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Gross morphological and morphometric studies on the different age group of hippocampus in madras red sheep

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Abstract
The study was conducted on hippocampus (N=6) each collected from six-month-old, eight-month-old and twelve-month-old adult Madras Red sheep. The hippocampus was semicircular in shape located behind the caudate nucleus in the floor of the lateral ventricle. The hippocampal gyrus appeared as an elevated curved mass which extended from the deep face of the pyriform lobe dorsolaterally encompassing the thalamus and occupied the floor of the inferior horn of the lateral ventricle, forming its posterior part. The gyrus was separated from the caudate nucleus by a band of white matter, the stria semicircularis over which the choroid plexus was laid on its ventricular surface. This gray matter nuclei was covered by a band of white matter, the alveus which gets connected to the fornix by the hippocampal fimbria. The average weight of the right and left hippocampus in six-month-old sheep was 1.60±0.06 g and 1.46±0.056 g and found to increase in eight and twelve-month-old sheep. Significant difference in the weight of two hippocampi was observed between the age groups. Other morphometric measurement such as the volume and linear length of the hippocampus was recorded in all the three age groups.

Keywords: Hippocampus, madras red sheep, gyrus

Introduction
Brain is the most amazing and most mysterious creation in the universe and even the super computer badly fades out in front of the brain. Hippocrates made a treatise that the brain was a gland which collected mucus and cooled the blood. All the jests and tears arise from the brain and brain only (Robin, 1981 and Turner, 1982) [10, 17]. There are considerable evidences that the limbic system is concerned with the emotional behaviour like the reactions of fear and anger and the emotions associated with the sexual behaviours in the mammals (Snell, 1980) [15]. The term limbic stems from (Broca, 1878) [4] anatomic description of the structures nearest to the border Limbus of the neocortical mantle, encircling the base of the cerebral hemisphere, which are relatively constant in their development in the brains of all mammals. He called the ring le grand lobe limbique, where the hippocampus is the major component. Both anatomical and physiological observations prove that the hippocampus is organised in a lamellar fashion and the orientation of the lamella differs among species (Warwick and Williams, 1989) [18]. The functions of the hippocampus have become modified in a specialised way than the rest of the limbic lobe. It does not preserve memory traces but makes the preservation of memory traces possible, due to its uniform internal structure like the serial components of a computer system (Turner, 1982) [17].
It will be unfair to suggest that there has not been a continuing thread of neurological research on the hippocampus of sheep. But, it is fair to say that such sorts of research work on sheep reared in the climate of Tamil Nadu state has been spasmodic. Hence this breed deserves all sort of scientific exploration. So, the present study on gross morphological and morphometric studies was carried out.

Materials Methods
The study was conducted was conducted in the Department of Veterinary Anatomy, Madras Veterinary College, Chennai-600 007. The heads of the adult Madras Red Sheep, six each from three different age groups *viz.*, six months, eight months and twelve months were procured from the Corporation Slaughter House, Perambur, Chennai. The age was calculated using dentition after being adjudged clinically healthy.

Gross anatomical studies of right and left hippocampus of adult Madras Red Sheep were made in the laboratory. Linear measurements were carried out on right and left side of hippocampus of adult Madras Red Sheep using a Vernier caliper. Length, volume and weight of both whole brain and hippocampus were also measured. The data of the present study was analyzed by standard statistical procedure with the help of SPSS 20 (2013) as per (Snedecor and Cochran, 1994) [14].

Results and Discussion

The hippocampus of the brain tissue in adult Madras Red sheep was semicircular in shape located behind the caudate nucleus in the floor of the lateral ventricle similarly in rabbit (Schwartz *et al.*, 1968) [11] and cat (Siegal *et al.*, 1974) [12]. This agrees with the present observation on the hippocampus of the adult Madras Red sheep of the three age groups studied. A portion of the two right and left hippocampal gyri appeared as oval bodies behind the caudate nucleus in coronal sections of the brain (Figure 1). However, the brain shows inverted v-shaped hippocampus in cat (Tombol *et al.*, 1978) [16], comma shaped hippocampus in human beings and foot like process in the hippocampus of homo sapiens (Warwick and Williams, 1989) [18]. This morphological difference in the hippocampus might be adduced to the fact that adult madras red sheep is an ungulate, whereas elephant and primates are of higher order in evolution.

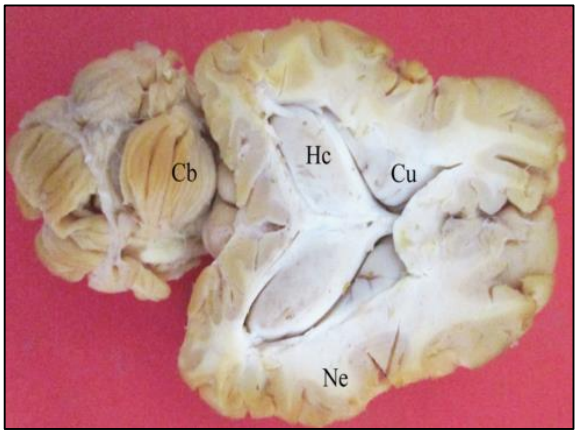

Fig 1: Fixed brain tissue from six month-old Maddras Red Sheep showing two hippocampi located on the floor of lateral ventricle. Hc- Hippocampus, Cu- Caudate nucleus, Cb- Cerebellum, Ne- Neocortex.

The hippocampal gyrus appeared as an elevated curved mass which extended from the deep face of the pyriform lobe dorsolaterally encompassing the thalamus and occupied the floor of the inferior horn of the lateral ventricle forming its posterior part (Figure 2).

This was similar to the observation made in rabbit (Schwartz *et al.*, 1968) [11] and cat (Siegal *et al.*, 1974) [12]. The gyrus was separated from the caudate nucleus by a band of white matter, the stria semicircularis over which the choroid plexus was laid on its ventricular surface. This grey matter nuclei were covered by a band of white matter, the alveus which gets connected to the fornix by the hippocampal fimbria.

This was similar to the observation made in cat (Krettek and Price, 1978) [7] and ferret (Singer, 1962) [13] but was different from the location of hippocampus of birds (Bingman and Yates, 1992) [2]. This agrees with the present observation in all the three age groups studied.

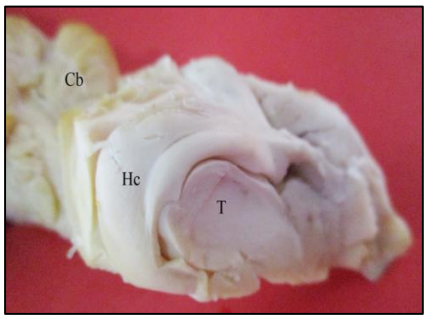

Fig 2: Fixed brain tissue from six month-old Maddras Red Sheep showing the curved hippocampal Gyrus encompassing over the thalamic body. Hc- Hippocampus, Cb- Cerebellum, T- Thalamus.

The hippocampus presented two surfaces, dorsolaterally covered by alveus and ventromedially a groove, the hippocampal fissure which separated it from the dentate gyrus. Hippocampal sulcus separated the ventromedial surface into lateral and medial portions. Dentate gyrus was laterally located with fimbria and parahippocampal gyrus was medial. However, parahippocampus of Tinamou, humming bird, falcon and cranes is under-developed (Portmann and Stinglein, 1961) [9] but in case of crocodiles and snakes hippocampus is prominent in dorsal cortical nuclear area (Crosby *et al.*, 1966 and Carey, 1966) [6, 5]. Small groove separated the fimbria from dentate gyrus. Cornu Ammonis (CA) was interlocked with dentate gyrus medially. The rostromedial part of the two hippocampi met each other at the level of hippocampal commissure (Figure 3 and 4). Along the concave margin of the dentate gyrus, the fimbria extended to form the crura of fornix. This observation is in full agreement with the findings of (Brigs, 1939) [3] and (Lauer, 1963) [8] on the hippocampus of sheep and other ungulates.

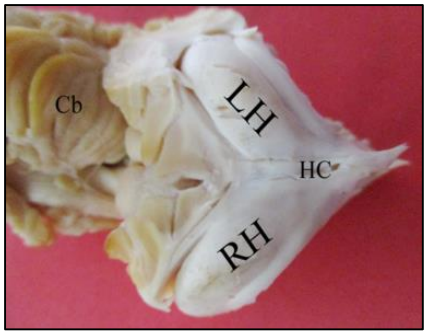

Fig 3: Rostromedial part showing two hippocampi meeting each other at the level of hippocampi commissure (Dorsal view-twelve month old). HC- Hippocampal Connisure, RH- Right Hippocampus, LH- Left Hippocampus, Cb-Cerebellum.

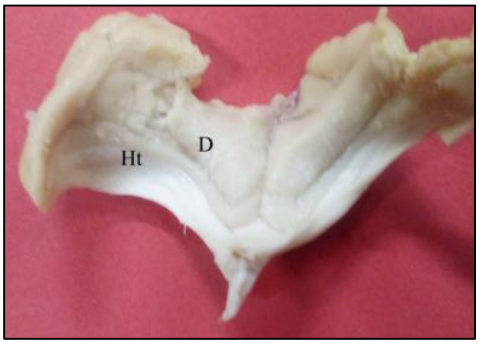

Fig 4: Two hippocampi of brain from twelve month-old Madras Red Sheep showing the ventral surface of hippocampus in contact with the dentate gyrus. D- Dentate gyrus, Ht- Hippocampal tissue.

The anterior septal end of hippocampal gyrus was narrow while the temporal end appeared to be wide and rounded (Figure 5). The lateral border of the hippocampus appeared convex in outline, margined by band of white matter. The medial border was concave, attached by distinct band of white fibres forming the fimbria.

The major curved portion of the hippocampus formed the Cornu Ammonis which formed the floor of the lateral ventricle situated behind the caudate nucleus. This observation is in total conformation with the findings of (Lauer, 1963) [8] on the hippocampus of ungulates. However, as compared to species of fish cornu ammonis was very well developed compared to dog fish shark (Ariens Kappers *et al.*, 1960) [1], reed fish and bow finned fish (Wright, 1967) [19], as obvious as sheep is in the higher rung of evolution ladder. This agrees with the present observation in all the three age groups studied.

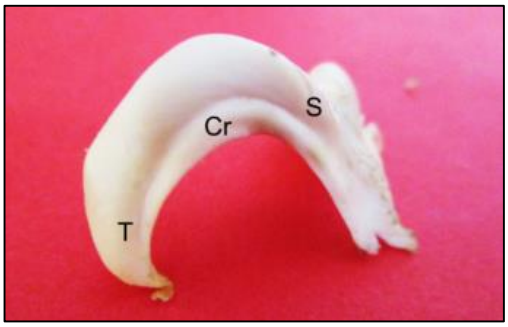

Fig 5: Right hippocampus from eight month-old Madras Red Sheep showing the two borders and cornu ammonis. S- Septal end of gyrus, T- Temporal end of gyrus, Cr- Crura of fornix.

The average weight of the right hippocampus in six-month-old sheep was 1.60±0.06 g and found to increase in eight and twelve-month-old sheep. Similarly, the weight of left hippocampus was also measured and significant difference in the weight of two hippocampi was observed between the age groups (Table 1 and 2).

The weight of hippocampus in proportion to the weight of the brain was 4.15 percentage in six month-old sheep and no significant difference was observed in the ratio among the three age groups studied (Table 2). The volume of this gray matter was found to be 2.47±0.17 ml of the right hippocampus in six month-old sheep, 2.38±0.11 ml and 2.5±0.07 ml in eight months and twelve months of age respectively. No significant difference in the volume of gray matter between the age groups was observed in the present study (Table 3).

Other morphometric measurement such as the linear length of the hippocampus was recorded in all the three age groups. The average length of hippocampus in six month-old Madras Red sheep was 3.35±0.08 cm and found to increase with age between right and left hippocampus. Significant difference was observed in the length of the hippocampal gyrus between the age groups studied (Table 4).

Table 1: Weight of the whole brain of Adult Madras Red sheep at different age groups

Age groups	Weight of Brain (grams) (Mean±SE)	F value
Six month-old	73.90±1.41 [a]	*84.82***
Eight month-old	82.63±0.75 [b]	
Twelve month-old	93.05± 0.83 [c]	

Mean bearing different superscript differs significantly ($p \leq 0.05$)

Table 2: Weight of the right and left hippocampus of Adult Madras Red sheep at different age groups

Age groups	Weight of Right Hippocampus (grams) (Mean±SE)	F value	Weight of Left Hippocampus (grams) (Mean±SE)	F value
Six month-old	1.60±0.07[a]	54.65**	1.46±0.056[a]	151.43**
Eight month-old	1.58±0.06[a]		1.82±0.033[b]	
Twelve month-old	2.39±0.56[b]		2.61±0.045[c]	

Mean bearing different superscript differs significantly (p≤ 0.05)

Table 3: Percentage of hippocampus of Adult Madras Red sheep at different age groups

Age groups	Weight of Brain (grams) (Mean±SE)	Weight of Hippocampus (grams) (Mean±SE)	Percentage of Hippocampus (%)
Six month-old	*73.90*±1.41 [a]	3.07 ± 0.06 [a]	4.15
Eight month-old	82.63±0.75 [b]	3.41 ± 0.06 [b]	4.14
Twelve month-old	93.05± 0.83 [c]	5.01 ± 0.08 [c]	5.8

Mean bearing different superscript differs significantly ($p \leq 0.05$)

Table 4: Volume of the right and left hippocampus of Adult Madras Red sheep at different age groups:

Age groups	Volume of Right Hippocampus (ml) (Mean±SE)	F value	Volume of Left Hippocampus (ml) (Mean±SE)	F value
Six month-old	2.38±0.17[a]	0.477[NS]	2.45±0.06[a]	0.903[NS]
Eight month-old	2.47±0.11[a]		2.51±0.04[a]	
Twelve month-old	2.50±0.07[a]		2.55±0.04[a]	

Mean bearing different superscript differed significantly ($p \leq 0.05$)

References

1. Ariens Kappers CV, Carl HG, Crosby EC. The sub mammalian and mammalian telencephalon exclusive of the non-olfactory cortex in the comparative anatomy of the nervous system of vertebrates. Hafner publishing company, Newyork 1960;3(1):1246-1292.
2. Bingman V, Yates G. Hippocampal lesions impair navigational learning in experienced homing pigeons. Behav. Neuro. Sci 1992;106:229-232.
3. Briggs EA. Anatomy of Sheep's Brain. 1st Edn. Angus & Robertson Ltd 1939, 7-19.
4. Broca P. Anatomie comparee des circonvolutions cerebrales, Le grandlobe limbique et lax scissure dans la serie des mammiferes. Anthropol 1878;2:285-498.
5. Carey JH. The nuclear pattern of the telencephalon of the black snake, Coluber constrictor constrictor.In evolution of the fore brain. Ed. Hassler,R. and H.Stephan. George thieme Verlag, Stuttgart 1966, 73-80.
6. Crosby EC, De Jonge BR, Schneider RC. Evidence for some of the trends in phylogenetic development of the vertebrate Telencephalon. In Evolution of the Forebrain. Ed. George thieme Verlag Stuggart 1966, 117-135.
7. Krettek JE, Price JL. A description of the amygdaloid complex in the rat and cat with observations on intra-amygdaloid axonal connections J. Comp. Neurol 1978;178:255-280.
8. Lauer EW. The hippocampus of ungulates. In „progress in brain research. Vol. Iii. Eds. Bargman, W.J. and P.schade. I edn. Elsevier publishing co., Amsterdam

1963, 218-229.
9. Portmann A, Stinglein W. The central nervous system. In, "the biology and comparative physiology of birds". Vol.2 Ed. A.J. Marshall. I Edn. Academic press, London 1961, 1-36.
10. Robin C. In Brain. I Edn. The Chaucer press Ltd., Suffolk 1981, 06.
11. Schwartz IR, Pappas GD, Shealy CW, Purpura DP. Fine of neurons of synapses in feline hippocampus during postnatal structure ontogenesis. Exp. Neurol 1968;22:394-407.
12. Siegal A, Edinger IH, Ohgami S. The topographical organisation of the hippocampal projection to the septal area. A comparative neuro anatomical analysis in the gerbil, rat, rabbit and cat. J Comp. Neurol 1974;157:359-378.
13. Singer M. The brain of the dog in section. I edn. W.B. Saunders Co., Philadelphia 1962, 51-72.
14. Snedecor GW, Cochran WG. Statistical Methods. 8th edn. Iowa State University Press, Ames, USA 1994.
15. Snell S. Clinical neuro anatomy for medical students. P.G. Publishing Private Ltd., New Delhi 1980, 279-280.
16. Tombol T, Somogyi G, Hajdu F. Golgi study on cat hippocampal formation. Anat. Embryol 1978;153:331-350.
17. Turner EA. Surgery of the mind. Carmen Press, Birmingham 1982, 1-24.
18. Warwick R, Williams PO. Grays anatomy. 37th Edn. Churchill Livingstone, Edinburgh 1989, 1034-1038.
19. Wright JD. Telencephalon of Bicher Polypterus. Ala. J Med. Sci 1967;4:252-273.