

Table of contents

SECTION 1 - HYPOTHALAMUS AND PITUITARY 1

Chapter 1	Pituitary anatomy and physiology	3
	Sara Galac, DVM, PhD	
	Pituitary anatomy	3
	Pituitary physiology	5
	Hormones of the adenohypophysis (AL)	6
	Hormones of the neurohypophysis	7
Chapter 2	GH excess: acromegaly (hypersomatotropism)	9
	Stijn J.M. Niessen, DVM, PhD, DECVIM, PGCertVetEd, FHEA, MRCVS	
	Christopher J. Scudder, BVSc, PhD, DACVIM, MRCVS	
	Background and history	9
	Incidence and pathogenesis	10
	Pituitary pathology	11
	Consequences of pituitary pathology	13
	Clinical features and diagnosis	13
	Treatment	19
	Prognosis	24
Chapter 3	Other pituitary tumors	27
	Guy C.M. Grinwis, DVM, PhD	
	Pituitary masses: hyperplasia, adenoma or carcinoma?	27
	Incidence and cell origins of pituitary tumors	27
	Effect of pituitary tumors on target organs and the direct effects of large tumors	29
	Functional consequences of autonomous hormone production	29
Chapter 4	Pituitary surgery	33
	Björn Meij, DVM, PhD, ECVS	
	Introduction and general observations	33
	Surgical anatomy	33
	Imaging of the feline pituitary gland	35
	Pituitary adenomas	39
	Transsphenoidal hypophysectomy	48

Postoperative care	53
Complications after pituitary surgery	54
Prognosis	56
Chapter 5 Pituitary irradiation	59
Alain P. Théon, MS, PhD, Dip ACVR-RO	
Introduction	59
Clinical presentation	59
Advanced imaging	59
Role of radiation therapy	60
Modalities of radiation therapy	60
Nonfunctioning tumors	64
Growth hormone-secreting pituitary tumors and acromegaly	67
Adrenocorticotrophic hormone-secreting pituitary tumors and feline Cushing's disease	72
Radiation-related adverse effects	74
Chapter 6 Pituitary GH deficiency and pituitary dwarfism	77
Dolores Pérez Alenza, DVM, PhD	
Introduction	77
Etiopathogenesis	77
Clinical features	77
Differential diagnosis for failure to grow	78
Diagnosis	80
Treatment	82
Chapter 7 Polyuria, polydipsia and diabetes insipidus	84
Robert E. Shiel, MVB, PhD, PGDipUTL, DECVIM-CA	
Introduction	84
Water requirements in healthy cats	84
Urine concentrating ability in healthy cats	85
Mechanisms of water retention	85
Causes of polyuria and polydipsia in cats	88
The diagnostic approach to polyuria and polydipsia	93
Treatment of central diabetes insipidus	96
Prognosis	96

SECTION 2 - THYROID GLAND

99

Editor: Dr. Mark E. Peterson, DVM, DACVIM (SAIM)

Chapter 8	Thyroid anatomy and physiology	101
	Duncan C. Ferguson, VMD, PhD, DACVIM, DACVCP	
	Anatomy of the feline thyroid gland	101
	General thyroid physiology	102
	Serum protein binding of thyroid hormones	104
	Hypothalamic-pituitary-thyroid axis	106
	Extrathyroidal metabolism of thyroid hormone	107
	Thyroid hormone kinetics in the cat	110
	Action of thyroid hormone	110
Chapter 9	Hyperthyroidism: background, etiopathogenesis and changing prevalence of feline thyroid disease	114
	Mark E. Peterson, DVM, DACVIM (SAIM)	
	History of thyroid disease in cats	114
	Studies into the etiopathology of feline hyperthyroidism	115
	Epidemiology of hyperthyroidism: a common worldwide disorder of senior to geriatric cats	122
	Why has feline nodular goiter reached such epidemic proportions?	123
	Conclusions	125
Chapter 10	Hyperthyroidism: clinical signs and physical examination findings	130
	Meredith L. Miller, DVM, DACVIM (SAIM)	
	John F. Randolph, DVM, DACVIM (SAIM)	
	Mark E. Peterson, DVM, DACVIM (SAIM)	
	Signalment	130
	Clinical signs	130
	Physical examination	135
Chapter 11	Hyperthyroidism: laboratory diagnosis	141
	Carmel T. Mooney, MVB, MPhil, PhD, DECVIM-CA	
	Clinicopathologic abnormalities associated with hyperthyroidism	141
	Thyroid hormone abnormalities associated with hyperthyroidism	145
	Other diagnostic tests	152
	Conclusion	154

Chapter 12	Thyroid and kidney disease in cats	156
	Tim Williams, MA, VetMB, PhD, FRCPath, Dip. ECVCP, MRCVS	
	Hyperthyroidism and chronic kidney disease (CKD)	156
	Effect of hyperthyroidism on serum test results of renal function	158
	Effect of hyperthyroidism on urinary markers of renal function	159
	Effect of hyperthyroidism on systolic blood pressure	159
	Effect of treatment of hyperthyroidism on renal function	161
	Effect of azotemia on how hyperthyroid cats are managed	163
	Suggested management strategies for hyperthyroid cats with CKD	164
Chapter 13	Thyroid imaging	169
	Michael R. Broome, DVM, MS, DABVP	
	Mark E. Peterson, DVM, DACVIM (SAIM)	
	Introduction	169
	Thyroid embryology, radiographic anatomy, and ectopic thyroid tissue	169
	Normal thyroid	170
	Hyperthyroidism	173
	Ectopic thyroid	177
	Thyroid carcinoma	180
	Thyroid cysts	185
	Hypothyroidism	189
Chapter 14	Treatment of hyperthyroidism: antithyroid drugs	198
	Sylvie Daminet DACVIM, DECVIM-CA, MSc, PhD	
	Considerations prior to initiating therapy with antithyroid drugs	198
	Mechanism of action of antithyroid drugs	200
	Formulations of antithyroid drugs	200
	Dosages of antithyroid drugs	201
	Adverse reactions with antithyroid drugs	203
	Monitoring cats treated with antithyroid drugs	204
	Other drugs of interest in managing hyperthyroid cats	206
	Success rate and survival in hyperthyroid cats managed with an antithyroid drug	206
	Renal function and hyperthyroidism	207
	Conclusion	209

Chapter 15	Treatment of hyperthyroidism: surgical thyroidectomy	211
	James A. Flanders, DVM, DACVS	
	Introduction and overview	211
	Anatomy of the thyroid gland and surrounding structures	211
	Preoperative evaluation	212
	General anesthesia	213
	Feline thyroidectomy techniques	214
	Perioperative complications	223
	Postoperative recurrence of hyperthyroidism	224
	Surgical excision of thyroid adenocarcinoma	224
	Summary and conclusions	224
 Chapter 16	 Treatment of hyperthyroidism: radioiodine	 227
	Mark E. Peterson, DVM, DACVIM	
	M ^a del Pilar Xifra, BVSc	
	Michael R. Broome, DVM, MS, DABVP	
	Introduction	227
	Advantages and disadvantages of radioiodine treatment of hyperthyroidism	227
	Principles of radioiodine treatment	228
	Specific indications for radioiodine treatment	231
	Patient selection and preparation before radioiodine treatment	231
	Thyroid scintigraphy for evaluation of hyperthyroid cats before ¹³¹ I treatment	235
	Estimation of the radioiodine dose to administer to cats with hyperthyroidism	239
	Adverse effects or complications associated with radioiodine treatment	247
	Follow-up thyroid function testing after radioiodine treatment	247
	Prognosis after radioiodine treatment	250
 Chapter 17	 Treatment of hyperthyroidism: diet	 255
	John P. Loftus, PhD, DVM, DACVIM (SAIM)	
	Mark E. Peterson, DVM, DACVIM (SAIM)	
	General nutritional assessment for the hyperthyroid cat	255
	Weight loss and muscle wasting	255
	Nutrients needed for the hyperthyroid cat	256
	Nutritional management of feline hyperthyroidism: feeding a low-iodine diet	259

Chapter 18	Treatment of hyperthyroidism: severe, unresponsive, or recurrent hyperthyroidism	267
	Michael R. Broome, DVM, MS, DABVP Mark E. Peterson, DVM, DACVIM (SAIM)	
	Introduction	267
	Etiology and pathogenesis of severe, unresponsive or recurrent hyperthyroidism	267
	Correlation between the severity and duration of hyperthyroidism and the severity of clinical signs	271
	Causes for treatment failure	272
	Therapy for severe, unresponsive hyperthyroidism	276
	Summary	277
Chapter 19	Hypothyroidism	281
	Mark E. Peterson, DVM, DACVIM (SAIM)	
	Introduction	281
	Causes of hypothyroidism	281
	Clinical subtypes of hypothyroidism	282
	Naturally occurring, congenital hypothyroidism in kittens and junior cats	282
	Naturally occurring hypothyroidism in adult cats	290
	Iatrogenic hypothyroidism in adult cats	297
	Refractory hypothyroidism	309

SECTION 3 - CALCIUM AND PARATHYROID GLANDS 317

Chapter 20	Hypercalcemia	319
	Thomas K. Graves, DVM, PhD, DACVIM	
	Overview	319
	Calcium physiology	319
	Laboratory testing	321
	Initial investigation in hypercalcemic cats	322
	Differential diagnosis of hypercalcemia	324

Chapter 21 Feline primary hypoparathyroidism and hypocalcemia 335

Barbara J. Skelly, MA, VetMB, PhD, CertSAM, DACVIM (Small Animal Internal Medicine),
DECVIM-CA (Internal Medicine), MRCVS

Introduction	335
Distribution of calcium in the body	335
Control of calcium (Ca) homeostasis	335
Hypocalcemia in people and dogs	340
Hypoparathyroidism in cats	341
Differential diagnosis of hypocalcemia	345
Diagnostic testing	348
Treatment	350

SECTION 4 - ADRENAL GLANDS 355

Chapter 22 Adrenal anatomy and physiology 357

Sara Galac, DVM, PhD

Adrenal anatomy	357
Adrenal physiology	358

Chapter 23 Cushing's syndrome (hypercortisolism) 363

Sara Galac, DVM PhD

Dan Rosenberg, DVM, PhD

Introduction	363
Etiology	363
Clinical features	364
Clinicopathological findings	366
Endocrine testing	367
Diagnostic imaging	371
Treatment	373
Prognosis	377

Chapter 24 Primary hyperaldosteronism (Conn's syndrome) 381

Hans S. Kooistra, DVM, PhD, Dipl. ECVIM-CA

Introduction	381
Primary hyperaldosteronism	385

Chapter 25	Other adrenal cortical tumors and pheochromocytoma	392
	Carlos Melián, DVM, PhD Laura Pérez-López, DVM	
	Introduction and differential diagnosis	392
	Working up a feline adrenal mass	392
	Excessive progesterone production	395
	Combined excesses in progesterone and aldosterone	396
	Excessive androgen or estradiol production	397
	Pheochromocytoma	397
	Non-functional adrenal tumors	399
Chapter 26	Adrenal surgery via open and laparoscopic approaches	402
	Philipp D. Mayhew, BVM&S, MRCVS, DACVS Jeffrey Mitchell, DVM	
	Introduction	402
	Diagnostic evaluation	403
	Case selection	403
	Patient preparation	403
	Surgical techniques	404
	Post-operative care	408
	Complications	408
Chapter 27	Feline hypoadrenocorticism	410
	Ian Ramsey, BVSc, PhD, DSAM, Dipl. ECVIM-CA (Internal Medicine), FHEA, FRCVS	
	Introduction	410
	Prevalence	410
	Causes	410
	Age, breed and gender	411
	Clinical signs	411
	Clinical pathology	412
	Diagnostic imaging	414
	Electrocardiography and echocardiography	414
	Endocrine tests	414
	Differential diagnoses	416
	Treatment	417
	Prognosis	419

Chapter 28	Glucocorticoid therapy	422
Nadja S. Sieber-Ruckstuhl, Prof., Dr. Med. Vet., Dipl. ACVIM, Dipl. ECVIM-CA		
Claudia E. Reusch, Prof., Dr. Med. Vet., PhD, Dipl. ECVIM-CA		
Physiology		422
Pharmacology		422
Therapeutic applications		426
Adverse effects		428
Glucocorticoid reduction protocol		429

SECTION 5 - ENDOCRINE PANCREAS 431

Chapter 29	Anatomy, histology and physiology of the feline endocrine pancreas	433
Thomas A. Lutz, Prof. Dr. med. vet.		
Anatomy of the feline pancreas		433
Cell types		434
Cross-differentiation		434
General function of islet hormones		435
Secretory control		436
Relative importance of pancreatic hormones and their contribution to the pathophysiology of diabetes mellitus		437
Pancreatic amyloid as the most typical histological finding in diabetes mellitus		438
Chapter 30	Pathogenesis and clinical observations of uncomplicated diabetes mellitus	442
Eric Zini, Prof. Dr. Med. Vet., Dipl. ECVIM-CA		
Introduction		442
Prevalence and epidemiology		442
Risk factors		442
Pathophysiologic mechanisms		443
DM and pancreatitis		446
Clinical and laboratory findings		447
Survival and prognostic factors		450

Chapter 31 Diabetic ketosis, ketoacidosis, and the hyperosmolar syndrome 454

Lucy J. Davison, MA, VetMB, PhD, DSAM, Dipl. ECVIM-CA, MRVCS

Introduction	454
Glucose homeostasis	454
Clinical presentation of DKA and HHS	456
Principles of management of DKA and HHS	459
Fluid and electrolyte therapy	461
Insulin therapy	463
Additional supportive therapy in DKA and HHS	465
Prognosis of DKA and HHS in cats	466

Chapter 32 Insulin treatment of diabetes mellitus 468

Federico Fracassi, DVM, PhD, Dipl. ECVIM-CA (Internal Medicine)

Aims of the treatment and management plan	468
Insulin therapy	469
Choosing an insulin	477
Frequency of insulin administration, initial insulin dose and change in the type of insulin	477
Storage, mixing and dilution of insulin	478
Owner education	480
Insulin dosing pens	481

Chapter 33 Gastrointestinal hormones and the use of non-insulin therapies for diabetes mellitus 487

Chen Gilor, DVM, PhD, DACVIM

Introduction	487
Incretin hormones physiology and pharmacology	488
Metformin	497
Glipizide	497
Acarbose	498
SGLT-2 antagonists	498
Challenges in managing feline DM and potential uses of non-insulin therapies	499

Chapter 34	Dietary management for diabetes mellitus	503
	Linda M. Fleeman, BVSc, PhD, MANZCVS	
	Charlotte R. Bjørnvad, DVM, PhD, Dipl. ECVCN	
	Overview	503
	Learning outcomes	503
	Case 1: feeding cats that refuse or dislike their “diabetes diet”	503
	Case 2: an insulin overdosed diabetic cat that has just recovered from a severe “hypo” (neuroglycopenia)	506
	Case 3: non-prescription diet alternatives	508
	Case 4: achieving weight loss in a diabetic cat	512
	Case 5: managing diabetes in a cat with concurrent disease	514
	Case 6: the client has looked up a lot of information about diabetes in cats on the internet.	516
Chapter 35	Monitoring diabetes in cats	522
	Claudia E. Reusch, Prof. Dr. Med Vet, Dipl. ECVIM-CA	
	Elena Salesov, Dr. Med Vet	
	Clinical signs	522
	Blood glucose monitoring	523
	Continuous glucose monitoring systems (CGMS) and flash glucose monitoring systems	532
	Urine glucose measurement	536
	Fructosamine concentration	538
	Glycated hemoglobin	539
Chapter 36	Diabetic remission	542
	Ruth Gostelow, BVetMed(Hons), MVetMed, DipACVIM, DipECVIM-CA, PhD	
	Definition of diabetic remission	542
	Physiology of diabetic remission	542
	Incidence of diabetic remission	546
	Predictors of diabetic remission	546
	Maximizing the likelihood of diabetic remission	547
	Identification and management of the diabetic cat in remission	550
	Prognosis and diabetic relapse	551
	Conclusions	552

Chapter 37 The unstable diabetic 556

Jacquie Rand, BVSc, DVSc, Dipl. ACVIM (Internal Medicine)

Susan Gottlieb, BVSc, MANZCVS

Overview	556
Initial goals of therapy and factors that influence remission	557
Classification of diabetes mellitus and relevance to unstable diabetic cats	559
Inappropriate choice of insulin	560
Inappropriate dosing	561
Choice of intensive versus conservative insulin management of newly-diagnosed diabetics	562
Client factors	563
Underlying diseases	566
Rebound hypoglycemia (Somogyi)	569
The brittle diabetic	570
Monitoring	571
Other management strategies	573
Conclusion	574

Chapter 38 Hypoglycemia 579

Johan P. Schoeman, BVSc, MMedVet(Pretoria), PhD(Cantab), DSAM(RCVS-UK), DECVIM-CA, MRCVS

Introduction	579
Pathophysiology of hypoglycemia	579
Blood glucose measurement	580
Differential diagnoses	581
Specific diseases or syndromes associated with hypoglycemia in cats	582
Diagnostic approach	585
Treatment of hypoglycemia	588

SECTION 6 - BLOOD PRESSURE, BODY CONDITION AND NUTRITION 593

Chapter 39 Feline obesity 595

Juan José Ramos-Plá, DVM, PhD

Epidemiology	595
Pathophysiology of obesity	596
Obesity-related diseases	600
Treatment	603

Chapter 40	Disorders of lipid metabolism	609
	Panagiotis G. Xenoulis, DVM, Dr.med.vet., PhD	
	Introduction	609
	The basics of lipoprotein metabolism	609
	Definitions and measurement of feline serum lipid concentrations	612
	Effect of lipemia on the measurement of other analytes	614
	Causes of feline hyperlipidemia	614
	Clinical consequences of hyperlipidemia in cats	616
	Diagnostic approach to cats with hyperlipidemia	618
	Treatment of feline hyperlipidemia	620
Chapter 41	Cachexia and sarcopenia	627
	Lisa M. Freeman, DVM, PhD, DACVN	
	Cachexia	627
	Sarcopenia	627
	Diagnosis of cachexia and sarcopenia	628
	Potential interventions for cachexia and sarcopenia	628
	Practical approach to treatment of cachexia and sarcopenia in cats	630
	Conclusion	632
Chapter 42	Hypertension	633
	Andy H. Sparkes, BVetMed, PhD, DipECVIM, MANZCVS, MRCVS	
	Introduction	633
	Measurement of blood pressure in cats	633
	Defining hypertension and deciding when to treat	638
	Consequences of hypertension	639
	Endocrine causes of hypertension	640
	Management of hypertension	642
Annex	Conversion tables	645
	Conversion to Systeme International (SI) Units	646