of body.[22] Zinc is necessary part of hormone systems,and a deficiency of this vital trace elements will lead to impaired growth.[23] Association of copper with zinc for normal bodily growth is a well known fact.[24] The ratio of copper to zinc is clinically more important than concentration of either of these trace elements.[24] One of the most common trace metal imbalances is elevated copper and depressed zinc. A higher level of zinc relative to copper in our study conforms with previous findings of zinc concentration in different foetal tissues. A uniform concentration of both zinc and copper throughout foetal life in developing clavicles supports the importance of zinc- copper ratio in growth process. Further studies on growing bones in experimental animals after artificially altering the concentration of minerals are needed to reach some conclusion regarding their significance.

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