Quantitative estimation of islet tissue of pancreas in Australian mammals
(Comparative histological study)

by

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SUMMARY

Quantitative estimation of islet tissue of pancreas in Australian Mammals

This is a comparative histological study of the islet tissue of the pancreas in selected prototherian, metatherian and eutherian mammals.

Six animals, three male and three female, of each of the following species were used

Prototheria - Echidna (Tachyglossus aculeatus)

Metatheria - Possum (Trichosurus vulpecula)
- Grey kangaroo (Macropus fuliginosus)

Eutheria - Hopping mouse (Notomys alexis)
- Water rat (Hydromys chrysogaster)

All animals were weighed either before or immediately after death.

The pancreas was removed and weighed and the relationship between the weight of the pancreas and weight of the animal calculated. No linear relationship was found in any of the species.

Estimations of islet tissue mass and of individual cell types were made on paraffin sections of Bouin-fixed tissue taken from head, neck, body and tail regions of the pancreas of each animal. Islet tissue mass was assessed using a linear scanning technique (Carpenter and Lazarow, 1962, J. Histochem. Cytochem. 101, 324-328) on sections stained with haematoxylin and eosin.

The relationship between percentage islet tissue and the weight of the pancreas was calculated. There is a clear relationship in possum (Trichosurus vulpecula), hopping mouse (Notomys alexis) and water rat (Hydromys chrysogaster).

The relationship between average islet mass and body weight was calculated. No linear association exists between them.

Specific cell types were assessed using a point-intercept method (Weibel et al., 1966, J. Cell Biol. 30, 23-38). Sections stained with aldehyde fuchsin were used for the assessment of beta (β) cells in all the species in the head, neck, body and tail regions.
For the assessment of alpha (α) cells the same procedure was employed using sections stained with Grimelius' silver nitrate stain (Grimelius, 1968, Acta Soc. Med. Upsal 73, 271-294) in echidna (Tachyglossus aculeatus) and possum (Trichosurus vulpecula), phosphotungstic acid haematoxylin in grey kangaroo (Macropus fuliginosus) and water rat (Hydromys chrysogaster), and an immunoperoxidase method for glucagon in hopping mouse (Notomys alexis).

For the assessment of delta (δ) cells, the same procedure was employed using sections stained by an immunoperoxidase method for somatostatin in echidna (Tachyglossus aculeatus), possum (Trichosurus vulpecula), hopping mouse (Notomys alexis), and water rat (Hydromys chrysogaster), and Epple's modification (Epple, 1967, Stain Tech. 42, 53-66) of the modified Davenport technique (Hellerstrom and Hellman, 1960, Acta endocr. 35, 518-532) in grey kangaroo.

For the assessment of the pancreatic polypeptide cells (PP), the same procedure was applied using section stained by an immunoperoxidase method for pancreatic polypeptide in echidna (Tachyglossus aculeatus), possum (Trichosurus vulpecula), grey kangaroo (Macropus fuliginosus), hopping mouse (Notomys alexis) and water rat (Hydromys chrysogaster).

Positive regional differences noted were a greater percentage proportion of islet tissue in the tail region in hopping mouse (Notomys alexis) and water rat (Hydromys chrysogaster) (Eutherian species) and also a lower proportion of alpha cells in the head region of the above Eutherian species. Alpha cells were peripherally situated in the islets in these species. A greater proportion of PP cells was found in the head region of echidna (Tachyglossus aculeatus), possum (Trichosurus vulpecula) and water rat (Hydromys chrysogaster).

Staining methods were compared in quantitating tissues, using immunoperoxidase techniques for insulin and aldehyde fuchsirn in water rat (Hydromys chrysogaster), immunoperoxidase technique for glucagon and phosphotungstic acid haematoxylin in grey kangaroo (Macropus fuliginosus), immunoperoxidase technique for glucagon and Grimelius' silver nitrate stain
(Grimelius, 1968, Acta Soc. Med. Upsal. 73, 271-294) in possum (Trichosurus vulpecula), immunoperoxidase for somatostatin and modified Davenport's silver technique (Hellerstrom and Hellman, 1960) using Epple's modification (Epple, 1962) in grey kangaroo (Macropus fuliginosus). The results were the same using both staining methods in each case where staining was successful.

These results show some elements of agreement with a previously proposed hypothesis (Bonner-Weir and Weir, 1979, Gen. Comp. Endocr. 38, 28-37) regarding the general pattern of arrangement of the mammalian endocrine pancreas.