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MORPHOLOGICAL STUDIES ON MESO AND METANEPHRIC KIDNEY IN NELLORE SHEEP

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Abstract: The present research work carried out in 45 embryos and foetuses of local Nellore sheep aged from 20 days (0.7 cm CRL) to 150 days (44 cm CRL days) of gestation. In group I at 20 days (0.7 cm CRL), the mesonephros located lateral to the testis. It was cream in color, oval in shape and located between metanephric kidney cranio-medially and testes caudo-laterally by 39 days (3.2 cm CRL). At 41 days of gestation (4 cm CRL), mesonephros was located at the base of metanephric kidney and placed more caudal in 48 days (6.5 cm CRL). In group II the left kidney was slightly curved in shape, broader anterior extremity than posterior extremity in 50 days sheep embryo (7.5 cm CRL) and the mesonephros was slowly modified into ductus differens at 58 days (10 cm CRL) in male and in 60 days (12 cm CRL) uterine tubes in female.

Keywords: Gross morphology, Mesonephros, Metanephros and Nellore sheep.

Introduction

Sheep plays a significant role in the agricultural economy of several tropical countries and occupies unique position among livestock. Down through the centuries, rearing of sheep has remained a primary occupation for a vast section of the rural population in India. Sheep rearing is a major source of income for landless labor and small and marginal farmers of semi-arid regions in Andhra Pradesh (Ekambram *et al.,* 2013). Development of the mesonephros, prior to the origin of metanephros, has been exemplified in man and animals as an expression of retained ancestral characters of urinary system during early embryonic life.

Materials and methods

The present study was conducted on 45 local Nellore sheep embryos and foetuses. The embryos and foetuses were collected immediately after slaughter from the abattoirs located in and around Vijayawada, Andhra Pradesh. The foetuses were randomly collected from 20 days (0.7 cm CRL) to 150 days (42 cm CRL) and were arranged in three groups. Group I (1-50 days), Group II (51-100 days) and Group III (101-150 days). Among these 45 foetuses, 31 were male, 7 were female and 7 were undifferentiated grossly.

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The approximate age of embryos and foetuses was determined on the basis of their CRL upto 3 cm CRL size (Bryden *et al.,* 1972) and for later ages by using the following formula (Hejazi *et al.,* 2011).

$$X= 2.74Y+30.15$$

Where 'X' was the age of the foetus and 'Y' was the crown rump length of the foetus in cm. The morphometry was done by using monopan balance, vrnier callipers and scale. Morphometric analysis was carried out by paired t-test, using SPSS, Graphical representation was done by using Microsoft excel.

Results and Discussion

Location

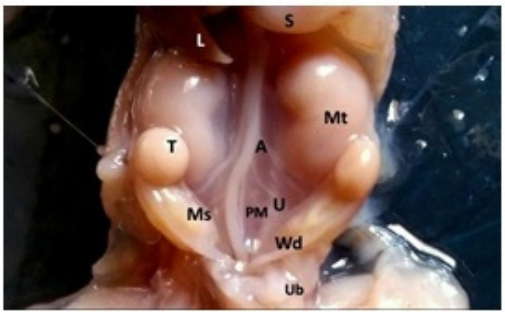
In the present study, mesonephros in group I embryos at 20 days (0.7 cm CRL) was located lateral to the testis and occupied larger part of the coelomic cavity. Cranially, it was continued by pronephros and caudally, it opened with the mesonephric duct into the urogenital sinus. At 39.5 days (3.2 cm CRL) of gestation (Fig.1), mesonephros was located between metanephric kidney cranio-medially and testes caudo-laterally and by 41 days (4 cm CRL), it was located at the base of the metanephric kidneys (Fig.2).

The mesonephros was further extended towards the caudal end in 42.5 days embryos (4.5 cm CRL) and placed more caudally at 48 days (6.5 cm CRL). Medially, mesonephros was related to testes at 50 days (Fig.3) which was slowly modified into ductus differens in male at 58 days (10 cm CRL) and uterine tubes in female at 60 days (12 cm CRL) (Fig.4). Due to decrease in size from 41 days than the earlier age, the mesonephros and testes were pushed towards posterior end of metanephric kidney at 50 days in male foetus (10 cm CRL) and at 60 days (12 cm CRL) in female foetus. The anterior end of metanephros was attached to the posterior extremity of the adrenal gland at 41 days of gestation. Similar observations were made by Bello *et al.* (2012) and Morovatisharifabad and Salehi (2015) in 60-120 days camel foetus.

Fig.1 Photograph of 39 day old sheep embryo embryo showing showing the location of kidneys

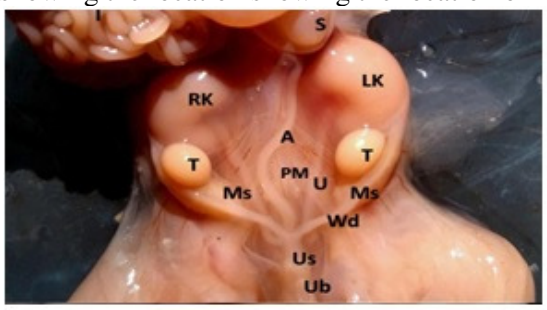
Ms-Mesonephros
Mt-Metanephros
T-Testes

Fig.2 Photograph of 41 day old sheep the location of kidneys



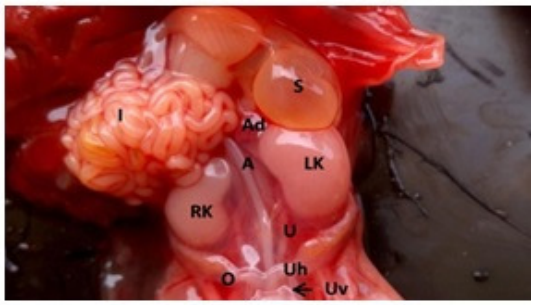
Ms-Mesonephros U- Ureter
S- Stomach L-Liver
Mt-Metanephros T-Testes
A- Aorta Wd-Wolffian duct
PM-Psoas Major Ub-Urinary bladder

Fig.3 Photograph of 50 day old sheep embryo showing the location showing the location of kidneys



Ms-Mesonephros LK-Left Kidney PM-PsoaMajor
RK-Right Kidney T-Testes Ub-Urinary bladder
A- Aorta U- Ureter
S-Stomach Us-Urogenital sinus
Wd-Wolffian duct I-Intestines

Fig. 4 Photograph of 60 day old foetus of Kidneys



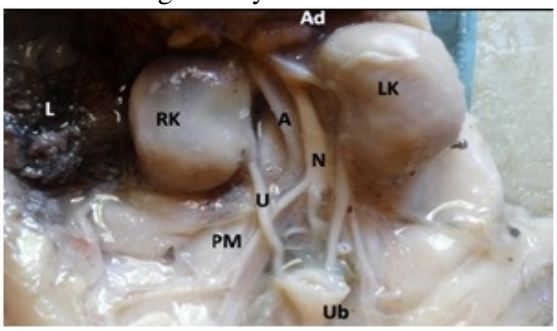
LK-Left Kidney RK-Right Kidney
Ad- Adrenal gland O-Ovary
A- Aorta U- Ureter
S-Stomach Uh-Uterine horns
I-Intestines Uv-Uterovesical pouch

Colour and Shape

At 39 days of gestation (3.5 cm CRL), the mesonephros was cream in colour and appeared as elongated and oval shaped structure (Fig1). Its cranial border was rounded and caudal border was tapered giving the appearance of elongated bulged cord like structure at 41days (4 cm CRL) (Fig.2). Due to increase the concavity on the medial surface and appearance of medial fissure on the right kidney which appeared as triangular in shape. Left kidney was slightly curved in shape with broader anterior extremity than posterior extremity in 50 days sheep embryo (7.5 cm CRL) (Fig. 3). The renal hilus was extended on the ventro-medial aspect of the metanephric kidney upto 60 days (12 cm CRL) of gestation (Fig. 4). Later it was restricted to the medial surface and the ureters were traversing downwards to the bladder on

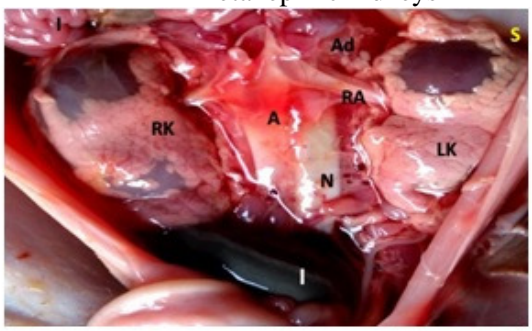
both the kidneys until birth (Fig.4&5). In 60 days (12 cm CRL) foetuses the right kidney was bean shaped with broader posterior extremity (Fig.4). The left kidney appeared as slightly curved bean. Both the kidneys were pale cream in colour. In the medial border was compressed to concave. The lateral border was thick at cranial part and comparatively thin at caudal part. The cranial extremity was wide whereas the caudal extremity was thin and flat 78days (17.5cm CRL) (Fig. 5). It was also surrounded by thick layer of peri renal fat but the colour of the kidney was drastically changed to brown in 145 days (Fig.6).

Fig. 5 Photograph of 78 day old foetus showing the metanephric foetus showing Kidneys



LK-Left Kidney RK-Right Kidney PM-Psoas Major
Ad- Adrenal gland A- Aorta N- Nerve plexus
U- Ureter L-Liver Ub-Urinary bladder

Fig.6 Photograph of 145 day old metanephric kidneys



LK-Left Kidney RK-Right Kidney N-Nerve
Ad- Adrenal gland A- Aorta
RA-Renal artery U- Ureter
S-Stomach I-Intestines

The metanphric kidneys of all age groups varied in colour from light to dark brown. Similar observations were made by Bello *et al.* (2012) and Morovatisharifabad and Salehi (2015) in camel embryos by *in vivo* studies. The shape of metanephric kidneys was irregularly ovoid upto 39.5 days (3.2 cm CRL), smooth (Fig.1), covered with a thin fibro-muscular capsule and changed to bean shape with rounded extremities at 41 days of gestation (4 cm CRL) (Fig.2). Which are in agreement with the findings of Bello *et al.* (2012) and Morovatisharifabad and Salehi (2015) in 90 days camel foetus and Jafar (2014) in 60-65 days buffalo foetus. However, Malik and Vais (1998) reported that the shape of kidneys was irregularly ovoid upto 10 cm CRL and changed to bean shape with rounded extremities in 20 cm and above CRL in goat foetuses.

Morphometry

In present study since the mesonephric kidneys were appeared as very small, were morphometric detals taken from 39 days onwards in group I (table.2). The average weight length and width of the metanephric kidney was 0.56 gm, 0.27 cm and 0.12 cm in left kidney

and 0.55 gm, 0.28 gm, and 0.1 gm in right kidney at 39.5 days and it was optimized at 150 days of gestation (table.2).

Table 1: Length, width and weight of mesonephros in various gestational ages

Sl. No	Age of the foetus (days)	Mesonephros		
		Average Length (cm)	Average Width (cm)	Average Weight (gm)
1	39.5	0.80	0.35	0.047
2	41	0.75	0.31	0.040
3	42.5	0.71	0.29	0.030
4	45.5	0.60	0.25	0.025
5	49	0.44	0.20	0.023
6	50	0.35	0.17	0.021
7	52	0.27	0.15	0.019
8	54.5	0.21	0.13	0.016
9	58	0.20	0.11	0.013

Table 2: Morphometic details of metanephric kidney in various age groups

Sl.no	CRL (cm)	Age (days)	Left kidney			Right kidney		
			Weight (gm)	Length (cm)	Width (cm)	Weight (gm)	Length (cm)	Width (cm)
1	3.2	39	0.53	0.27	0.12	0.53	0.25	0.12
2	3.5	39.5	0.56	0.27	0.12	0.55	0.26	0.13
3	3.7	40	0.58	0.29	0.14	0.57	0.27	0.14
4	4.0	41	0.62	0.31	0.14	0.62	0.29	0.14
5	4.5	42.5	0.68	0.36	0.15	0.65	0.33	0.15
6	5.0	44	0.71	0.41	0.18	0.69	0.40	0.18
7	6.0	46.5	0.76	0.49	0.22	0.73	0.45	0.22
8	7.0	49	0.81	0.54	0.27	0.79	0.53	0.26
9	7.5	50	0.86	0.60	0.30	0.83	0.60	0.30
10	8.0	52	0.86	0.61	0.32	0.83	0.60	030
11	9.0	54.5	0.90	0.66	0.34	0.89	0.64	0.33
12	10.0	57	0.93	0.76	0.46	0.91	0.75	0.45
13	11.0	59	0.95	0.82	0.58	0.93	0.81	0.57
14	12.0	60	0.97	0.93	0.60	0.95	0.92	0.59
15	15.0	71	1.01	1.35	0.80	1.00	1.30	0.79
16	16.0	74	1.10	1.50	0.85	1.09	1.49	0.83
17	17.5	78	1.15	1.61	0.89	1.13	1.58	0.85
18	19.5	83.5	1.19	1.76	0.99	1.17	1.72	0.98
19	21.0	87	1.24	2.00	1.10	1.23	1.95	1.09
20	24.0	96	1.69	2.20	1.50	1.65	2.2	1.60
21	25.5	100	1.75	2.37	1.53	1.74	2.36	1.53
22	26.0	101	2.14	2.5	1.56	2.10	2.48	1.51
23	27.0	105	2.40	2.7	1.74	2.40	2.7	1.73
24	28.0	107	2.85	2.90	1.99	2.83	2.88	1.97
25	31	115	3.29	3.10	2.20	3.25	3.10	2.19
26	33	120	4.10	3.95	3.52	4.10	3.89	3.90
27	42	145	7.3	4.9	3.61	7.1	4.9	3.52
28	44	150	9.10	6.10	4.00	9.00	6.00	4.00

Morphometric analysis of kidney revealed that there was no significant difference within the groups between left and right kidneys and there was no significant difference in group I and Group II in terms of weight and width, but there was significant difference in weight and width of both kidneys in group III. There was a significant difference in length in the all the age groups (table.3).

Table 3: Morphometric analysis of metanephric kidney

Groups	Particular	Standard mean		Std.Deviation ± Std.Error	
		Left	Right		
I	Weight	0.6789	0.6622	0.11570±0.03857	0.10628±0.03543
	Length	1.1450	1.1126	0.29395±0.8486	0.29246±0.08443
	Width	4.4530	4.3971	2.65674±1.01549	2.63367±0.99543
II	Weight	0.3933	0.3756	0.12400±0.4133	0.12749±0.04250
	Length	1.3808	1.3600	0.62241±0.17967	0.61912±0.17872
	Width	3.7357	3.7071	1.33501±0.50459	1.30936±0.49489
III	Weight	0.1822	0.1822	0.6648±0.2216	0.06379±0.02126
	Length	0.8300	0.8258	0.40394±0.11661	0.42376±0.12233
	Width	2.6600	2.6886	1.01280±0.38280	1.07637±0.40683

In contrary, Malik and Vais, (1998) described that the right kidney was heavier (11.30 g) than the left (10.66 g) in all age group foetuses and all the parameters of right and left kidneys varied in different age groups. The length, thickness and cross sectional area of right kidney were greater than those of left kidney except width, which was more in left kidney up to 20 cm CRL goat foetuses. However, Gopinath *et al.* (1997) observed unnoticeable difference in respective measurements within the foetuses of same group at all ages (0-150 days) although length, width, thickness and weight were found to increase with concomitant increase in the body weight and crown-rump length (CRL) of the foetus as age advanced. Further, Salehi and Morovathi (2012) recorded variation in growth between the left and right kidneys of camel in terms of length and width at 45 days and 60 days of gestation. Significant variation in thickness was recorded from 45 days and 120 days.

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