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Parathyroid histology in the Rhinocerotidae

by A. J. E. CAVE *and* F. J. AUMONIER, *Departments of Anatomy and Physiology, St. Bartholomew's Hospital Medical College, London, England*

SYNOPSIS

The histology of the parathyroid gland is described for adult specimens of *Rhinoceros unicornis*, *Didermocerus sumatrensis*, and *Ceratotherium simum*. In the two Asian forms the gland parenchyma is disposed as rounded cell-clusters, in the African form as solid branching cell-cords. In all genera the gland is highly vascular and its cells are surrounded by sinusoids. The histological evidence provided for the parathyroids of *Didermocerus* and *Ceratotherium* is reported for the first time.

Relatively little has been recorded concerning the visceral histology of the Rhinocerotidae, an ancient perissodactyl group moving inevitably towards extinction because of progressive loss of natural habitat. Material suitable for microscopical examination can but rarely be obtained in the field, so that recourse must necessarily be had to the carcases of animals dying in captivity. Even such material is likely to he henceforth confined to the Indian rhinoceros (*Rhinoceros unicornis*), the African white, square-lipped or Burchell's rhinoceros (*Ceratotherium simum*) and the African black or hook-lipped rhinoceros (*Diceros bicornis*), for already the Javan rhinoceros is reduced to some 20 specimens in the Udjong Kulon Reserve and the Sumatran rhinoceros to perhaps 120 specimens, of which the only captive animal is an aged female in the Copenhagen Zoo.

The published accounts of rhinoceros histology are few and are necessarily often no more than preliminary studies, utilizing the material available and indicating the need for more detailed investigation of a wider and more satisfactory range of material. Thus for *Rhinoceros unicornis* Gervais and Gervais (1875) gave an imperfect account of small gut histology; Burne (1905) published brief notes on the stomach, gut, and parathyroid glands; Kolmer (1918) described the structure of a long-preserved adrenal gland; Cave (1962) implemented histologically Owen's (1862) classic account of the pedal gland; Ryder (1962) described the intimate structure of the horn, Cave (1964) that of the thymus, and Cave and Aumonier (1962*a*, 1964*a*) that of certain of the lymph nodes.

For *Didermocerus sumatrensis* Cave and Aumonier (1962*b*) described the lymph node histology and reported briefly (1963*a*) upon the alimentary canal, liver, lung, kidney, adrenal, and thyroid from an aged, unhealthy female, of which Cave (1964) detailed the thymic structure.

For *Diceros bicornis* Cave and Aumonier (1962*a*, 1963*b*) reported on lymph node structure and (1965) on the histology of the preputial glands, while Cave (1964) described the thymus histology.

For *Ceratotherium simum* Cave and Allbrook (1958, 1959) recorded the minute structure of the skin and nuchal hump; Cave and Aumonier (1960) published brief observations upon the colon, kidney, and liver of a wild-killed animal: later (1964*b*) they reported on the lymph node structure and described (1965) the preputial glands, noted separately by Cave (1966).

Organs other than those mentioned in this summary have, as opportunity offered, been studied microscopically so that a small corpus of information on rhinoceros histology is being assembled for future publication. This present notice augments Burne's (1905) findings for *Rhinoceros unicornis* and submits the first account of parathyroid histology in *Didermocerus* and in *Ceratotherium.*

MATERIAL AND METHODS

The parathyroid glands were dissected out from the formalin-preserved viscera of the following specimens: an 18 year old male Indian rhinoceros (*Rhinoceros unicornis*) and a 10 year old female African white rhinoceros (*Ceratotherium simum*) from the menagerie of the Zoological Society of London, and an old female Sumatran rhinoceros (*Didermocerus sumatrensis*) from the Zoologischer Garten, Basle. For the gift of this material we are deeply indebted to the Council of the Zoological Society of London and to Dr. S. Lindt, of the Veterinär-pathologisches Institut, University of Berne, and Dr. L. Forcart, of the Basel Naturhistorisches Museum.

The excised glands were formalin-fixed, and embedded in paraffin wax; the blocks were cut at a 10 μ thickness and the resulting sections were stained variously with haematoxylin and eosin, van Gieson, orcein, Weigert, Verhoff, and chlorazol black.

OBSERVATIONS

Rhinoceros unicornis: 18-year-old male

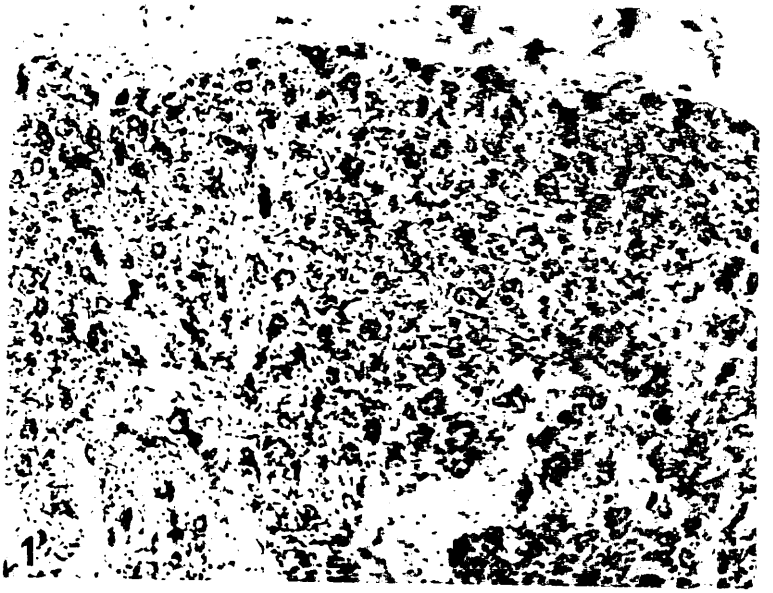
Four parathyroid glands are present in this specimen, one dextral, three sinistral. The dextral gland is embedded superficially in the mid-region of the corresponding thyroid lobe. The three sinistral glands lie in cranio-caudal sequence, the uppermost in a position corresponding to that of its contralateral fellow, the middle gland under cover of the thyroid lobe and the lowermost gland upon the trachea, some distance from the thyroid. (For the topographical variability of the parathyroids in this species see Cave (1953)).

Histologically the parathyroid gland is a highly vascular, imperfectly lobulated organ, whose lobules, separated by fibrous septa, are composed of cells of tolerably uniform shape and size, disposed not in cords but as solid rounded clumps. A few of these clumps appear to possess a lumen. In the delicate connective tissue supporting these cells clusters and in the interlobular septa elastin is present. Oxyphil cells are observable in some of the sections but the general state of preservation is too unsatisfactory to admit of the differentiation of cell types. The entire parenchyma is extremely vascular, blood-vessels therein being numerous and relatively large: the cell clusters are surrounded by sinusoids rather than by true capillaries (figs. 1, 2).

These findings agree with those of Burne (1905) who reported the parathyroid of his adult male animal to show cells in solid masses or in "globular alveoli" surrounded by very delicate connective tissue, and who regarded the gland itself as representative of type 3 and type 4 of Welsh's (1898) currently attempted classification of parathyroid glands.

Didermocerus sumatrensis: aged female

Right and left parathyroid glands are present, somewhat bean-shaped bodies, some 11·5 mm long × 4 mm wide, of a brownish-beige colour which contrasts sharply with the purply-brown tint of the thyroid gland. A distinct parathyroid artery reaches the gland from the A. thyroidea, and three delicate but dissectable parathyroid veins unite to form a tributary of the thyroid veins (fig. 3). Preservation is



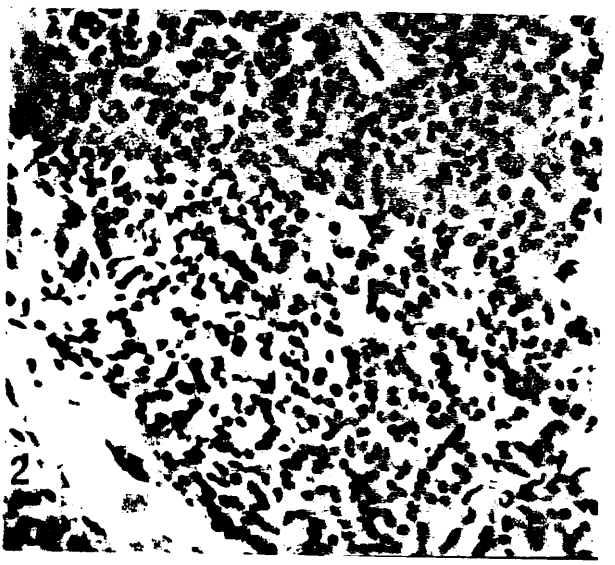


Fig. 1. *Rhinoceros unicornis*, ad. male. Parathyroid gland showing disposition of the parenchymal cells in clusters. × 100. Hæmatoxylin and eosin.
Fig. 2. *Rhinoceros unicornis*, ad. male. Higher magnification of parathyroid gland, showing details of parenchyma, stroma, and blood-vessels. × 300. Haematoxylin and eosin.

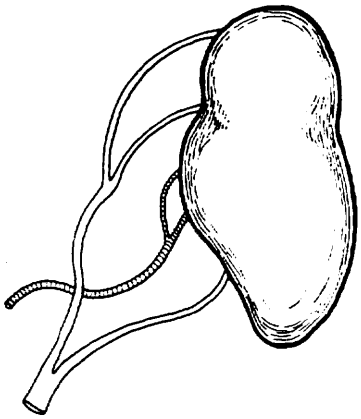


Fig. 3. *Didermocerus sumatrensis*, old female. Drawing of isolated parathyroid gland.

poor and pathological change is indicated by a massive invasion of the gland by lymphoid tissue and by the large amount of pigment taken up by the macrophages.

The parathyroid gland is enclosed within a fibrous capsule, from which septa, supporting blood-vessels, pass into the interior. The chief cells are arranged somewhat diffusely and have a tendency to form rounded clusters rather than cords (figs. 4, 5). The genuine parathyroid parenchyma appears to be confined to the peripheral (subcapsular) portion of the organ. The most superficial chief cells may well have contained lipoid material, since removed during histological preparation. It is unfortunate that this animal was heavily diseased and that its parathyroid glands, like most of its other organs, should reflect a degree of pathological change. Nevertheless the limited histological information yielded is valuable, since there is no previous mention of the structure of the *Didermoceros* parathyroid in the literature and practically no expectation of such material being ever again available for examination.

Ceratotherium simum: 10–11-*year-old female*

The parathyroid gland of this specimen is of typical mammalian constitution save for an enormous preponderance of collagen. Its microscopic appearance, therefore, is less that of parenchymal lobules separated by fibrous septa than of a matrix of densely packed collagen fibres supporting a diffusely disposed parenchyma. This last is in the form of solid, branching and anastomosing cords, composed of light chief cells, i.e. of small cells with rounded nuclei and pale cytoplasm. The state of

Fig. 4. *Didermocerus sumatrensis*, old female. Parathyroid gland tissue invaded by lymphoid tissue and fat. × 100. Haematoxylin and eosin.

Fig. 5. *Didermocerus sumatrensis*, old female. Portion of parathyroid gland, showing the invading lymphocytic mass, the surviving parenchyma, and the compressed sinusoids. × 300. Haematoxylin and eosin.

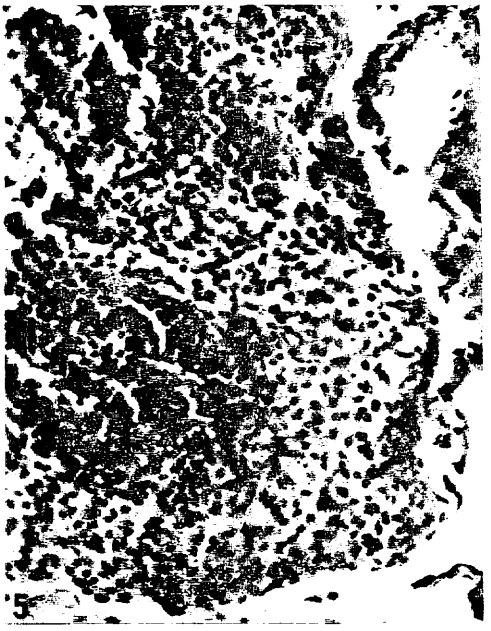
Fig. 6. *Ceratotherium simum*, ad. female. Parathyroid gland, showing a preponderance of collagen and a tendency towards the cord-like arrangement of the cells. × 100. Haematoxylin and eosin.

Fig. 7. *Ceratotherium simum*, ad. female. Parathyroid parenchyma more highly magnified to show the branching cell cords and the abundant collagen. × 300. Haematoxylin and eosin.

preservation precludes any further differentiation of cell types. The entire gland is remarkably vascular; the sections reveal a fair number of small, thick-walled arteries and show the cell cords to be intimately surrounded by large and thin-walled sinusoids (figs. 6, 7).

Diceros bicornis

Regrettably no present evidence is available concerning parathyroid histology in this form. In two specimens examined (an old female and a four year old male) the



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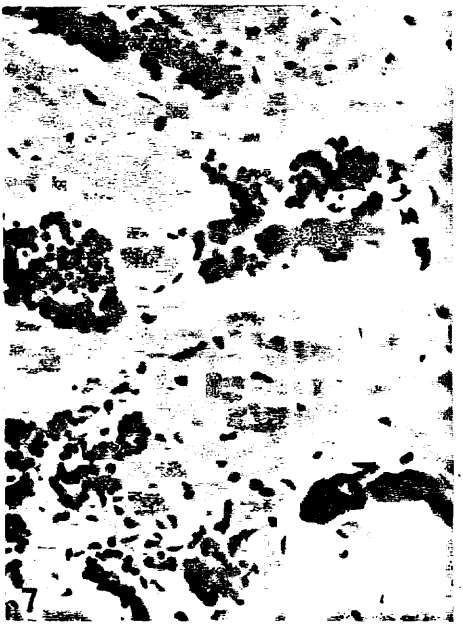

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larynx and its adnexa were not available after necropsy. A three year old female-animal showed two ununited thyroid lobes, neither of which revealed the least hint of any epithyroid or intrathyroid parathyroid gland tissue. Certain appearances in the specimen suggested that in this animal the parathyroids had been situated under cover of the thyroid lobes, in the loose cellular tissue clothing the surface of the trachea.

DISCUSSION

The limited range of the material reported on herein is restrictive of comment. For *Rhinoceros unicornis* present findings confirm those of Burne (1905), besides establishing the presence in this form of oxyphil cells, which are said to be usually absent from the parathyroids of the lower mammals. The appearance of a potential lumen within some of the cell clumps of the present specimen may represent the beginning of that follicle formation which, as a phenomenon associated with age, proved more obtrusive in Burne's older animal. In the *Didermocerus* material the great increase of collagen, the invasion of the parathyroid parenchyma by lymphoid tissue and the probable presence of lipoid in some of the chief cells are changes probably to be associated with old age. The general evidence of the sections is, however, supportive of the conclusion that in earlier, healthy life this *Didermocerus* parathyroid gland differed in no essential histological particular from that of *Rhinocerus unicornis*.

In the *Ceratotherium* parathyroid the invariable disposition of the parenchyma in the form of anastomosing solid cords of cells may be characteristic of this form; but since in *Homo*, for example, both cell cords and cell clusters may co-exist within the parathyroid parenchyma, the taxonomic significance of this *Ceratotherium* arrangement cannot be assessed until further material shall have been examined.

Information is largely wanting concerning parathyroid histology in the remaining perissodactyl families (Tapiridae, Equidae). Nothing relevant appears to have been so far recorded for any species of tapir, while standard veterinarian treatises—e.g. Ellenberger-Baum (1943) and Sissons (1947)—make brief reference to the topography of the equine parathyroid but omit all description of its histological structure. Maximow and Bloom (1957), however (though again without the submission of histological particulars), make the interesting statement that "of all mammalian parathyroid glands examined cytologically thus far, those of the horse seem most nearly to resemble those of man". Our own limited evidence, so far as it goes, demonstrates a similarly close histological correspondence between the rhinocerine and the human parathyroid, but the interpretation of such close resemblance cannot be profitably attempted in the present paucity of information concerning parathyroid histology in mammals generally.

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