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# THE TAIL OF THE CAUDATE NUCLEUS OF THE CHICK EMBRYO

**(GALLUS gallus domesticus). By GOUDA, J. G.**

## INTRODUCTION

The paraxial mesoderm is part of the secondary mesoderm located on both sides of the developing neural tube. It will be segmented to blocks called somitic blocks or somites. The number of the somites is equal to the number of the vertebrae in the spine of the vertebrate kingdom. Bilateral chains, each consisting of bipolar cells, originating from the caudal part of the fore-brain vesicle at its junction with the mid brain vesicle had been reported to be responsible for such segmentation (Ref. 1 and 2). In support of that is failure of segmentation of the paraxial mesoderm after surgical removal of one chain in the operated side (OP.S.) followed by further incubation of the embryo (Fig 6 and Ref. 12).

The basal ganglia are a group of subcortical nuclei located in the floor of the lateral ventricle of the cerebral hemisphere. They are formed of the caudate nucleus which lies medially, and the lentiform nucleus, which lies laterally and form the globus pallidus and the putamen. The basal ganglia are responsible primarily for motor control, as well as other roles such as motor learning, executive functions and behaviours and emotions (3).

## MATERIAL & METHOD

Twenty four new hampshire chick embryos of stage 13 (4) were used as a material. The embryos have been divided into two groups each consisting of twelve embryos. New's technique (5) was used to culture chick embryos in vitro.

The first group of embryos were fixed in cacodylate fixative and studied as whole mount specimens using a light microscope. Following that, the embryos were critically dehydrated and viewed with the stereo scanning electron microscope.

Six embryos of the second group were subjected to fine dissection using cactus needle (6). The aim was to expose the lateral ventricle and its contents. To achieve that, the pallium (the outer thin layer of the brain) was gently removed from the ventral and lateral parts of the fore-brain vesicle. The basal ganglia (the striatum) were then exposed, The caudate nucleus consisting of head, body, and tail (caudate) was viewed and its tail was followed to its destination using the light microscope.

The other six embryos of the second group were prepared for viewing with the confocal electron microscope. To achieve that, a radioactive material (peroxidase rhodamine isothiocyanate-R-HRP) was used. The aim was to follow migration of the cells of the striatum. A pipette filled with R-HRP was attached to an Eppendorf microinjector 5242 and a Narishige hydraulic micromanipulator. Twenty five nl. of an R-HRP solution was injected at the tip of the head fold. Specimens were then incubated at 37.5°C. for five hours after which they were viewed using the confocal (epifluorescent microscope).

A third group of embryos - twelve in number - were cultured in ovo until stages 4, 5, 6, 7, 8, and 9 days. Specimens were fixed in 10% formalin after which they were sectioned sagittally and studied as whole mount specimens. A fourth group of seventeen adult Hen's brains were fixed in formalin 10%.

Followed by sectioning sagittally and studied as whole mount specimens.

## RESULTS

Specimens of the first group in which the light microscope was used showed bilateral chains, each consisting of bipolar cells. The proximal part of the chain was located at the caudal part of the fore-brain vesicle at its junction with the midbrain vesicle. The caudal part of the chain was seen to be directed towards the cranial aspect of the paraxial mesoderm (Fig. 5).

Embryos of the first group in which a stereo-scanning electron microscope was used showed many foramina of different sizes & shapes in the wall of the fore-brain vesicle. Some of those foramina were vacant and others were seen with bodies of different sizes & shapes lodged within. Similar bodies were seen within the groove between the folding neural plate at the brain region (Fig. 4 and Ref, 7, 8, and 9).

Specimens of the second group of embryos in which fine dissection of the fore-brain vesicle was done (peeling the pallium of the fore-brain vesicle) showed the basal ganglia occupying the floor of the lateral ventricle of the brain. The caudate nucleus being located medially and the lentiform nucleus which will form the globus pallidus and putamen located laterally. The tail (caudate) of the caudate nucleus was seen to be directed to the point of origin of the chain of bipolar cells observed in the wholemount specimens studied using the light microscope (Fig. 1, 2, 3, and 10 and Ref. 2).

Specimens of the second group of embryos in which R-HRP was injected and the confocal microscope was used showed that the cells occupying the caudate (tail) of the caudate nucleus possessed the radioactive material and transmitted it to the daughter cells which proceed to the junction between the fore-brain and the mid-brain vesicles (the point from which the bilateral chains of bipolar cells originate). The radioactive material was also seen in some cells located lateral and medial to the chain as well as the area of the striatum (Fig. 7 and Ref. 10, 11, and 12).

Looking at the sagittal sections of embryos of the third group of stages 4, 5, 6, 7, 8, and 9 days shows no distinct connection between the brain and the spine exists (Fig. 8). Sagittal sections of adult Hen's brains of the fourth group showed structures coinciding with those of the human brain (Fig. 9).

## DISCUSSION

Migration of the brain cells from their point of origin to their designated areas is a well known phenomenon (13). Based on that and what has been observed in the piece of work, the cells of the caudate nucleus migrate towards the proximal part of the paraxial mesoderm. The latter will be divided into blocks called somitic blocks or somites. Such somites will give origin to the sclerotomes and dermomyotomes. In support of such migration is the appearance of the bilateral chains of bipolar cells responsible for somite formation (Fig. 5). The sclerotomes of both sides plus part of the notochord (a cord joining the pituitary gland and the caudal part of the embryo) in between form the primordial vertebral body. The dermomyotome will give origin to the dermis of the skin and muscles in relation to the axis of the embryo (13).

The cells exhibited peroxidase rhodamine isothiocyanate (R-HRP) and seen to be located medial and lateral to the chains of bipolar cells most likely had a relation with the musculature in relation to the somites. These finding support the reported function of the basal ganglia. (3)

The foramina seen in the pallium of the brain vesicles most likely are formed by an engulfing property of secretion of certain chemicals by the migrating cells from inside to the outside of the vesicle like the trophoblastic cells of the cotyledons insinuating themselves within the decidua basalis of the uterus to form the placenta. Supporting that there are bodies lodging within some of those foramina (Fig. 4 and Ref. 8 and 10). The assumption that

those foramina are due to the severe dehydration of the specimen prior to viewing with the stereo-scanning electron microscope is unlikely because if this is the case, cracking or fissures will be the result and foramina.

The results of the third and fourth groups of embryos confirm that the relation between the brain and somatogenesis takes place earlier than that. (Fig. 8 and 9).

## SUMMARY

New hampshire species of chick embryos of stage 13 were used as a material. Embryos were cultured in vitro using New's technique, and fixed in cacodylate fixative. Light, stereo-scanning, and confocal electron microscopes were used. Rhodamine phosphate isothiocyanate (radioactive material) was used to follow the migrated cells from the caudate (tail) of the caudate nucleus. Such cells have been seen to migrate from the caudate of the nucleus to a point caudal to the fore-brain vesicle (at the junction between the fore-brain and midbrain vesicle). The migrated cells form a chain proceeding to the proximal part of the paraxial mesoderm (the chains previously reported by Godda & England (1). Moreover, some of the migrated cells have been seen located lateral & medial to the chains. Such cells most likely had a relation with the musculature in relation to the somites.

## CONCLUSION

The tail (caudate) of the caudate nucleus most likely is the source of the bipolar cells forming the bilateral chains responsible for segmentation of the paraxial mesoderm of the chick embryos (GALLUS gallus domesticus).

## REFERENCES

1. Gouda, J. G. and M. A. England (1994). A New Structure Of Possible Neural Origin In Chick Embryo (Gallus Domesticus), Journal Of Anatomy, 1. April.
2. Gouda, J. G. (2018). The Effect Of Surgical Removal Of The Brain's Area Assume To Be Critical To The Development Of The Vertebral Column In Chick Embryo (GALLUS gallus domesticus), The 9th. Annual Conference Of The Graduate College-Al Neelain-Khartoum.
3. Hagai Bergman (2021). The Hidden Life Of The Basal Ganglia; At Of The Base Of Brian And Mind. The MIT Press Massachusetts Institute Of Technology - Cambridge, Massachusetts, London England.
4. Hamburger, V. and Hamilton, H. L. (1951). A Series Of Normal Stages In The Development Of The Chick Embryo. J Morphol, 88; 49.
5. New, D-A. T. (1955). A New Technique For The Cultivation Of The Chick Embryo In Vitro. J. Embryo L. EXP. Morph, 3, 320.
6. England, M. A. (1981). Application Of The SEM To The Analysis Of Morphogenetic Events. J. Micros. 123, 133.
7. Gouda, J. G. (1974). Closure Of The Neural Tube In Relation To The Developing Somites In The Chick Embryo (GALLUS gallus domesticus). J. Anat. 118, 360.
8. Gouda, J. G. (1974). Studies On The Relation Between Early Developing Somites and Neural Tube In The Chick Embryo. M. Phil. Thesis University Of London.
9. Gouda, J. G. (1974). Closure Of The Neural Tube In The Chick As Seen By A Light & Stereo-Scanning Microscope. Journal Of Anatomy. Vol-124 Part 2.
10. Gouda, J. G. (1980). Studies On The Closure Of The Neural Tube In The Chick Embryos (GALLUS gallus domesticus). Ph.D. Thesis, University Of Khartoum - Sudan.
11. Gouda, J. G. (2017). Epifluorescent Microscopic Studies On The Fate Of Mesenchymal Cells At The Tips Of The Head Folds (At The Level Of The Mesodermal Borders) Of The Chick Embryos (GALLUS gallus domesticus), The 9th. Annual Conference Of THe Graduate College-Al Neelain-Khartoum.
12. Gouda, J. G. (1992). More Light On The Development Of Early Stages Of Chick Embryo (GALLUS gallus domesticus). Ph.D. Thesis, University Of Khartoum
13. Henry Gray & Henry Vandyke Carter (2020). Henry Gray's Anatomy Of The Human Body. 42nd. Edition, LEA & Febiger, Philadelphia and New York.

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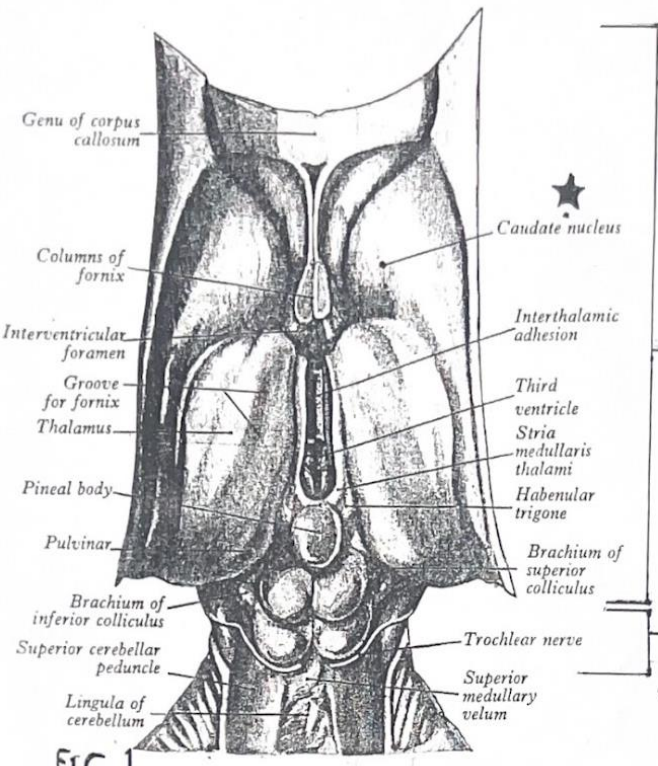


FIG. 1 Dorsal aspect of the caudate nuclei, thalami, pineal body and tectum, revealed by removal of most of the corpus callosum, the body of the fornix, and of the tela choroidea.

AFTER GRAY

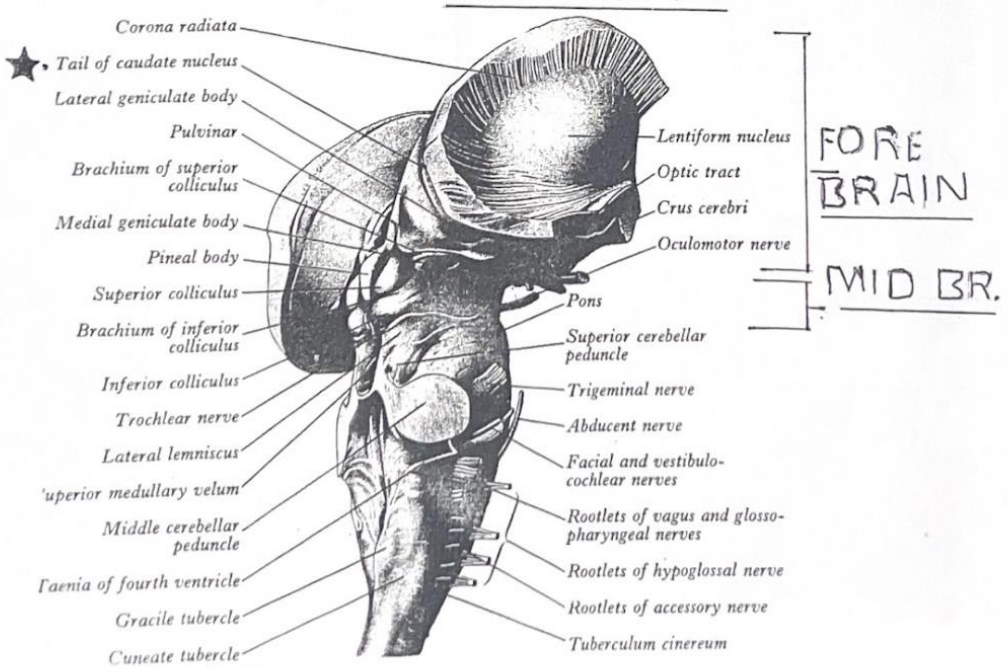


FIG. 2 Posterolateral aspect of the hindbrain and midbrain, exposed by removal of the cerebellum and most of the cerebrum.

9 AFTER GRAY

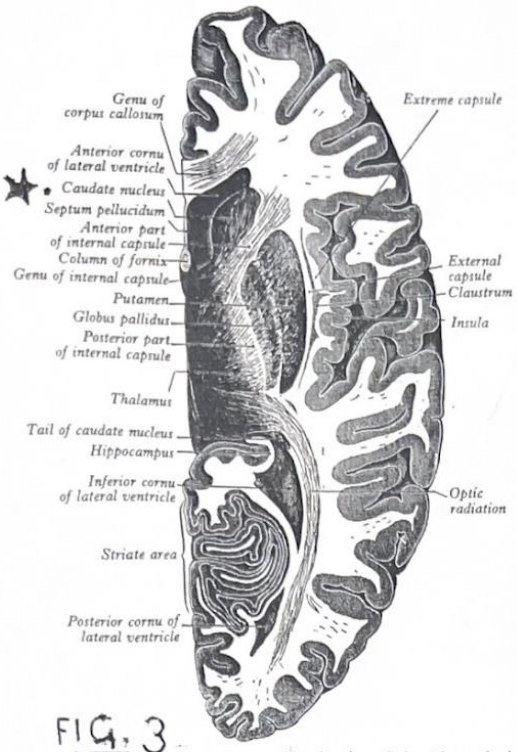


FIG. 3

Superior aspect of a horizontal section through the right cerebral hemisphere.


FIG. 4

S.E.M. photograph of the dorsal aspect of the closing neural tube rostral to the first somite of stage 9 embryo.
Note: sytoplasmic processes (Cp), Neural fold (NF), FORAMINA (↑), Neural groove (Ng), Neuroepithelium (Ne) and unknown bodies (✕) × 3180.

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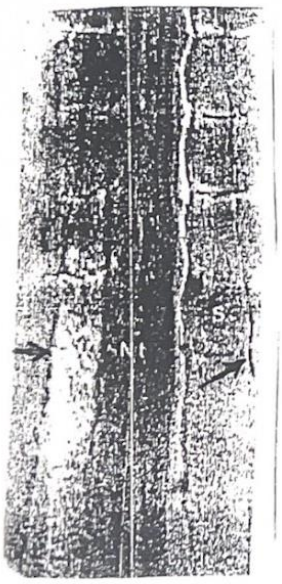


FIG. 5 ×400


FIG. 6 ×400

10.


FIG. 7 ×120

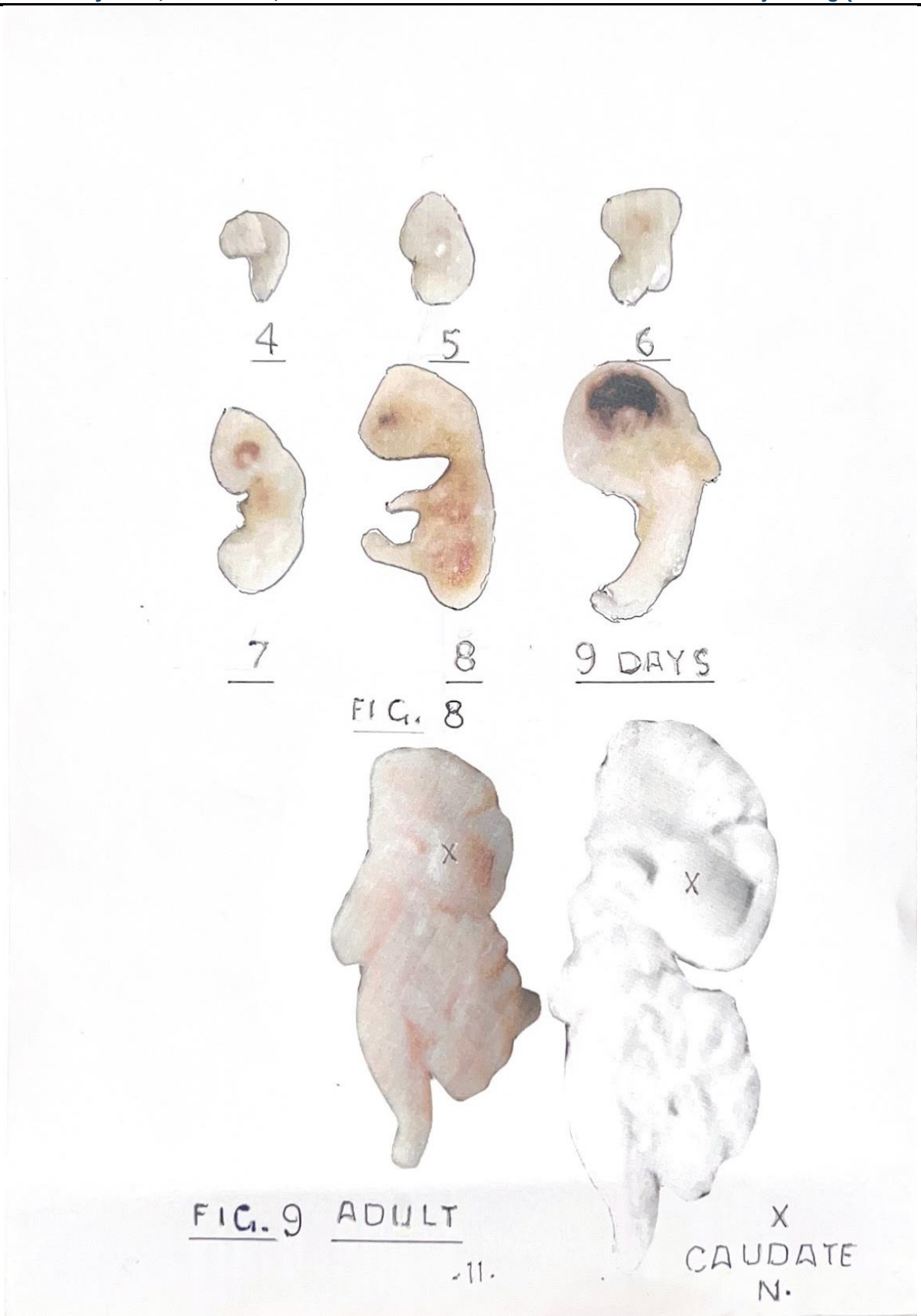


FIG. 8




FIG. 9 ADULT X CAUDATE N.

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To whome it may concern

Dr. **JOHN GIRGIS GOUDA** is working as professor and head department of anatomy in our college ,moreover he is working on implementation and organizing a master degree in human anatomy.

Professor **GOUDA** is highly oualified and one of the eminent anatomists .

He taught anatomy to post and undergraduates of many universities locally, regionally and intrnationaly including leicester university , England .

I strongly recommend him for any post concerning anatomy for post and undergraduates .

BEST REGARDS,,,

Prof. TARIG ABBAS
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