The red patas monkey (*Erythrocebus patas*): An analysis of pathological changes and organ/body weight data in laboratory animals in a 12 year period

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INTRODUCTION

Non-human primates are used routinely in toxicity studies and in medical research but sources of reference material relating to normal background pathology are frequently difficult to find. Surveys of organ and body weights have been reported for the rhesus monkey (*Macaca mulatta*) (*Cupp & Uemura* 1981) and marmoset (*Callithrix jaccus*) but comparable data does not seem to be available for the red patas monkey which has been availavle for experimental studies in Europe for many years. Its value in investigations in emphasised in a recent publication that discusses in detail, breeding programmes (*Kaplan, Anthony at al.* 1981).

The use of larger species in experimental toxicology is limited by their availability and economic considerations. This means that the number of animals allocated to control groups will be small. Thus, evaluation of test animals in a study will involve a direct comparison with the control animals available; this information being supplemented by experience gained in using the species over several years. The present report has been compiled from a survey of the control data accumulated in the Wyeth Laboratories (Maidenhead, U.K.) in the period from 1969–1981.

Unfortunately, the animals were not bred in that laboratory and their ages are not accurately known. However, the animals are deemed to be representative of patas monkeys available for biomedical research studies.

MATERIAL AND METHODS

The animals used in this survey were supplied by Shamrock Farms Ltd. (Henfield, Sussex, England). They were examined by a qualified veterinarian and were in a good state of health when received, and throughout the entire observation period. They had been subjected to a regulatory 6-months quarantine period and were certified free from rabies, Mycobacterium spp. (tuberculosis, Shigella spp. and Salmonella spp. infections.

The survey included 76 animals (38 male and 38 female). They had been designated as controls in routine toxicological studies; as such they had been dosed orally with distilled water or other suitable solvent with a recognised low toxicity threshold (i.e. 0.5 % gum tragacanth in water).

At the end of the observation period (one to six months), monkeys were killed by an intravenous injection of pentabarbitone sodium (Sagatal®). Each animal was weighed and subjected to a full *post-mortem* examination.

The following organs were routinely sampled, weighed and representative tissues preserved in 10 % phosphate buffered formalin for histopathology. (The eyes were preserved in Davidson's fluid which is preferred to formalin for this tissue).

Organs preserved for histopathology include:
Brain, pituitary, heart, spleen, thymus, kidneys, adrenal glands, thyroid and parathyroid, liver, salivary glands, pancreas, testis/ovary and reproductive tract.

(Other tissues sampled but not weighed included – spinal cord, sciatic nerve, aorta, cervical and mesenteric lymph nodes, gall bladder and bile duct, skeletal muscle and tongue).

Organ weights were expressed as absolute, or relative to body weight.

For histopathology, tissues samples were routinely embedded in paraffin wax in the usual way and thin sections stained with Haematoxylin and Eosin. Additionally, nervous tissue was stained with thionin for Nissl granule granulation and nerve cell body demonstration.

RESULTS

The monkeys surveyed here were in apparant good health through the entire study periods and no fatalities were recorded. At autopsy, one female animal exhibited a large mediastinal abscess, but gross observations in other animals were unremarkable.

The male animals in this survey weighed more than the females, but whereas most of the females were sexually mature as indicated by regular oestrus cycles, the majority of males weighing less than 5 kg were still quite immature.

Table 1.
Absolute organ weights in red patas monkeys.

	MALES	FEMALES
Body weight (kg)	4.49±0.21	3.79±0.10
Organ weight (g)		
Brain	91.70±1.90	83.90±1.20
Heart	35.29±2.14	27.35±1.02
Liver	112.80±3.90	103.30±2.90
Lung (Left)	16.14±0.88	13.13±0.51
Lung (Right)	17.56±0.84	14.90±0.57
Kidney (Left)	10.33±0.38	9.64±0.27
Kidney (Right)	10.21±0.37	9.49±0.31
Spleen	6.16±0.42	5.91±0.33
Thymus	5.59±0.43	4.36±0.29
Pituitary	0.054±0.009	0.052±0.006
Adrenal (Right)	0.53±0.03	0.55±0.03
Adrenal (Left)	0.62±0.03	0.62±0.03
Thyroid (Right)	0.35±0.03	0.33±0.02
Thyroid (Left)	0.36±0.03	0.31±0.02
Testis (Right)	1.45±0.32	–
Testis (Left)	1.45±0.32	–
Ovary (Right)	–	0.237±0.022
Ovary (Left)	–	0.248±0.026

Absolute organ weights (Table 1) varied widely and showed a poor correlation with body weight in both males and females. However, a good correlation was evident where relative brain weight was expressed as

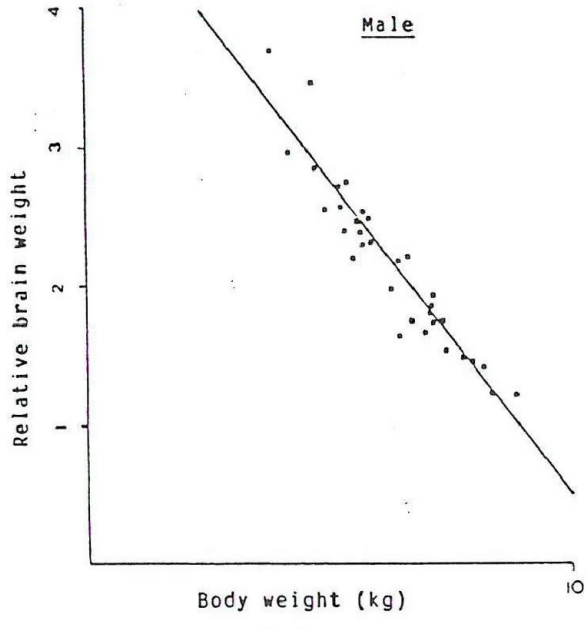

Fig. 1a.

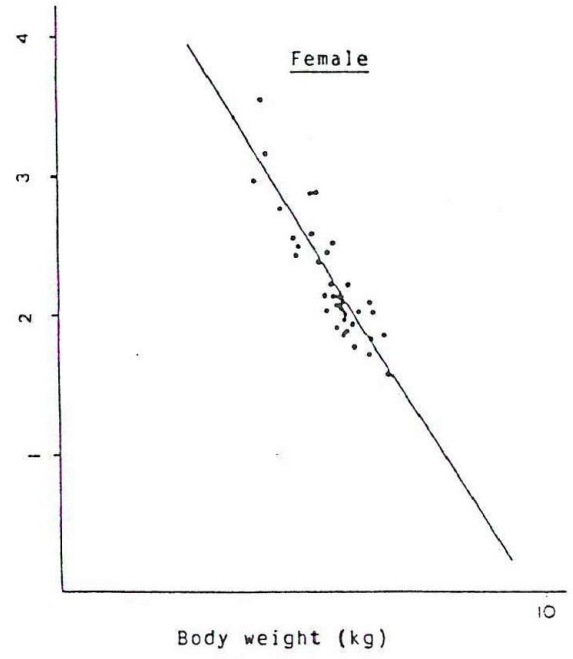

Fig. 1b.

Fig. 1a, b. Relative brain weight in relation to body weight in red patas monkeys.

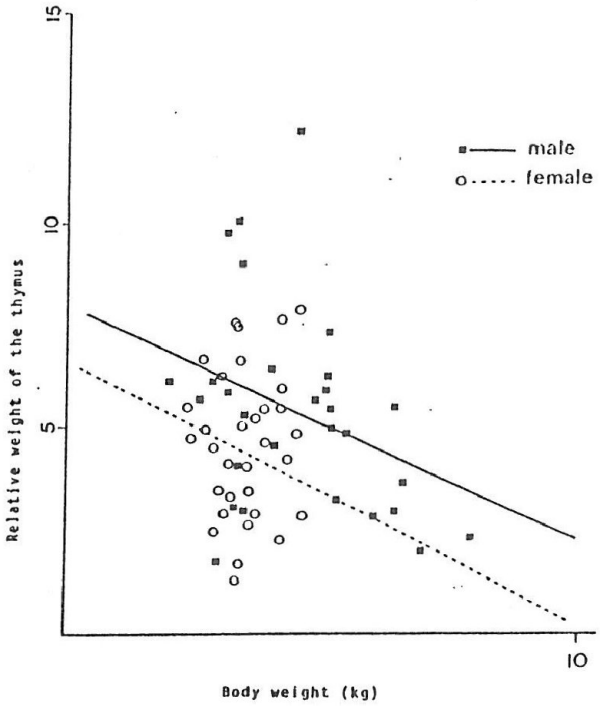

Fig. 1c. Relative thymic weight in relation to body weight in red patas monkeys.

a function of body weight (Fig. 1a, b). For other tissues, notably the thymus, the correlation between the relative weight and body weight was not good (Fig. 1c).

Pathological Changes: (Table 2).
Approximately half the monkeys showed histopathological evidence of chronic respiratory disease manifest by a mild to moderate lymphoid infiltration with occasional foci of polymorponuclear cells. Occasionally pulmonary alveolar macrophages were identified containing dust particles or haemosiderin pigment. These were present mainly in perivascular or peribronchiolar areas.
Several animals showed evidence of nematode infections in the lungs and in the lower alimentary tract. Cross sections of worms were seen in bronchioli and associated with small abcsesses or granuloma at various sites in the small intestine and caecum.
Small foci of mononuclear cells were identified at numerous sites including the thyroid and salivary glands, pharynx, liver and kidneys. The affected monkeys frequently showed reactive lymphoid hyperplasia in the spleen and lymph nodes.
The female animals were mostly mature and exhibited characteristic ovarian morphology. Otherwise, the reproductive tract was unremarkable other than six cases of endometritis/vaginitis.
As most of the male animals were immature, testicular sections showed minimal evidence of spermatogenesis.
Other lesions of interest in these monkeys included two animals showing sarcocystic infection in the rectus muscles of the eye, tongue and skeletal muscle; a male animal with embryonic rests in the thyroid; and the female with the mediastinal abscess reported above. The abscess involved mainly the pericardial and pleural membranes, but a minimal ventricular myocarditis was also present. The abscess was probably of a long-standing nature and comprised a massive infiltration of polymorphonuclear cells with fibrin deposition.

Table 2. Histopathological lesions in 76 red patas monkeys.

		Male	Female
Brain	– focal or diffuse meningitis	7	3
	– glial cell proliferation	1	1
	– lymphocytic infiltration		4
Tongue	– lymphocytic infiltration	11	10
	– Sarcocystis sp. infection	1	1
Buccal Cavity	– chronic gingevitis	1	
Salivary Gland	– Focal adenitis/dacroadenitis	12	11
	– granuloma (? parasitic)	1	
Trachea	– lymphocytic infiltration	9	5
	– mucosal hyperplasia	1	

Table 2. (Continued).

		Male	Female
Thyroid	– sub-acute thyroiditis	7	5
	– branchial cysts	1	
	– parafollicular cell hyperplasia	1	
Eyes	– Lymphoid infiltrates in eyelid	2	3
	– Sarcocystic infection in muscle	1	
Lungs	– chronic interstitial pneumonitis	24	19
	– alveolar macrophages – haemosiderin	16	21
	– dust particles	5	4
	– pleuresy with pleural thickening	2	2
	– dystrophic mineralisation in pulmonary blood vessels	1	1
	– nematode granuloma	1	1
	– giant cell granuloma	1	2
	– acute bronchitis	1	1
	– bronchopneumonia		1
Kidney	– chronic interstitial nephritis	22	22
	– interstitial fibrosis	1	
	– tubular dilatation	2	4
	– chronic pyelitis	1	
	– pyelonephritis		1
	– focal mineralisation in tubules	6	7
	– hydropic degeneration		1
Liver	– focal lymphocyte infiltration	27	26
	– hepatocellular vacuolation		
	a. centriacinar	2	
	b. periacinar	3	2
	c. generalised	3	11
	– fatty degeneration	6	3
	– bile duct proliferation	1	2
	– bile duct granuloma (? parasitic)	1	
	– intraparenchymal granuloma		2
Urinary Bladder	– chronic inflammation	12	6
Spleen	– follicular hyperplasia	1	
	– reactive hyperplasia	4	4
	– parasitic granuloma		1
Lymph nodes	– reactive hyperplasia	3	3
	– infiltration of foamy macrophages	6	5
Thymus	– branchial cysts		1
Heart	– chronic myocarditis	2	4
	– pericarditis	1	1
Pancreas	– chronic pancreatitis	6	3
	– islet cell hyperplasia		1
	– interstitial fibrosis		2
Pituitary	– anterior lobe cysts	1	2
Adrenal gland	– lymphoid infiltrates	1	
Sketetal muscle	– focal myositis	1	
	– sarcocystic infection		1
Gastrointestinal t ract	– gastric erosion		1
	– colonic abscess (? parasitic)	3	1
	– oesophageal granuloma (? parasitic)		1
	– chronic colitis		2
Thorax	– mediastinal abscess		1
Uterus/Vagina	– chronic endometritis/vaginitis		6
Ovary	– cystic		2
	Total number of animals examined	38	38

DISCUSSION

Previous reviews on the biology and pathology of laboratory monkeys are not numerous and most relate to animals maintained in zoological collections (*Ruch* 1967). The apparant lack of neoplastic lesions in this study is perhaps not surprising in view of earlier studies indicating a very low incidence of spontaneous tumours in monkeys, and a minimal susceptibility to chemically induced carcinogenesis (*Kent & Pickering* 1958). A further plausible explanation for the low tumour incidence in captive monkeys, is that the animals are too young and have not attained the so-called "tumour age". Tumours are occasionally reported however, but rarely is the age of the animal known (*Kommineni, Groth et al.* 1978, *Jones & Casey* 1981, *Lansdown* 1982).

Other aspects of the pathology of this group of patas monkeys are unremarkable and very comparable to that seen in other species of laboratory animals. The low incidence of background pathology and docile temperament suggests that the patas monkey is a very suitable sub-human primate for laboratory research.

The prevalence of nematode, sarcocystic and other infections in animals available for research in Europe is not known, but they will reflect the local conditions in the tropical environment from which the animals are obtained.

It is unfortunate that the ages of these animals are not known enabling organ weights to be expressed more appropriately.

It is likely however, as with other species of laboratory animal, body and organ weights will correlate well with age, showing an exponential relationship in the active growth phase, and then a plateau when the animal attains maturity. This pattern has been demonstrated in recent studies with the marmoset which breeds well under laboratory conditions (*Wadsworth et al.* 1981).

It is hoped that publication of the present information will serve as an incentive for other workers to present details on the background pathology on other species of non-human primate available for medical research. It will be appreciated that as the demand for high quality animals increases, so more centres will become available for breeding large species in captivity, thus alleviating the problems associated with importing infected animals from the wild state. This facility will enable a more accurate evaluation of organ and body weight, and further enhance the available knowledge of the species.

Acknowledgements

I am grateful to the Wyeth Laboratories (U.K.) for allowing me to publish this material which was compiled during my tenure as Head of Pathology.

Summary

The histopathology and body and organ weights have been evaluated for 76 adult red patas monkeys used as controls in routine short term toxicity studies.

Body and organ weights varied considerably, males weighting 2.45–7.7 kg and females 2.65–4.80 kg. Absolute organ weights did not exhibit a clear graphical relationship to body weight, although brain weight did show an exponential relationship when its weight relative to body weight was plotted against body weight.

Neoplastic changes were not seen in any male or female animal. Common lesions included sialodacroadenitis, sub-acute thyroiditis, chronic respiratory disease, interstitial nephritis and cystitis. Pulmonary and intestinal nematode infections were present in ten animals. It is concluded that the range of lesions identified resemble those present in many other species of laboratory animal maintained under conventional laboratory conditions.

Sammendrag

Histopatologi og krops- og organvægte blev undersøgt i 76 voksne aber af arten *Erythrocehus patas,* anvendt som kontroldyr i toksikologiske studier.

Krops- og organvægte udviste betydelig kønsvariation. Hanner vejede 2.45–7.7 kg og hunner 2.65–4.80 kg.

Organvægtene viste ingen klar korrelation med kropsvægt, skønt hjernevægt viste en eksponentiel sammenhæng med kropsvægt.

Der blev ikke observeret neoplastiske forandringer i nogen af aberne.

Almindelige patologiske forandringer omfattede sialodacroadenitis, subakut thyroiditis, kronisk luftvejslidelse, interstitial nephritis og cystitis. Pul-

monære og intestinale nematodeinfektioner sås hos ti dyr.
Det konkluderes, at forandringerne minder om tilsvarende forandringer hos andre forsøgsdyr, der huses under konventionelle betingelser.

Yhteenveto / K. Pelkonen
Työssä raportoidaan lyhytaikaisissa toksisuuskokeissa kontrolleina olleen 76 aikuisen red pataapinan histopatologia ja elinpainot.
Ruumiinpainot ja elinten painot vaihtelivat suuresti: urokset painoivat 2.45–7.7 kg ja naaraat 2.65–4.8 kg. Absoluuttiset elinpainot eivät yleisesti olleet selvästi graafisesti suhteessa ruumiinpainoihin. Aivojen suhteellisen painon kuvaaja oli kuitenkin eksponentiaalinen suhteessa ruumiinpainoon.
Yhdessäkään eläimessä ei havaittu neoplastisia muutoksia. Yleisiä muutoksia olivat sialodacroadeniitti, subakuutti tyroidiitti, krooninen hengitystietulehdus, interstitiaalinefriitti ja kystiitti. Suoliston ja keuhkojen sukkulamatotartunta havaittiin kymmenessä eläimessä. Artikkelissa päädytään monissa muissakin koe-eläimissä, joita hoidetaan konventionaalioloissa.

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