Milan Halenka
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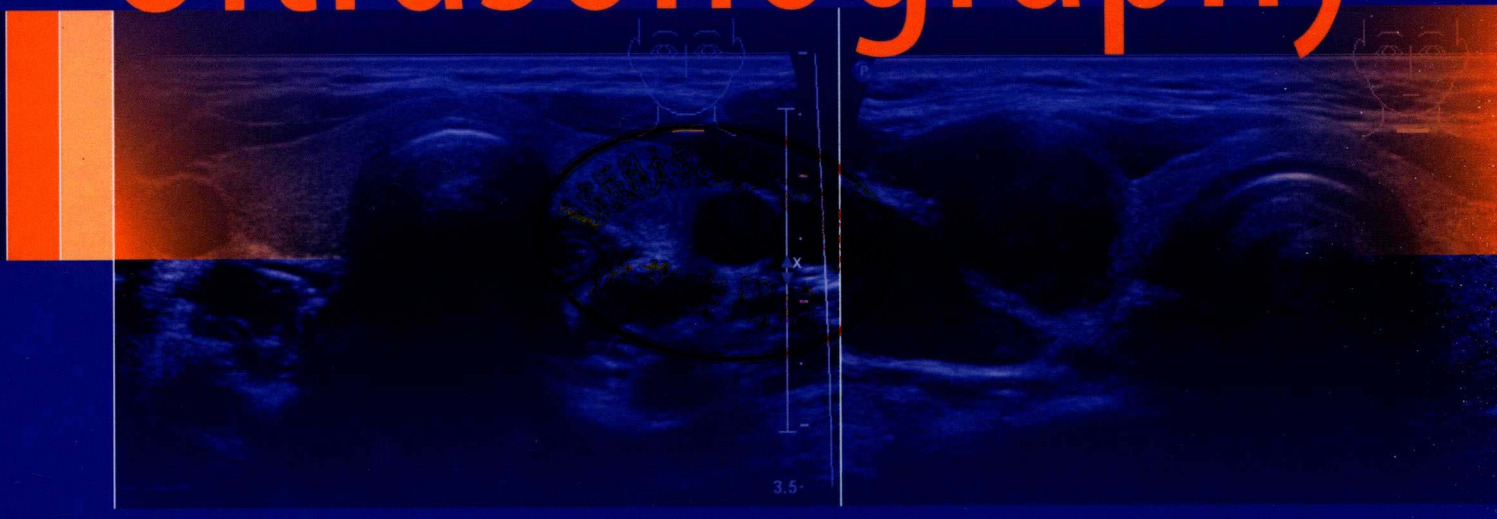
Atlas of Thyroid Ultrasonography



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Preface

Diagnosis and treatment of thyroid gland diseases are a very important part of the everyday clinical work of endocrinologists worldwide. Ultrasonography is an essential part of the clinical practice, and its development has largely broadened our clinical options. High-quality resolution ultrasound devices are now available in most hospitals and diagnostic centers around the globe. Ultrasonography can serve as the first diagnostic tool but the figure may sometimes provide the final diagnosis.

This book not only covers the whole spectrum of thyroid and parathyroid gland diseases but also aims to put them into the perspective of general endocrinology practice, utilizing the authors' own experience from long-term teaching of hospital practice.

This atlas is designed as a figure-based book. The authors hope that it serves its readers as a quick reference for clinical practice, not necessarily only in endocrinology practices but also in radiology practices, as well as other clinicians looking for easy-to-access figure information. Ultrasonography is an "expert-based" method partially dependent on the talent of the examiner but it also significantly depends on one's ability, in the right moment, to recall something already seen. As such, we hope that we can help place "first images" in the minds of beginners, indicating both common and rare ultrasonography appearances. Each disease is therefore depicted several times, in several views, to ease the first steps with ultrasonography.

This atlas is derived from its very successful Czech version, and although it is not the first ultrasonography publication, our everyday practice demonstrates the need for current and precise information.

We encourage our readers to employ a lot of patience at the beginning and wish them a great deal of success in their clinical practice.

Olomouc, Czech Republic — Milan Halenka
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Instructions for Readers

Figure Numbering and Marking

- The atlas is divided into chapters according to specific diagnoses. For each diagnosis there are several case reports in different US views.
- In each chapter the figure number corresponds to a single patient with a specific diagnosis. Letters correspond to different US views/cuts (e.g., whole thyroid gland [TG] *transverse*, detail of right lobe [RL] or left lobe [LL], *transverse* or *longitudinal*), in certain cases with CFDS.
- In the upper-right corner there is a pictogram showing the exact probe location.
- Unless stated otherwise the depth of penetration is 3.5 cm.

Atlas Concept

- Each figure is depicted twice on the same page: on the left side (number and small letters) without marks, on the right side (number and small double letters) with marks showing thyroid gland and the US finding. Figure description is below the right figure.
- This design is meant to allow readers to self-test their knowledge.

Acknowledgments

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This publication would not be possible without the support of the chief of our clinic, Professor Josef Zadrazil, MD, CSc. And our gratitude also goes to Professor Karel Pacak, MD, PhD, DSc, FACE, for encouragement to prepare the English version.

Key: Abbreviations and Symbols in Figures

	*Cross*, used to indicate lobes of thyroid gland (all figures)
	*Arrowhead*, used to indicate main US finding—large node, cyst, carcinoma, parathyroid adenoma
	*Blank arrowhead*, used to indicate main US finding—large lymphatic nodule, parathyroid adenoma
	*Arrow*, used to indicate main and accessory US finding—small nodule, parathyroid adenoma, dense calcification
	*Open arrow*, used to indicate accessory US finding—microcalcification, colloid clot, septum
	*Mark*, used to indicate small lymphatic nodule or small node
TRA	Trachea
CCA	Common carotid artery
IJV	Internal jugular vein
E	Esophagus
NL, nl	Large, small lymphatic nodule
C, c	Large, small cyst
LL, RL	Left Lobe, Right Lobe
PAd	Parathyroid adenoma

List of Abbreviations

AIT	Amiodarone-induced thyrotoxicosis
ASR-W	Age-standardized rate—world
ATA	The American Thyroid Association
ATC	Anaplastic thyroid carcinoma
BCC	Branchial cleft cyst
CCA	Common carotid artery
CFDS	Color flow doppler sonography
CLT	Chronic lymphocytic thyroiditis (=HT—Hashimoto thyroiditis)
CRP	C-Reactive protein
DC	Dermoid cyst
DTC	Differentiated thyroid cancer
DTD	Diffuse thyroid disease
EMP	Extramedullary plasmacytoma
ESR	Erythrocyte sedimentation rate
ETE	Extrathyroidal extension
FLT	Focal lymphocytic thyroiditis
FNAB	Fine-needle aspiration biopsy

FTC	Follicular thyroid carcinoma
FVPTC	Follicular variant of papillary carcinoma
HCC	Hurthle cell carcinoma
HT	Hashimoto´s thyroiditis (=CLT—chronic lymphocytic thyroiditis)
IDD	Iodine deficiency disorders
IJV	Internal jugular vein
ITA	Inferior thyroid artery
LL	Left lobe
LN	Lymph node
L/S	Long-to-short axes ratio
MEN 2A	Multiple endocrine neoplasia 2A
MEN 2B	Multiple endocrine neoplasia 2B
MIVAT	Minimally invasive video-assisted technique
MNG	Multinodular goiter
MTC	Medullary thyroid carcinoma
pHPT	Primary hyperparathyroidism
PAd	Parathyroid adenoma
PCa	Parathyroid carcinoma
PEIT	Percutaneous ethanol injection therapy
PET/CT	Positron emission tomography/computed tomography
PSV	Peak systolic velocity
PTC	Papillary thyroid carcinoma
PTL	Primary thyroid lymphoma
PTMC	Papillary thyroid microcarcinoma
RAIU	Radioactive iodine uptake test
RIT	Radioiodine therapy
RL	Right lobe
sHPT	Secondary hyperparathyroidism
SAC	School age children
SGT	Subacute granulomatous thyroiditis
S/L	Short to long axis ratio
SPECT/CT	Single photon emission tomography/computed tomography
SSG	Substernal goiter
STA	Solitary toxic adenoma
Tg-Ab	Thyroglobulin antibody
TMNG	Toxic multinodular goiter
TPO-Ab	Thyroid peroxidase antibody
TSH	Thyroid-stimulating hormone/thyrotropin
TSHR-Ab	Thyroid-stimulating hormone receptor antibody
TT	Total thyroidectomy
Tvol	Thyroid volume (mL)

Contents

Part I

Normal Thyroid Gland

Normal Ultrasound of Thyroid Gland and Lymph Nodes

1

1.1 Essential Facts

- The thyroid gland is composed of two lobes connected by a median isthmus.
- 40% of all patients have an accessory lobe—the pyramidal lobe, which is more or less developed. It extends from the isthmus toward the hyoid bone, in front of the thyroid cartilage.
- The thyroid lies in front of and on the sides of the trachea. It is bounded posterolateral by the carotid space, and its anterior and lateral aspects are covered by the strap muscles and the sternocleidomastoid muscles. The posterior surfaces of the lobes are adjacent to the perivertebral space and on the left to the esophagus [1].
- A thyroid lobe has the shape of the rotation ellipsoid. Method of Brunn is widely used to calculate thyroid volume (Tvol). Tvol is a sum of the two lobes each calculated according to the following formula: V = width × depth × length × 0.479; or, an optimized correction factor 0.52 can be used [2, 3].
- The contribution of the thyroid isthmus to total gland volume should be ignored [2]. But if the isthmus is >1 cm, its volume should be included [3].
- Caution! Differences in technique (e.g., the pressure applied with the transducer) and in estimation of thyroid anatomy (e.g., inclusion of the thyroid isthmus and estimation of capsule thickness) can produce interobserver errors in Tvol as high as 26% [3].

1.2 US Characteristics of the Thyroid Gland [4]

- The echogenicity: isoechoic, hypoechoic, markedly hypoechoic, and hyperechoic patterns. The strap muscles and submandibular glands were used as a reference for the determination of echogenicity.
- The echotexture: fine, coarse, and micronodulative patterns.
- The glandular vascularity: normal, mildly increased, markedly increased, and decreased patterns.
- The margin of the thyroid: smooth, microlobulated, and macrolobulated patterns.

M. Halenka, Z. Fryšák, *Atlas of Thyroid Ultrasonography*, DOI 10.1007/978-3-319-53759-7_1

1.3 Color Flow Doppler Sonography (CFDS) Pattern [5]

- *Pattern 0* (Fig. 5.1dd): absent intraparenchymal (or nodular) vascularity or minimal spots.
- *Pattern I* (Fig. 1.1bb): presence of parenchymal (or nodular) blood flow with patchy uneven distribution.
- *Pattern II* (Fig. 3.15bb): mild increase of color flow Doppler signal with patchy distribution (for nodules: mainly peripheral).
- *Pattern III* (Fig. 4.1bb): markedly increased color flow Doppler signal with diffuse homogeneous distribution, including the so-called *"thyroid inferno"* [6].

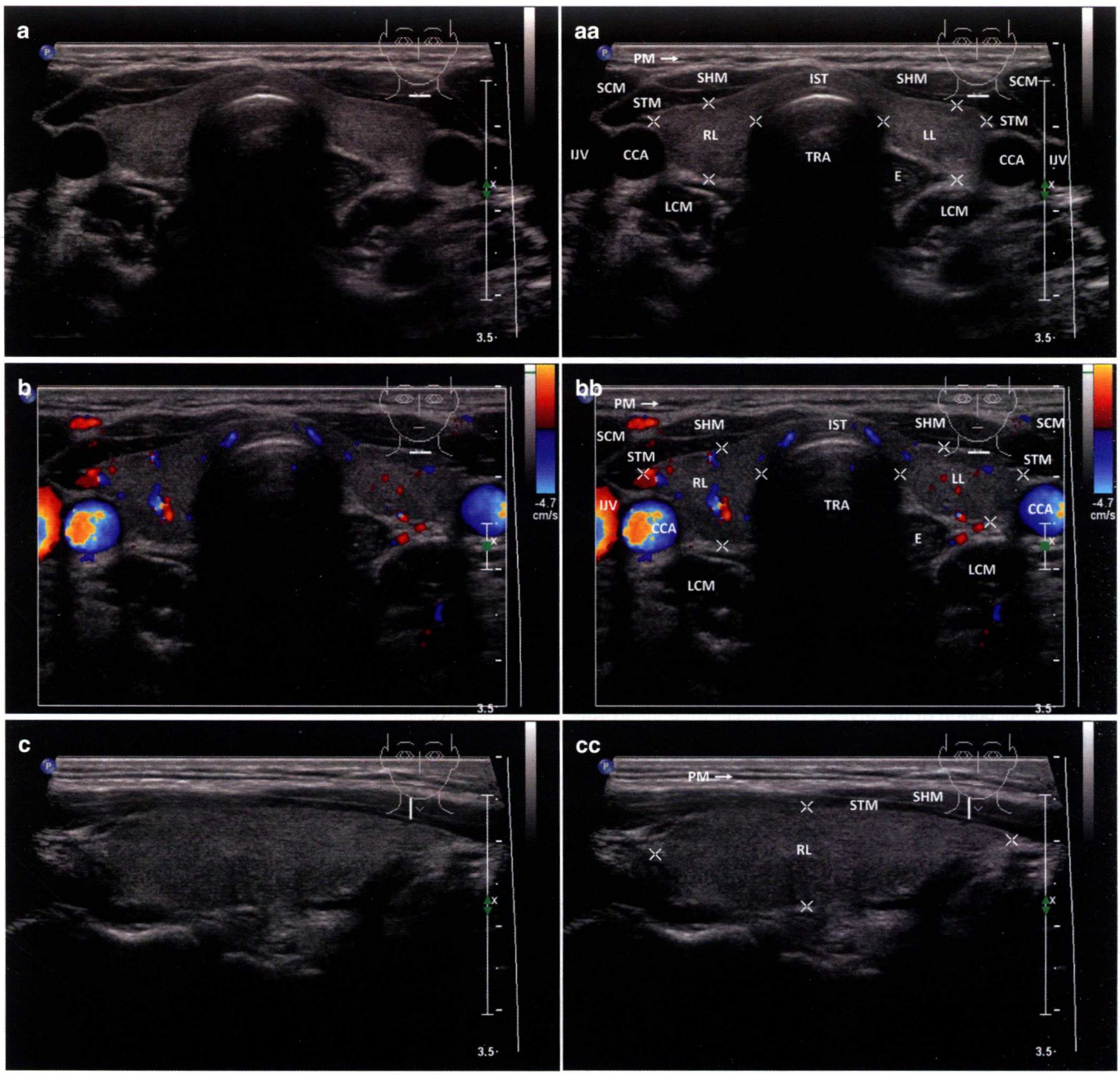

Fig. 1.1 (**aa**) Thyroid gland and surrounding structures: thyroid gland—homogeneous structure; isoechoic. CCA—common carotid artery; E—esophagus; IJV—internal jugular vein; IST—isthmus; LCM—longus coli muscle; LL—left lobe; PM—platysma muscle, RL—right lobe; SCM—sternocleidomastoid muscle; SHM—sternohyoid muscle; STM—sternothyroid muscle; transverse. (**bb**) Thyroid gland and surrounding structures, CFDS: normal parenchymal vascularity, *pattern I*; transverse.(**cc**) Detail of RL: homogeneous structure; isoechoic; longitudinal.(**dd**) Detail of RL, CFDS: normal parenchymal vascularity, *pattern I*; longitudinal. (**ee**) Detail of LL: homogeneous structure; isoechoic; longitudinal. (**ff**) Detail of LL, CFDS: normal parenchymal vascularity, *pattern I*; longitudinal