SEXUAL DIMORPHISM IN CERVICAL VERTEBRAL CANAL MEASUREMENTS OF HUMAN FOETUSES

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ABSTRACT

Little is known about postembryonic development of the human vertebral canal. Cervical parts of vertebral canal in 30 normal human foetuses was exposed in coronal plane and were divided in groups 1 and 2 which correspond with 2nd and 3rd trimester of pregnancy respectively. Groups 1 and 2 included 18 and 12 foetuses respectively with equal number of males and females in each. Length of cervical part of spinal canal and transverse diameter with height at different vertebral levels were recorded. Sexual dimorphism was noticed in foetuses of third trimester only. Length of cervical canal and height of vertebral bodies were significantly more in males while transverse diameter was statistically high in females. Cervical part of vertebral canal in human fetuses displays sexual dimorphism. Males have narrower and longer spinal canal compared to females.

Key words: foetuses, cervical, vertebral canal, dimorphism

INTRODUCTION

Developmental process during first two months of intrauterine life i.e. embryonic period has been thoroughly investigated. Unfortunately, post embryonic period i.e. foetal anatomy has received very little attention. Detailed study of foetal anatomy by some of the investigators recently has proved that there are enormous facts of the subject yet to be explained (Ghaus and Faruqi, 2006, 2007, 2009). Out of all the regions, central nervous system and its case (cranial cavity and vertebral canal) are very special in body. The latter is of great clinical importance due to its involvement in injuries and anomalies. Recently the importance of foetal anatomy has further enhanced due to emerging specialty of utero surgery. The early diagnosis of foetal disorders that may be irreversible in the neonate can be prevented by means of in utero surgery. In humans, most foetal operations are performed between 18 and 30 weeks (Demirkan and Cevik, 2004). So it becomes important to know about the normal morphology of vertebral canal in both the sexes at different gestational age. Enormous literature is available on morphometry of adult spine and the influence of a developmentally narrow canal in the pathogenesis of cervical spondylotic myelopathy (Wolf et al 1956, Payne and Spillane 1957, Burrows 1963). So for the early diagnosis of abnormal development of vertebral column it is essential to know the normal dimensions at that particular vertebral level. Although foetal axial skeleton has attracted attention of some scientists (Noback and Robertson 1951, O'Rahilly et al. 1983), their informations were based on imaging techniques posing possibilities of error. So in our study direct measurements of vertebral canal were done with the help of vernier caliper.

The aim of the present study is to provide accurate measurements of cervical vertebral canal in human foetuses with special emphasis on sexual dimorphism if any.

MATERIALS AND METHODS

Thirty foetal cadavers comprising of equal males and females were collected from museum of Department of Anatomy, T.M.M.C. & R.C, Moradabad. Ethical clearance was obtained from Institutional Ethics Committee. Foetal foot length parameter was used for determining the gestational age of foetuses (Streeter, 1920). For the purpose of study 30 foetuses were divided into two groups with gestational age < 25 and > 25 weeks respectively. The two groups therefore, correspond with 2nd and 3rd trimesters of pregnancy respectively. Both the groups had equal number of male and female foetuses. The first group consisted of 9 each while second group comprised of 6 each. A vertical cutaneous incision was given on the back of foetus extending from external occipital protuberance superiorly to natal cleft inferiorly. Scissors were introduced in sacral hiatus on either side of midline and vertebral canal was opened by laminectomy till it reached the posterior arch of atlas. Spinal cord was removed after making a cut in its upper end at the level of atlas. Length of the cervical part of vertebral canal was measured from upper border of anterior arch of atlas to lower border of seventh cervical vertebral body (Figure 1). Transverse diameter of cervical vertebral canal and height of cervical vertebral body were measured at different vertebral levels (Figure 2). Readings were analyzed by using Student's't' test.

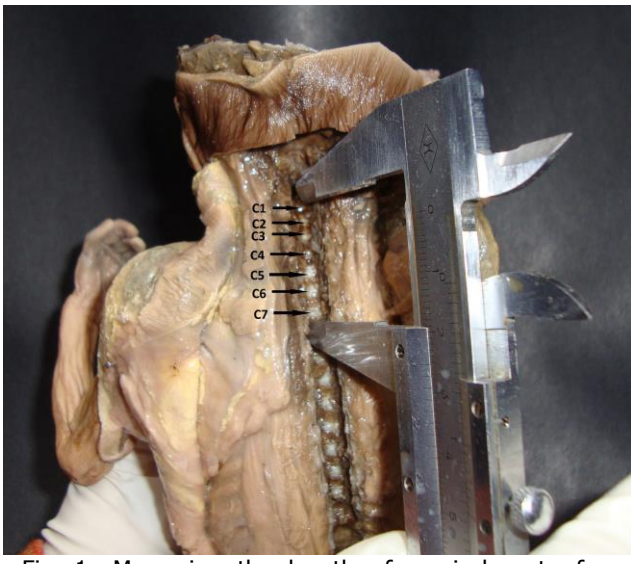

Fig. 1: Measuring the length of cervical part of vertebral canal with Vernier callipers.

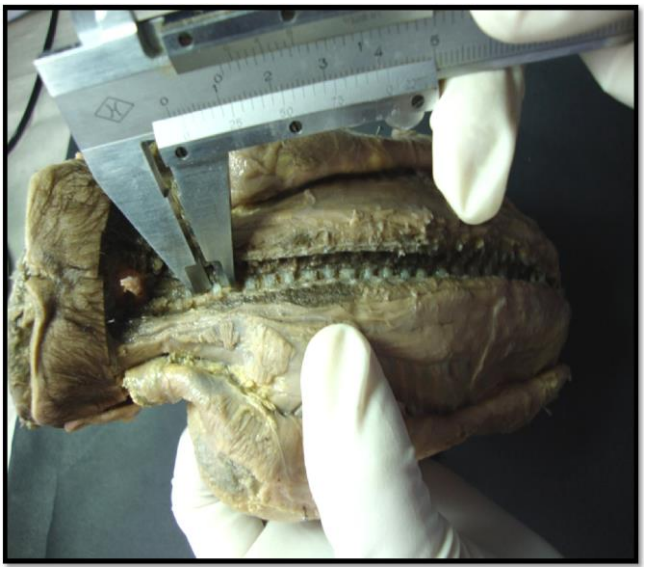

Fig. 2: Measuring the height of posterior surface of cervical vertebral body.

RESULTS

None of the parameters showed sexual dimorphism in fetuses of 2nd trimester. On the other hand, all the parameters showed sexual dimorphism in fetuses of 3rd trimester. Length of cervical part of vertebral canal was 33.1 mm in male and 26.7 mm in female fetuses of 3rd trimester and difference was highly significant statistically(Table 1). Transverse diameters of cervical part of vertebral canal at all seven cervical vertebral levels showed a statistically significant higher value in females than males (Table 2). Heights of cervical vertebral bodies at

C3 onwards upto C7 level during 3rd trimester were found to be higher in males than those in females and the differences were statistically highly significant at all levels (Table 3).

Table 1: Sexual dimorphism in lengths of cervical vertebral canal of human foetuses (mm)

Group	No. of Males	Mean ± S.D. (M)	No. of Females	Mean ± S.D. (F)	Difference (M-F)	P Value
IInd Trimester	9	20.7 ± 4.1	9	21.4 ± 3.8	-0.7	0.5001*
IIIrd Trimester	6	33.1 ± 1.2	6	26.7 ± 1.9	6.4	0.0024**

*Non Significant, **Significant

Table 2: Sexual dimorphism in transverse diameters of cervical part of vertebral canal at different vertebral levels (mm).

Vertebral level	MEAN ± S.D. (mm)							
	IInd Trimester				IIIrd Trimester			
	Males $(M)_1$	Females $(F)_1$	Difference M_1-F_1	P Value	Males $(M)_2$	Females $(F)_2$	Difference M_2-F_2	P Value
C-1	4.6 ± 0.8	4.7 ± 0.8	-0.1	0.4759*	5.5 ± 0.2	7.4 ± 0.4	-1.9	0.09**
C-2	4.8 ± 0.7	4.8 ± 0.8	0	0.4025*	5.7 ± 0.4	7.2 ± 0.3	-1.5	0.0001**
C-3	4.8 ± 0.9	4.7 ± 0.8	0.1	0.3867*	5.6 ± 0.6	7.2 ± 0.2	-1.6	0.0003**
C-4	4.8 ± 1.1	5.1 ± 0.8	-0.3	0.5569*	6 ± 0.4	7.2 ± 0.2	-1.2	0.0003**
C-5	4.6 ± 1.2	4.7 ± 0.9	-0.1	0.3815*	6.2 ± 0.4	7.5 ± 0.1	-1.3	0.0265**
C-6	4.8 ± 1.2	4.8 ± 0.8	0	0.3417*	6.3 ± 0.3	7.5 ± 0.1	-1.2	0.0212**
C-7	4.8 ± 1.4	4.8 ± 0.9	0	0.3465*	6.3 ± 0.3	7.6 ± 0.2	-1.3	0.0001**

*Non Significant, **Significant

Table –3: Sexual dimorphism in heights of vertebral body at different levels (mm).

Vertebral level	MEAN ± S.D. (mm)	
	Group I	Group II

	Males $(M)_1$	Females $(F)_1$	Difference M_1-F_1	P Value	Males $(M)_2$	Females $(F)_2$	Difference M_2-F_2	P Value
C-3	3 ± 0.6	3.3 ± 0.5	-0.3	0.8058*	4.6 ± 0.4	3.3 ± 0.2	1.3	0.002**
C-4	3.1 ± 0.6	3.2 ± 0.4	-0.1	0.4940*	5.3 ± 0.4	3.7 ± 0.5	1.6	0.001**
C-5	3.1 ± 0.9	3.3 ± 0.7	-0.2	0.5700*	5.1 ± 0.6	3.3 ± 0.3	1.7	0.001**
C-6	3.1 ± 0.7	3.2 ± 0.6	-0.1	0.3815*	5.6 ± 0.3	4 ± 0.4	1.6	0.0105**
C-7	3.3 ± 0.9	3.5 ± 0.6	-0.2	0.5124*	5.7 ± 0.4	3.9 ± 0.5	1.8	0.0008**

*Non Significant, **Significant

DISCUSSION

Specific references related to sexual dimorphism for cervical vertebral canal did not exist in literature. But the same for adult humans did exist in scientific literature records. In a study by Muller in embryos of eight post ovulatory weeks, only qualitative observation of length of cervical part of vertebral canal were made without providing any quantitative informations as in our study where large number of foetuses of different age groups were considered. Castellana and Kosa were other scientists who did detailed morphological studies on cervical vertebrae in the foetal- neonatal human skeleton. The age of the sample ranged from 4 lunar months to 10 lunar months. But their emphasis was ossification centres for use in forensic and anthropological osteology, thus providing no information about the dimensions of vertebral canal. Oon noted cervical spinal canal in females narrower than those in males. O'Higgins observed both cervical canal width and cervical vertebral body size greater in male subjects. Kosif et al measured height of cervical vertebral column and diameters of cervical spinal canal in 101 females and 93 males and found that males had higher values for these measurements. Most of our findings collected from human fetuses regarding sexual dimorphism did confer with aforementioned findings except transverse diameters of cervical canal which were contradictory i.e. more in females than males. Thus we concluded that cervical spinal canal in human fetuses is narrower and longer in males than in females and its adult morphology in males with greater capacity was acquired post natally.

In conclusion, sexual dimorphism was noticed in all parameters under consideration during third trimester only. All cervical vertebral canal parameters (length, transverse diameters at different vertebral levels and heights of C_3- C_7 vertebral bodies) showed a steady but variable rate of growth with increasing gestational age. Results of sexual dimorphism were variable. Values for length of spinal canal and heights of all cervical vertebral bodies were more in males than females while measurements for transverse diameters of spinal canal at all vertebral levels were higher in females than males. In other words the spinal canal was narrower and longer in males compared to females, during third trimester. The measurements provided by our study will be helpful in early diagnosis of congenital anomalies of vertebral canal and in intrauterine foetal surgeries.

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