MyNM Conference 2018
Malaysian Society Of Nuclear Medicine & Molecular Imaging (MSNMMI)
27 – 29 September 2018 | SWAN CONVENTION CENTRE, SUNWAY MEDICAL CENTRE

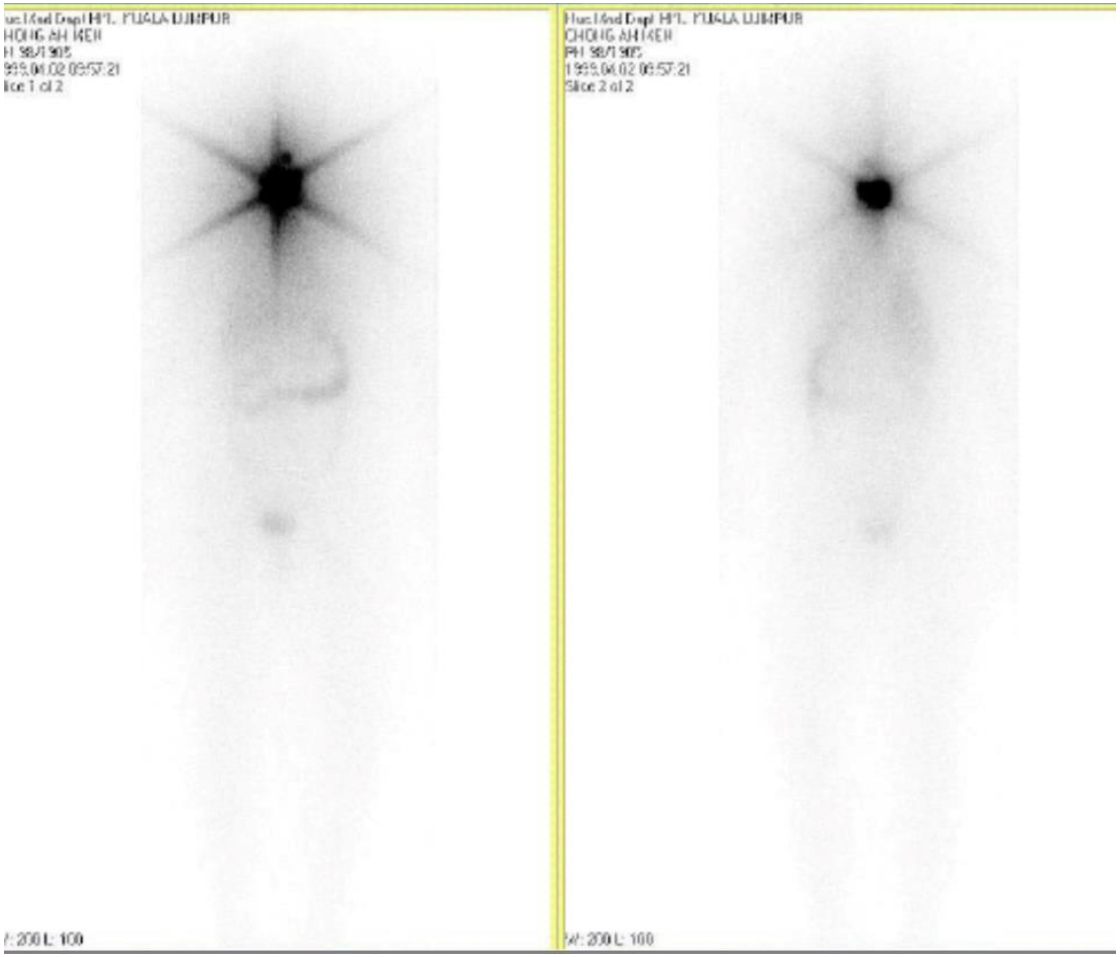
Updates in Radioactive Ablation for Well Differentiated Thyroid Cancer

Dr Zool Hilmi Bin Awang
Nuclear Medicine Physician
Fellowship in Theranostic Nuclear Medicine (Germany)
National Cancer Institute
Putrajaya

Thank you Prof Ahmadzadehfar Hojjat, Bonn, Germany 2017

From Zool Hilmi b Awang

Malaysia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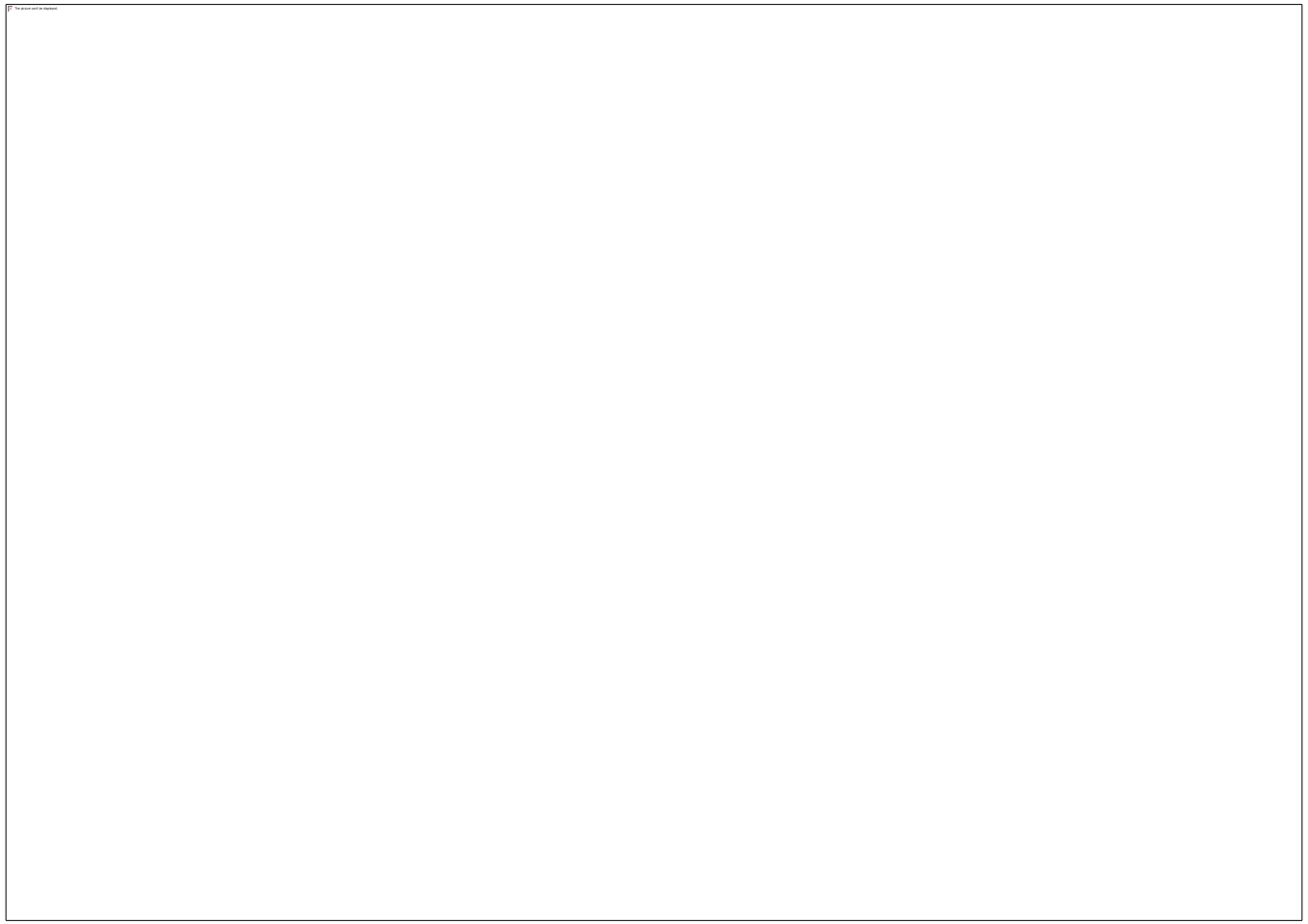
RELEVANT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GOAL


Benefits

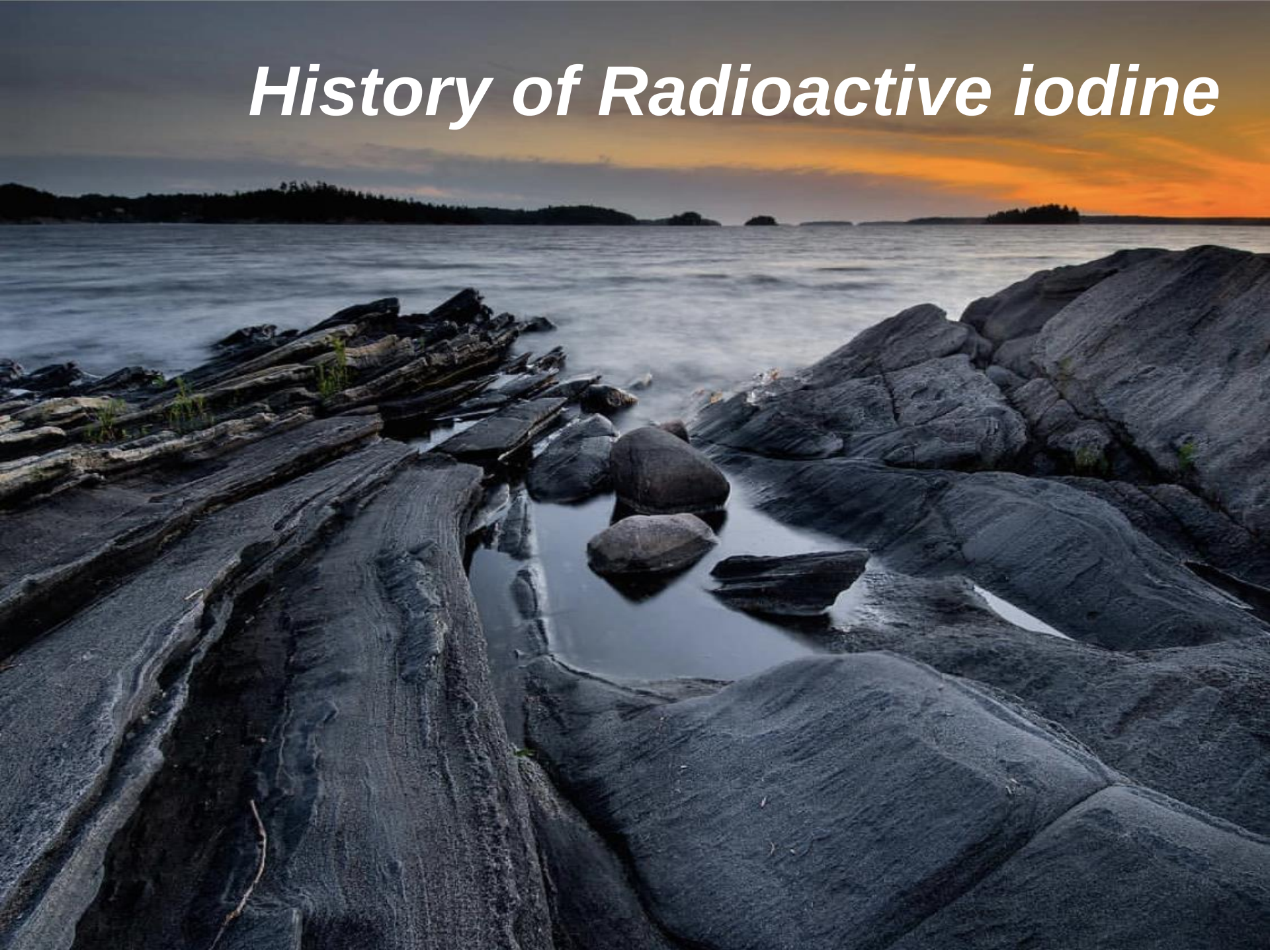
2015 American Thyroid Association Management Guidelines for Adult Patients with Thyroid Nodules and Differentiated Thyroid Cancer

The American Thyroid Association Guidelines Task Force on Thyroid Nodules and Differentiated Thyroid Cancer

Bryan R. Haugen,[1,*] Erik K. Alexander,[2] Keith C. Bible,[3] Gerard M. Doherty,[4] Susan J. Mandel,[5] Yuri E. Nikiforov,[6] Furio Pacini,[7] Gregory W. Randolph,[8] Anna M. Sawka,[9] Martin Schlumberger,[10] Kathryn G. Schuff,[11] Steven I. Sherman,[12] Julie Ann Sosa,[13] David L. Steward,[14] R. Michael Tuttle,[15] and Leonard Wartofsky[16]


ONE-SIZE FITS ALL
STORE
SALE

History of Radioactive iodine



RADIOACTIVE IODINE IN THE STUDY OF THYROID PHYSIOLOGY

VII. The Use of Radioactive Iodine Therapy in Hyperthyroidism

SAUL HERTZ, M.D.
Boston
and
ARTHUR ROBERTS, Ph.D.
Cambridge, Mass.

In previously published experiments of this series [1] radioactive iodine was used as an indicator in the study of animal and human thyroid physiology and iodine metabolism. Much of this preliminary work was done with a view to the discovery of the conditions under which radioactive iodine might be administered with maximum radiational effect in the pathologic thyroid of patients ill with hyperthyroidism. The present paper is a progress report on our early experiences (1941-1946) with such "internal irradiation" in the treatment of 29 cases of hyperthyroidism. It is, indeed, a three to five year follow-up report on these cases.

PROCEDURE

Patients were selected who had had no previous iodine treatment and who were judged clinically to have hyperthyroidism. The usual clinical tests were made and the patients were presented to the Thyroid Clinic of the Massachusetts General Hospital for discussion and determination of their suitability for this type of treatment. In each instance a dose of radioactive iodine, which had been made by the cyclotron at the Massachusetts Institute of Technology or by the Harvard University cyclotron, and separated chemically as sodium iodide, was then orally administered.

The samples of radioactive iodine used were obtained by deuteron bombardment of tellurium and at the time of administration consisted of a mixture of different radioactive isotopes of iodine. Over 90 per cent of the activity at this time consisted of the 12.6 hour isotope I^{130} and most of the remainder of the 8 day isotope I^{131}. The total activity administered varied between 0.7 and 28 millicuries. In 19 cases the total dose was administered to the individual patients as one dose; in 10 cases divided dosages were employed.

From the data already obtained from tracer studies it was considered desirable to keep the total amount of iodide administered below 2 mg. of iodine in order to insure maximum collection by the thyroid.

Urinary iodine excretion was determined during the first seventy-two hours after the administration of radioiodine. An indirect estimate of the thyroid retention of radioactive iodine was thereby obtained, since an approximate balance exists between administered iodine on the one hand and the sum of thyroid iodine retention and urinary excretion on the other.

Urinary studies were carried out on aliquot portions of carefully collected twenty-four hour specimens, which were kept iced and corked during the collection periods.

It was early found [2] that significant amounts of the original dose were to be found only in the first three days' specimens. Fecal excretion was tested and was found to be so low as to be negligible for the purpose of these experiments.

In a few cases external gamma ray counter measurements were made of the activity of the thyroid of patients following the administration of radioactive iodine. Such measurements are difficult, for obvious reasons, to evaluate quantitatively. However, day to day measurements of this type can give good data on the variation of thyroid iodine content. They were performed in order to follow the loss of iodine from the thyroid following the initial uptake and to evaluate the effect of routine iodinization following the administration of radioactive iodine.

External counter measurements were roughly calibrated against actual direct measurements on the thyroid glands at operation and after chemical separation [3] in 2 patients, previously scheduled for surgery, who received therapeutic amounts of radioactive iodine.

Following the administration of radioactive iodine, routine iodine (nonradioactive) in the usual dosage of saturated solution of potassium iodide 5 minims (0.3 cc.) twice a day was begun at periods varying from one day to several weeks after the radioactive iodine dose.

The basal metabolic rate of the patients treated was tested frequently both before and after the radioactive iodine administration. Basal metabolic levels were taken prior to treatment to establish a measure of the degree of thyrotoxicosis present. In addition to the basal metabolic rate, weights, pulse rates and physical findings were recorded and the total clinical picture was used to evaluate the effects of treatment. No adverse effects, such as fever, nausea or irradiation sickness,

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A report to March 15, 1946.

From the Thyroid Clinic and Metabolism Laboratory of the Massachusetts General Hospital and the Radioactivity Center, Massachusetts Institute of Technology. This material was presented in part to the American Society for Clinical Investigation in May 1942 (see abstract of proceedings, Physiol. Rev. **62**: 4, 1942). The work was aided by a grant from the John and Mary R. Markle Fund in the names of Professors

Figure 1. Samuel M. Seidlin, M. D. (1895-1955)

CANCER BIOTHERAPY & RADIOPHARMACEUTICALS
Volume 14, Number 2, 1999
Mary Ann Liebert, Inc.

Historical Vignette

The Beginnings of Radioiodine Therapy of Metastatic Thyroid Carcinoma: A Memoir of Samuel M. Seidlin, M. D. (1895-1955) and His Celebrated Patient

Edward Siegel
Adjunct Professor, Department of Radiology, University of Califiornia, San Francisco, San Francisco, CA

SUMMATION

Emerging from a stimulating encounter over fifty years ago between Dr. S. M. Seidlin and a celebrated patient at Montefiore Hospital in New York City are a number of findings that bear significantly on the contemporary practice of medicine relating to targeted radioisotope therapy. In 1943, Seidlin administered radioiodine to this patient, who was hyperthyroid although previously thyroidectomized, but who had several metastases from adenocarcinoma of the thyroid which localized the radioisotope. Seidlin recognized early that some thyroid metastases would take up radioiodine (i.e., function), but only after the normal thyroid gland was ablated, an essential preliminary procedure before radioiodine therapy should be administered, the clinical practice followed to this day, He held that removing the normal thyroid increased TSH production and eliminated the gland's competition for radioiodine, inducing the metastatases to function. From 1942 until his death in 1955, Seidlin and his group followed many patients having metastatic thyroid carcinoma, conducting fruitful investigations concerned with the induction of function, dosimetry, and the occurrence of leukemia in some massively treated patients.

STORAGE OF RADIOACTIVE IODINE IN A METASTASIS FROM THYROID CARCINOMA

By ALBERT S. KESTON, ROBERT P. BALL, V. KNEELAND FRANTZ, WALTER W. PALMER

+ See all authors and affiliations

Science 03 Apr 1942:
Vol. 95, Issue 2466, pp. 362-363
DOI: 10.1126/science.95.2466.362

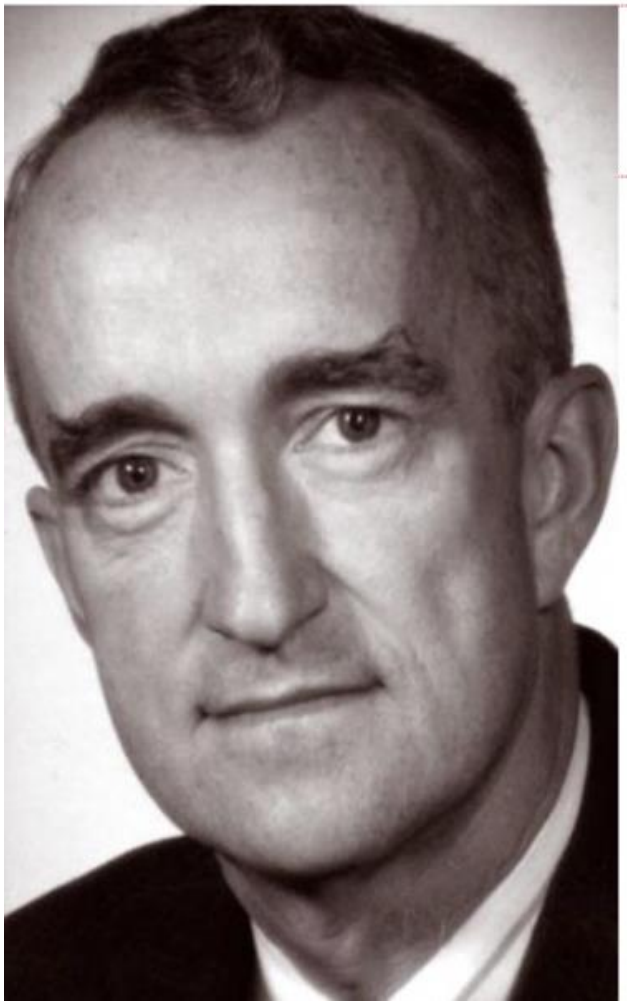
STORAGE OF RADIOACTIVE IODINE IN A METASTASIS FROM THYROID CARCINOMA[1]

A PATIENT with metastatic thyroid carcinoma was studied from the standpoint of storage of radioactive iodine. The carcinoma was of the adenoma malignum type with widespread bone metastases showing colloid follicles, and with no evidence of recurrence of the primary growth removed thirty-five years previously from the thyroid.

A tracer dose of radioactive iodine was given by mouth, and field plots of its distribution were determined by means of a Geiger-Müller counter. The Geiger counts indicated that more of the radioactive substance had been taken up by a metastasis in the right lower femur than by the thyroid gland itself. Other metastases, which, as a therapeutic measure, had been irradiated previously with deep x-ray, failed to take up the radioactive iodine in appreciable amount. The material present in the femoral metastasis and in the thyroid gland could not be washed out of these tissues by the administration of 54 mgm of potassium iodide, which indicates that the radioactive iodine was fixed in both these tissues.

The possibility of the use of radioactive iodine as a therapeutic agent was suggested because the meta-

[1] From the Departments of Biochemistry, Medicine, Radiology and Surgery, College of Physicians and Surgeons, Columbia University. This investigation was aided by a grant from the Josiah Macy, Jr. Foundation.



WILLIAM H. BEIERWALTES

Years at Michigan: 1944 - 1987

Medicine

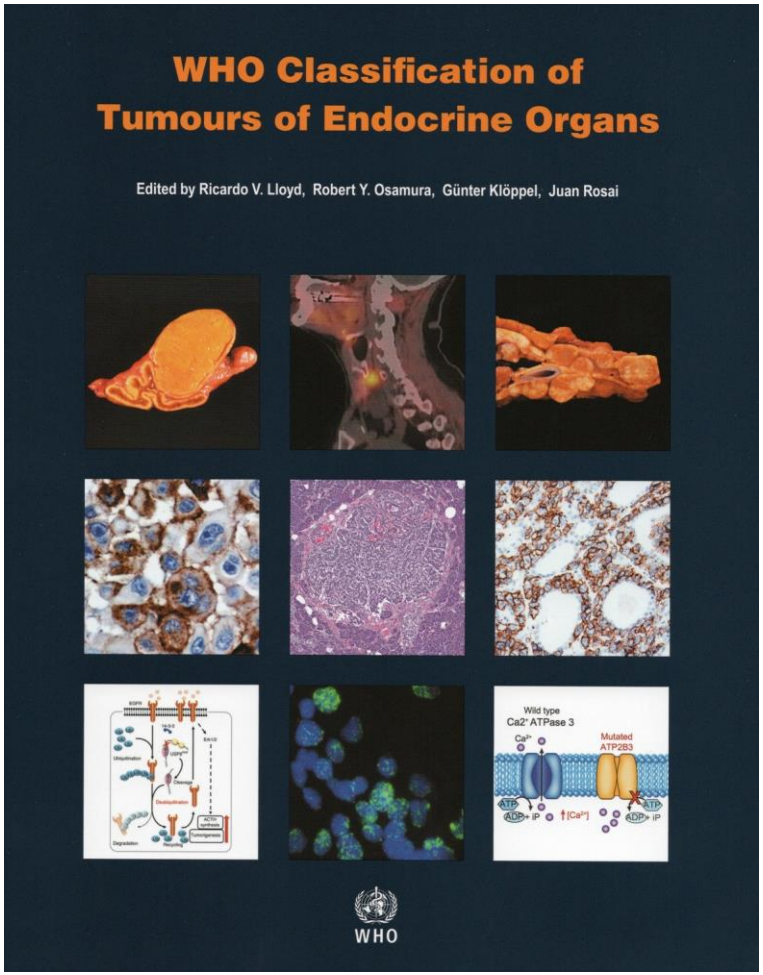
| Internal Medicine |

Professor of Internal Medicine

Chair Division of Nuclear Medicine

Professor Emeritus

"There is no question... we should ablate normal thyroid as part of the treatment of differentiated thyroid carcinoma"

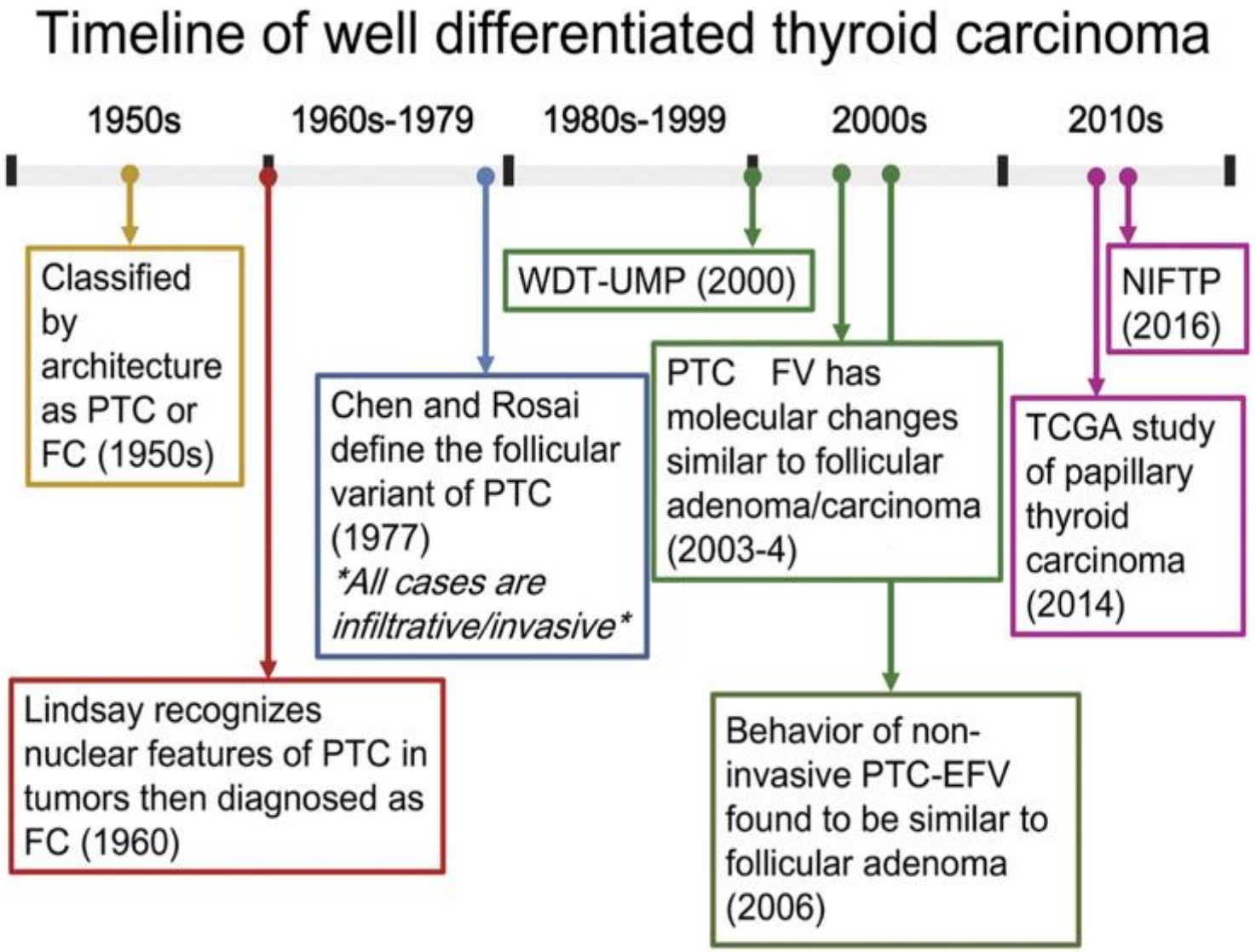


PATHOLOGIC DEFINITION

AJSP: Reviews & Reports • Volume 22, Number 4, July/August 2017

Pathology of Endocrine Tumors Update: World Health Organization New Classification 2017—Other Thyroid Tumors

Epithelial tumors
Follicular cell neoplasms
Benign follicular tumors Follicular adenoma Hyalinizing trabecular tumors Hurthle cell adenoma Borderline follicular tumors/encapsulated or well circumscribed follicular pattern tumors with well develop or equivocal nuclear features of PTC FT-UMP WDT-UMP NIFTP Carcinoma Papillary carcinoma Follicular carcinoma Hurthle carcinoma Poorly differentiated carcinoma Anaplastic (undifferentiated) carcinoma Squamous cell carcinoma



From: The History of the Follicular Variant of Papillary Thyroid Carcinoma
J Clin Endocrinol Metab. 2016;102(1):15-22. doi:10.1210/jc.2016-2976
J Clin Endocrinol Metab | Copyright © 2017 by the Endocrine Society

AJSP: Reviews & Reports • Volume 22, Number 4, July/August 2017

Pathology of Endocrine Tumors Update: World Health Organization New Classification 2017—Other Thyroid Tumors

Variants of Papillary Thyroid Carcinoma
Conventional/classic
Papillary microcarcinoma
Encapsulated
Follicular
Defused sclerosing
Tall cell
Columnar cell
Cribriform-morular
Hobnail
Oncocytic
Spindle cell
Clear cell variant
Warthin like variant
Solid/trabecular variant
Papillary thyroid carcinoma with fibromatosis fasciitis-like stroma

Goals of Initial Therapy of DTC

- Improve overall survival.

- Improve overall survival.
- Reduce recurrent and morbidity.

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- Staging and risk stratification.

- Improve overall survival.
- Reduce recurrent and morbidity.
- Staging and risk stratification.
- Reduce treatment-related morbidity and unnecessary therapy.

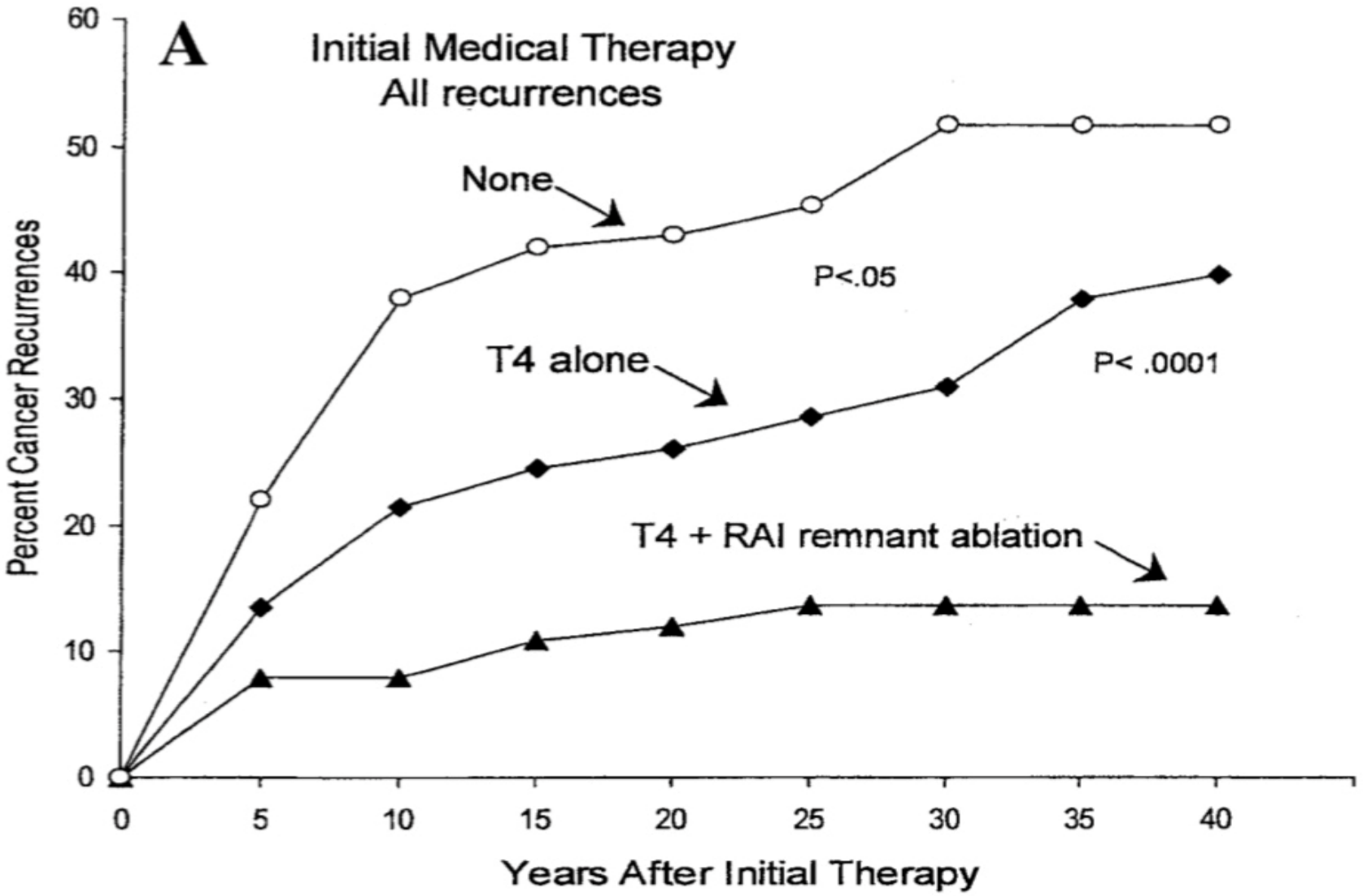
2015 American Thyroid Association Management Guidelines for Adult Patients with Thyroid Nodules and Differentiated Thyroid Cancer

The American Thyroid Association Guidelines Task Force on Thyroid Nodules and Differentiated Thyroid Cancer

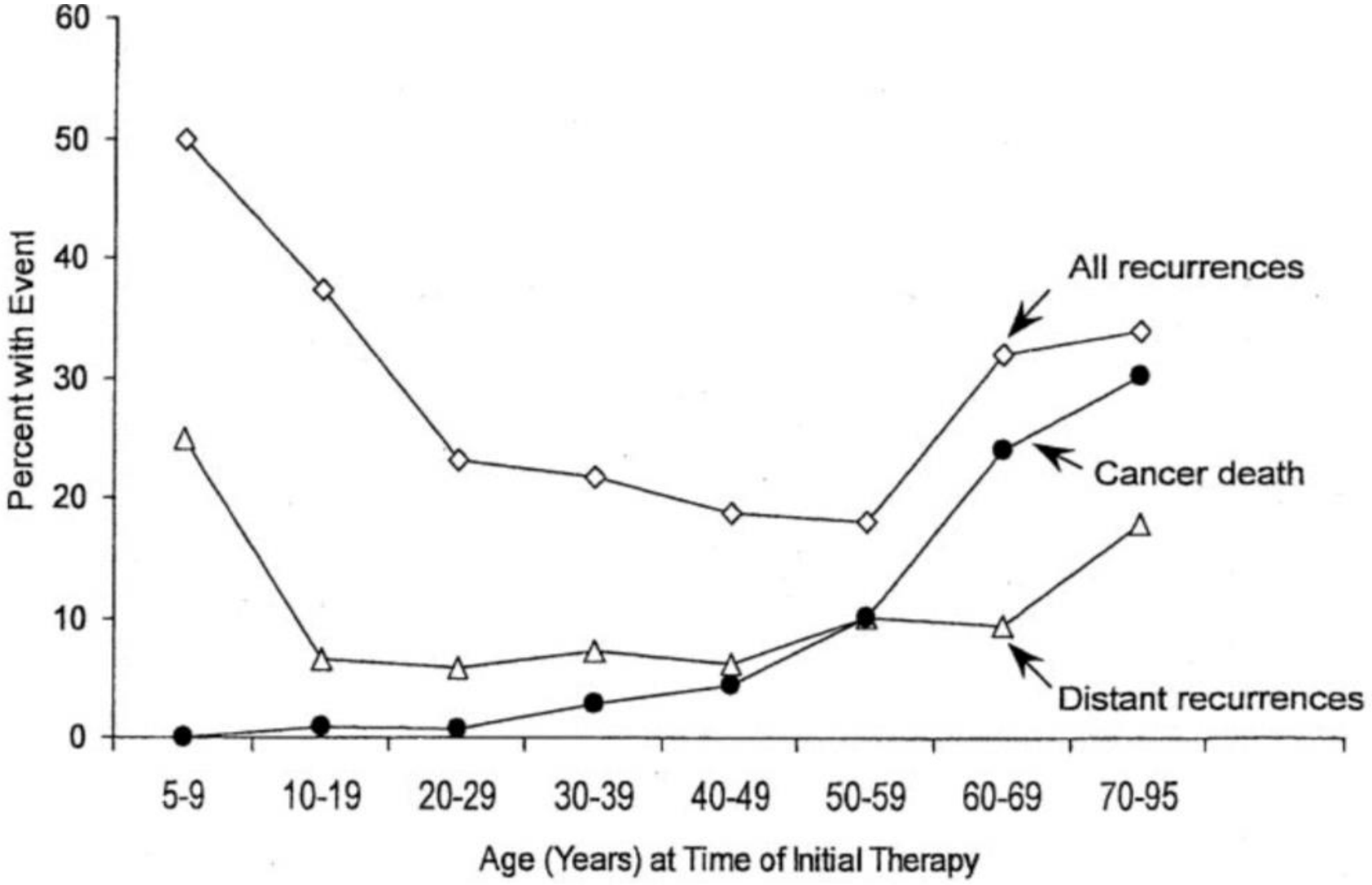
Bryan R. Haugen,[1,*] Erik K. Alexander,[2] Keith C. Bible,[3] Gerard M. Doherty,[4] Susan J. Mandel,[5] Yuri E. Nikiforov,[6] Furio Pacini,[7] Gregory W. Randolph,[8] Anna M. Sawka,[9] Martin Schlumberger,[10] Kathryn G. Schuff,[11] Steven I. Sherman,[12] Julie Ann Sosa,[13] David L. Steward,[14] R. Michael Tuttle,[15] and Leonard Wartofsky[16]

1. Remove the primary tumor, disease that has extended beyond the thyroid capsule, and clinically significant lymph node metastases. Completeness of surgical resection is an important determinant of outcome, while residual metastatic lymph nodes represent the most common site of disease persistence/recurrence (270–272).
2. Minimize the risk of disease recurrence and metastatic spread. Adequate surgery is the most important treatment variable influencing prognosis, while RAI treatment, TSH suppression, and other treatments each play adjunctive roles in at least some patients (273–275).
3. Facilitate postoperative treatment with RAI, where appropriate. For patients undergoing RAI remnant ablation, or RAI treatment of presumed (adjuvant therapy) or known (therapy) residual or metastatic disease, removal of all normal thyroid tissue is an important element of initial surgery (276).
4. Permit accurate staging and risk stratification of the disease. Because disease staging and risk stratification should be used to guide initial prognostication, disease management, and follow-up strategies, accurate postoperative risk assessment is a crucial element in the management of patients with DTC (277,278).
5. Permit accurate long-term surveillance for disease recurrence.
6. Minimize treatment-related morbidity. The extent of surgery and the experience of the surgeon both play important roles in determining the risk of surgical complications (232,233,279,280).


Benefits of Radioactive Iodine



Mezzaferri et al. Journal of Clinical End & Met 2001



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RAI	Function
Metastatic disease	Probable residual tumours based on histopathological evidence of positive margins, extra-thyroidal extensions or involvement of tumours in resected lymph nodes

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Adjuvant therapy	Based on assumption of occult tumours based on assessment of risk factors

RAI	Function
Metastatic disease	Probable residual tumours based on histopathological evidence of positive margins, extra-thyroidal extensions or involvement of tumours in resected lymph nodes
Adjuvant therapy	Based on assumption of occult tumours based on assessment of risk factors
Remnant ablation	Improve sensitivity to radioactive iodine, to detect and destroy recurrence of the disease

RAI	***Dosage***
Residual thyroid beds	80-100 mCi (3 – 3.7 GBq)

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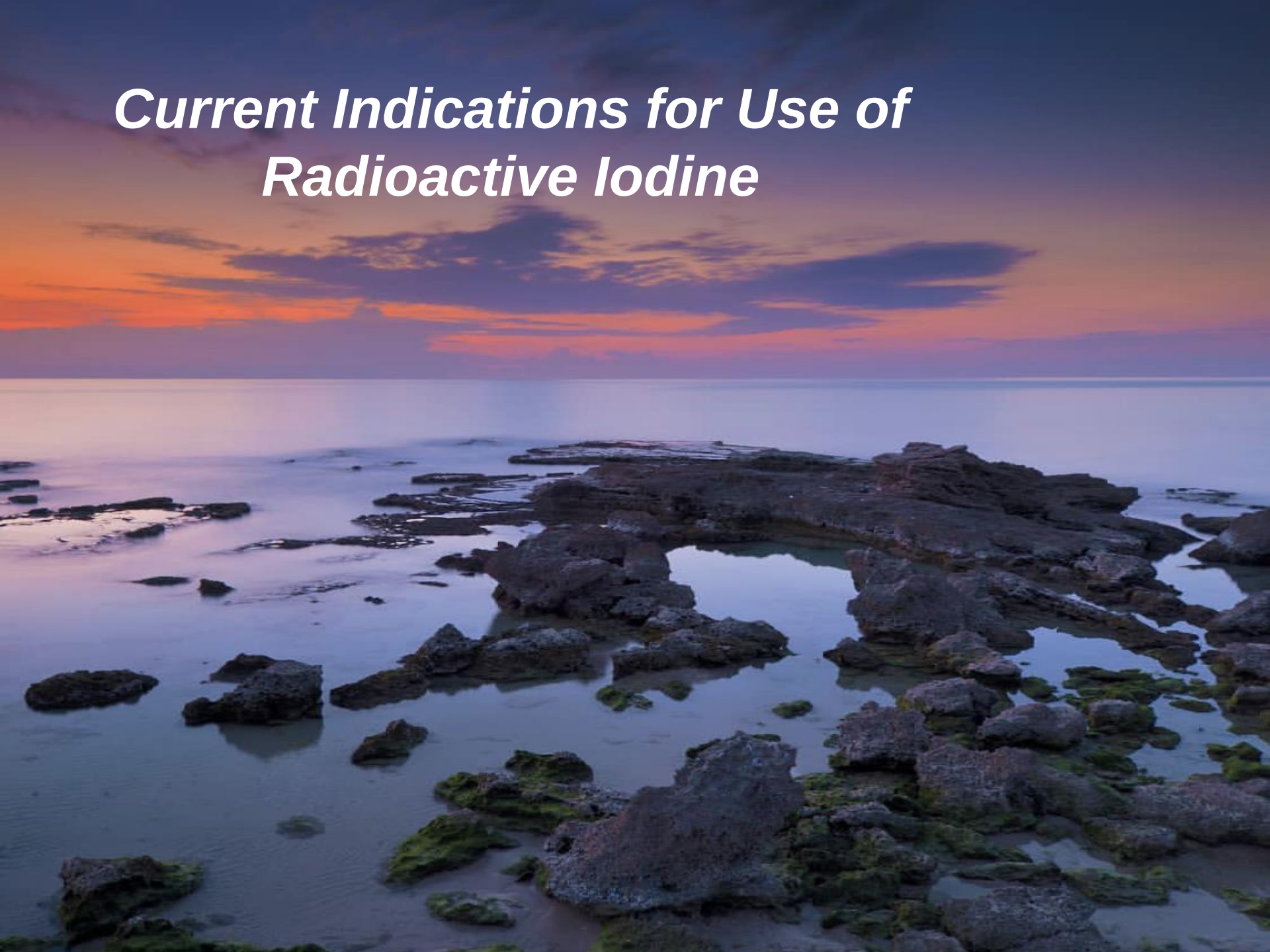
Regional metastases	120 mCi (4.4 GBq)

RAI	***Dosage***
Residual thyroid beds	80-100 mCi (3 – 3.7 GBq)
Regional metastases	120 mCi (4.4 GBq)
Lung and skeletal metastases	150 mCi (5.5 GBq)



Current Indications for Use of Radioactive Iodine

Role of RAI	Function	2009 ATA recommended dosage	2015 ATA recommended dosage
Remnant ablation	Ablate residual thyroid tissue to facilitate surveillance	30-100 mCi	30 mCi

ATA, American Thyroid Association*

Role of RAI	Function	2009 ATA recommended dosage	2015 ATA recommended dosage
Remnant ablation	Ablate residual thyroid tissue to facilitate surveillance	30-100 mCi	30 mCi
Adjuvant therapy	Ablate microscopic thyroid cancer tissue to decrease recurrence risk	100-200 mCi	30-150 mCi

ATA, American Thyroid Association*

Role of RAI	Function	2009 ATA recommended dosage	2015 ATA recommended dosage
Remnant ablation	Ablate residual thyroid tissue to facilitate surveillance	30-100 mCi	30 mCi
Adjuvant therapy	Ablate microscopic thyroid cancer tissue to decrease recurrence risk	100-200 mCi	30-150 mCi
Therapy	Ablate known locoregional or metastatic thyroid cancer to eradicate or control disease	100-200 mCi (empiric dosing) or determine by dosimetry. Repeat RAI therapy by 6-12 months as long as disease concentrates RAI and response clinically*	100-200 mCi (empiric dosing) or determine by dosimetry. Repeat RAI therapy by 6-12 months as long as disease concentrates RAI and response clinically*

ATA, American Thyroid Association*

Outcome after ablation in patients with low-risk thyroid cancer (ESTIMABL1): 5-year follow-up results of a randomised, phase 3, equivalence trial

Martin Schlumberger, Sophie Leboulleux, Bogdan Catargi, Desiree Deandreis, Slimane Zerdoud, Stephane Bardet, Daniela Rusu, Yann Godbert, Camille Buffet, Claire Schvartz, Pierre Vera, Olivier Morel, Danielle Benisvy, Claire Bournaud, Marie-Elisabeth Toubert, Antony Kelly, Ellen Benhamou, Isabelle Borget

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ELSEVIER

Contents lists available at SciVerse ScienceDirect

Clinical Oncology

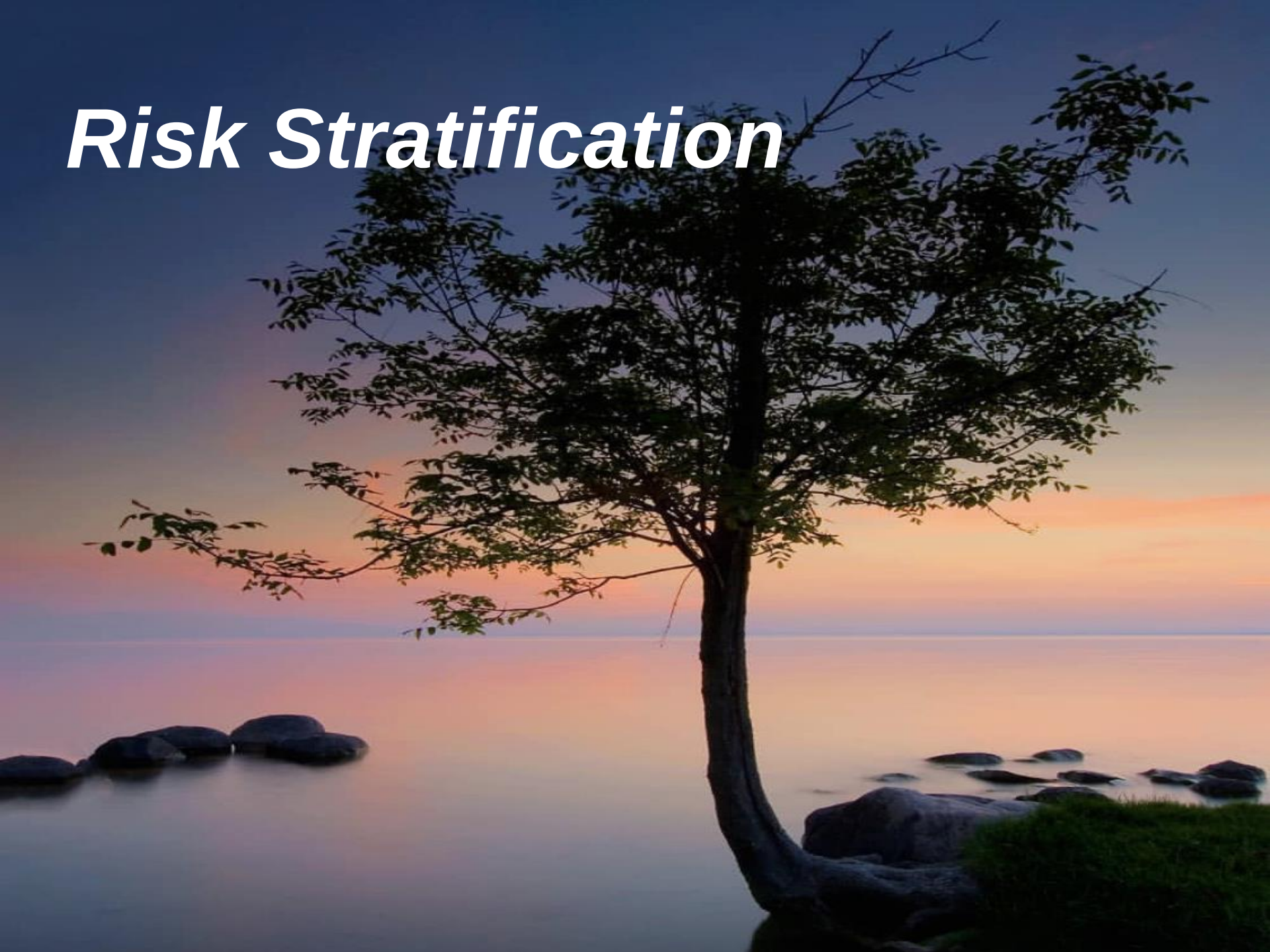
journal homepage: www.clinicaloncologyonline.net

Editorial

Iodine or Not (IoN) for Low-risk Differentiated Thyroid Cancer: The Next UK National Cancer Research Network Randomised Trial following HiLo

U. Mallick [*], C. Harmer [†], A. Hackshaw [‡], L. Moss [§] on behalf of the IoN Trial Management Group

[*] *Northern Centre for Cancer Care, Freeman Hospital, Newcastle Upon Tyne, UK*
[†] *Former Head of Thyroid Unit, Royal Marsden Hospital, London & Sutton, UK*
[‡] *Cancer Research UK & UCL Cancer Trials Centre, Cancer Institute, University College London, London, UK*
[§] *Velindre Cancer Centre, Cardiff, UK*


Risk Stratification

Risk category	2009 ATA Guidelines	2015 ATA Guidelines additional	2015 RAI recommendation	% NED after TT/RAI
Low risk	No local or distant metastasis	Clinical N0	Not routinely recommended	78-86%
	No microscopic tumor remaining	≤ 5 pathologic N1 micrometastases (< 2mm in size)		
	No ETE	Intrathyroidal encapsulated Follicular variant of PTC		
	No vascular invasion	Intrathyroidal FTC with capsular invasion and minimal vascular invasion (< 4 foci)		
	Non aggressive histology	Intrathyroidal papillary microcarcinoma, unifocal or multifocal, including BRAF mutation		
	If RAI given, no RAI avid metastatic foci outside the thyroid bed on the post treatment WBS			

ATA, American Thyroid Association, ETE, extra thyroidal extension, TT, total thyroidectomy, NED, no evidence of disease, PTC, papillary thyroid carcinoma, FTC, follicular thyroid carcinoma, RAI, radioactive iodine

Risk category	2009 ATA Guidelines	2015 ATA Guidelines additional	2015 RAI recommendation	% NED after TT/RAI
Intermediate risk	Minimal ETE	Clinically N1	Can be considered	52-63%
	RAI metastatic avid foci in neck in 1st post treatment WBS	> 5 pathologic N1 (all involve LN < 3mm in size)		
	Aggressive histology (tall cell, columnar)	Multifocal papillary microcarcinoma with ETE and BRAF mutation		
	PTC with vascular invasion			

ATA, American Thyroid Association, ETE, extra thyroidal extension, TT, total thyroidectomy, NED, no evidence of disease, PTC, papillary thyroid carcinoma, FTC, follicular thyroid carcinoma, RAI, radioactive iodine

Risk category	2009 ATA Guidelines	2015 ATA Guidelines additional	2015 RAI recommendation	% NED after TT/RAI
High risk	Gross ETE	Pathologic N1 with LN ≥ 3cm in size	Routinely recommended	14-31%
	Incomplete tumor resection	FTC with extensive vascular invasion (> 4 foci)		
	Distant metastases			
	Post operative TG suggestive of distant metastases			

ATA, American Thyroid Association, ETE, extra thyroidal extension, TT, total thyroidectomy, NED, no evidence of disease, PTC, papillary thyroid carcinoma, FTC, follicular thyroid carcinoma, RAI, radioactive iodine

7th edition	Age < 45 years			8th edition	Age < 55 years		
I	Any T	Any N	M0	I	Any T	Any N	M0
II	Any T	Any N	M1	II	Any T	Any N	M1
7th edition	**Age ≥ 45 years**			**8th edition**	**Age ≥ 55 years**		
I	T1a/b	N0	M0	I	T1a/b T2	N0/NX N0/NX	M0 M0
II	T2	N0	MO	II	T1a/b T2 T3a/b	N1a/b N1a/b Any N	M0 M0 M0
III	T1a/b T2 T3	N1a N1a N0/N1a	M0 M0 M0	III	T4a	Any N	M0
IVa	T1a/b T2 T3 T4a	N1b N1b N1b N0/N1a/N1b	M0 M0 M0 M0	IVa	T4b	Any N	M0
IVb	T4b	Any N	M0	IVb	Any T	Any N	M1
IVc	Any T	Any T	M1	-	-	-	-

Lamartina et al, F1000 Research, 2018

	Distant Mets	Gross ETE present?	Tumor size	LN status	Stage
< 55 yrs old	No	Any	Any	Any	I
	Yes	Any	Any	Any	II
≥ 55 yrs old	No	No	< 4 cm (T1-2) ± Micro ETE	N0/Nx	I
				N1a/N1b	II
			> 4 cm (T3a)	N0/Nx/N1a/N1b	II
		Only strap muscle (T3b)	Any	Any	II
		Subq/larynx/thrachea/esophagus/PLN (T4a)	Any	Any	III
		Prevertebral fascia/ encasing major vessels (T4b)	Any	Any	IVA
	Yes	Yes	Any	Any	IVB

Tuttle et al, Thyroid, 2017

7th edition	8th edition
Tumor	
T1a : Tumor ≤ 1 cm limited to the thyroid	T1a : Tumor ≤ 1 cm limited to the thyroid
T1b : Tumor > 1 cm but ≤ 2 cm limited to the thyroid	T1b : Tumor > 1 cm but ≤ 2 cm limited to the thyroid
T2 : Tumor > 2 cm but ≤ 4 cm limited to the thyroid	T1b : Tumor > 2 cm but ≤ 4 cm limited to the thyroid
T3 : Tumor > 4 cm but limited to the thyroid or minimal extrathyroidal extension (perithyroidal soft tissue or sternothyroid muscle) from a tumor of any size	T3a : Tumor > 4 cm limited to the thyroid T3b :gross extrathyroidal extension invading strep muscles (sternohyoid, sternothyroid, thyrothyroid, omohyoid) from a tumor of any size
T4a : gross extrathyroidal extension invading subcutaneous soft tissue, larynx, trachea, esophagus or recurrent laryngeal nerve from a tumor of any size	T4a : gross extrathyroidal extension invading subcutaneous soft tissue, larynx, trachea, esophagus or recurrent laryngeal nerve from a tumor of any size
T4b : gross extrathyroidal extension invading prevertebral fascia or encasing the carotid artery or mediastinal vessels from a tumor of any size	T4b : gross extrathyroidal extension invading prevertebral fascia or encasing the carotid artery or mediastinal vessels from a tumor of any size

Lamartina et al, F1000 Research, 2018

Age at diagnosis cut off rise

- Previous 45 years , current 55 years old

Older patients

- Minor extrathyroidal extension no longer mandate stage III
- Lymph node metastases no longer mandate stage III/IV

Many patients will be re-classified into lower prognostic stages

Tuttle et al, Thyroid, 2017


Thyroglobulin Levels for Radioactive Iodine
Decision-making and Surveillance

Risk category	2009 ATA Guidelines	2015 ATA Guidelines		
		Excellent to intermediate response to therapy	Biochemical incomplete response to therapy	Structural incomplete response to therapy
Low risk	0.1-0.5 mU/L	0.5-2.0 mU/L	0.5-1.0 mU/L	< 0.1 mU/L
Intermediate risk	< 0.1 mU/L	0.5-2.0 mU/L	0.5-1.0 mU/L	< 0.1 mU/L
High risk	< 0.1 mU/L	0.1-0.5 mU/L	0.5-1.0 mU/L	< 0.1 mU/L

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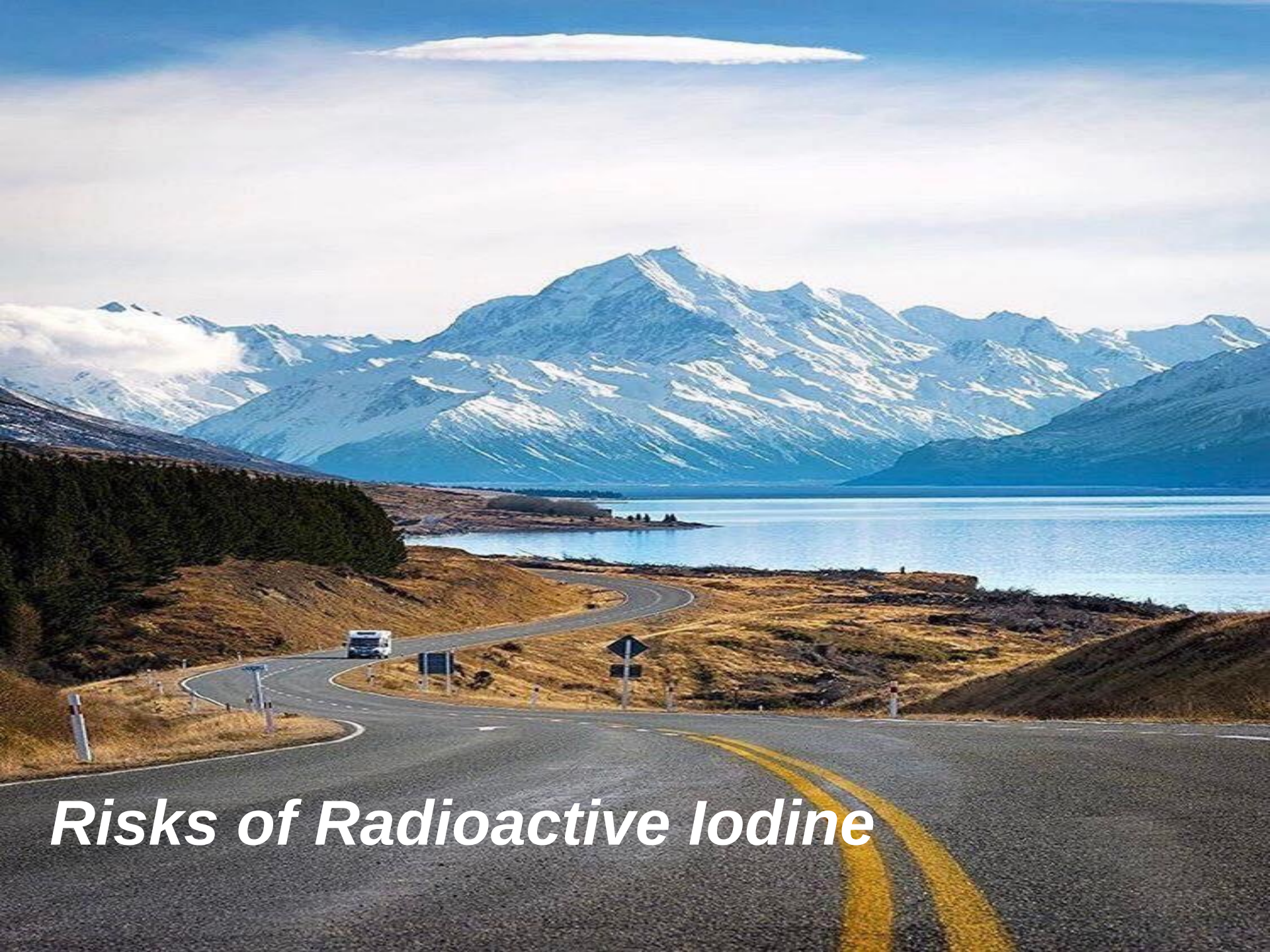
Intermediate risk	< 0.1 mU/L	0.5-2.0 mU/L	0.5-1.0 mU/L	< 0.1 mU/L
High risk	< 0.1 mU/L	0.1-0.5 mU/L	0.5-1.0 mU/L	< 0.1 mU/L


Risks of Radioactive Iodine

Toxicity	Latency	30-50mCi	100 mCi	> 100 mCi
Nausea	Acute	4%	13%	
Neck pain		7%	17%	
Lacrimal dysfunction		8-20%	10-24%	
Salivary dysfunction		6-13%	5-16%	
Altered taste		0%	6%	
Altered smell		0%	2%	
Infertility (male)	Subacute			Transient decrease of FSH and reduce sperm motility
Infertility (female)	Late			Lower birth rate in women 35-39 years
Sialoadenitis				2-67%
Nasolacrimal duct obstruction				3.4%
Second primary malignancy				Increased risk of solid tumors and leukemia

Marti et al, EJSO, 2017

JOURNAL OF CLINICAL ONCOLOGY

ORIGINAL REPORT

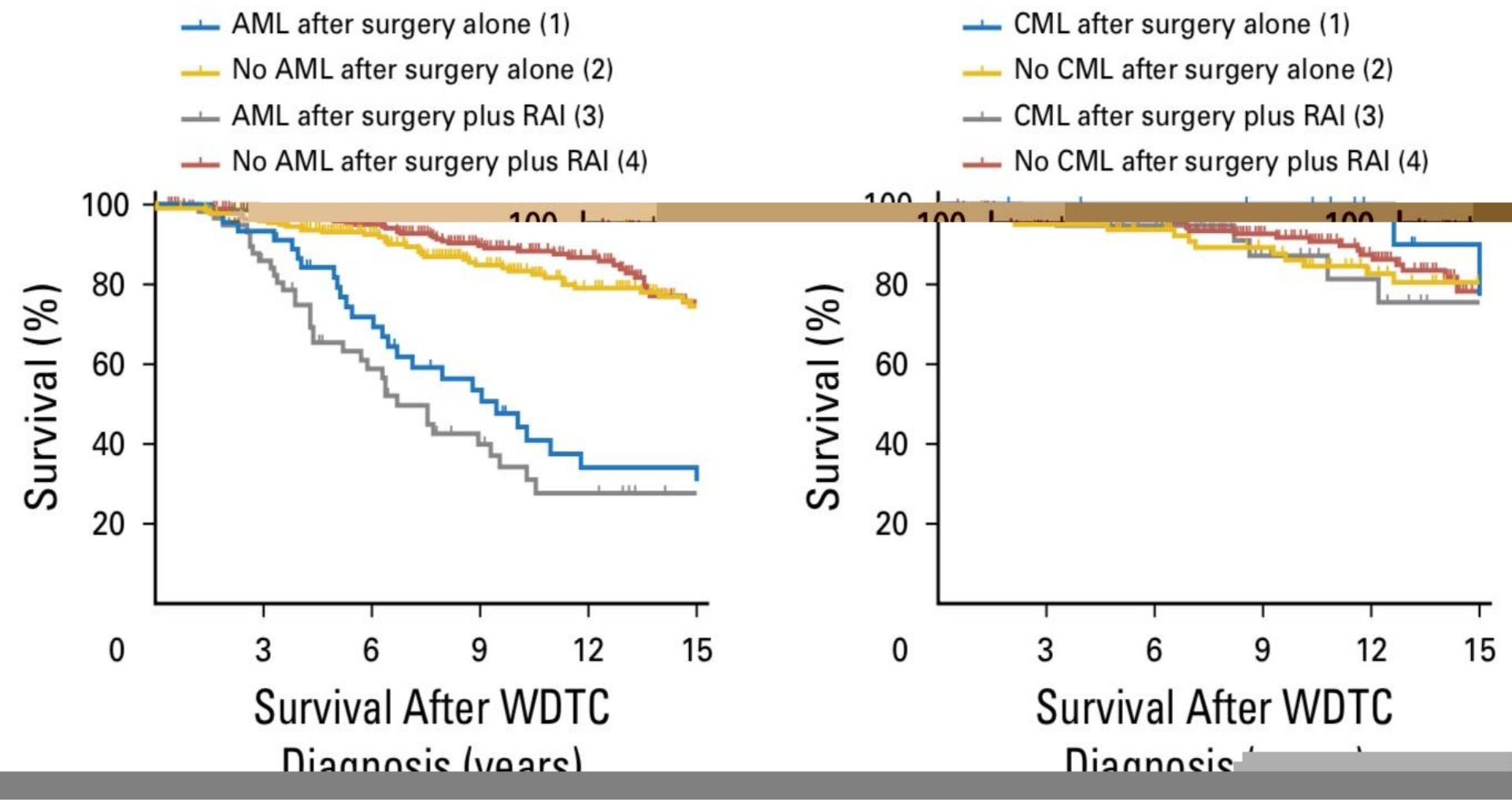
Risk of Hematologic Malignancies After Radioiodine Treatment of Well-Differentiated Thyroid Cancer

Remco J. Molenaar, Surbhi Sidana, Tomas Radivoyevitch, Anjali S. Advani, Aaron T. Gerds, Hetty E. Carraway, Dana Angelini, Matt Kalaycio, Aziz Nazha, David J. Adelstein, Christian Nasr, Jaroslaw P. Maciejewski, Navneet S. Majhail, Mikkael A. Sekeres, and Sudipto Mukherjee

Multivariable Competing Risk Regression Analysis of Risk of Developing Hematologic Malignancies in Patients with WDTC

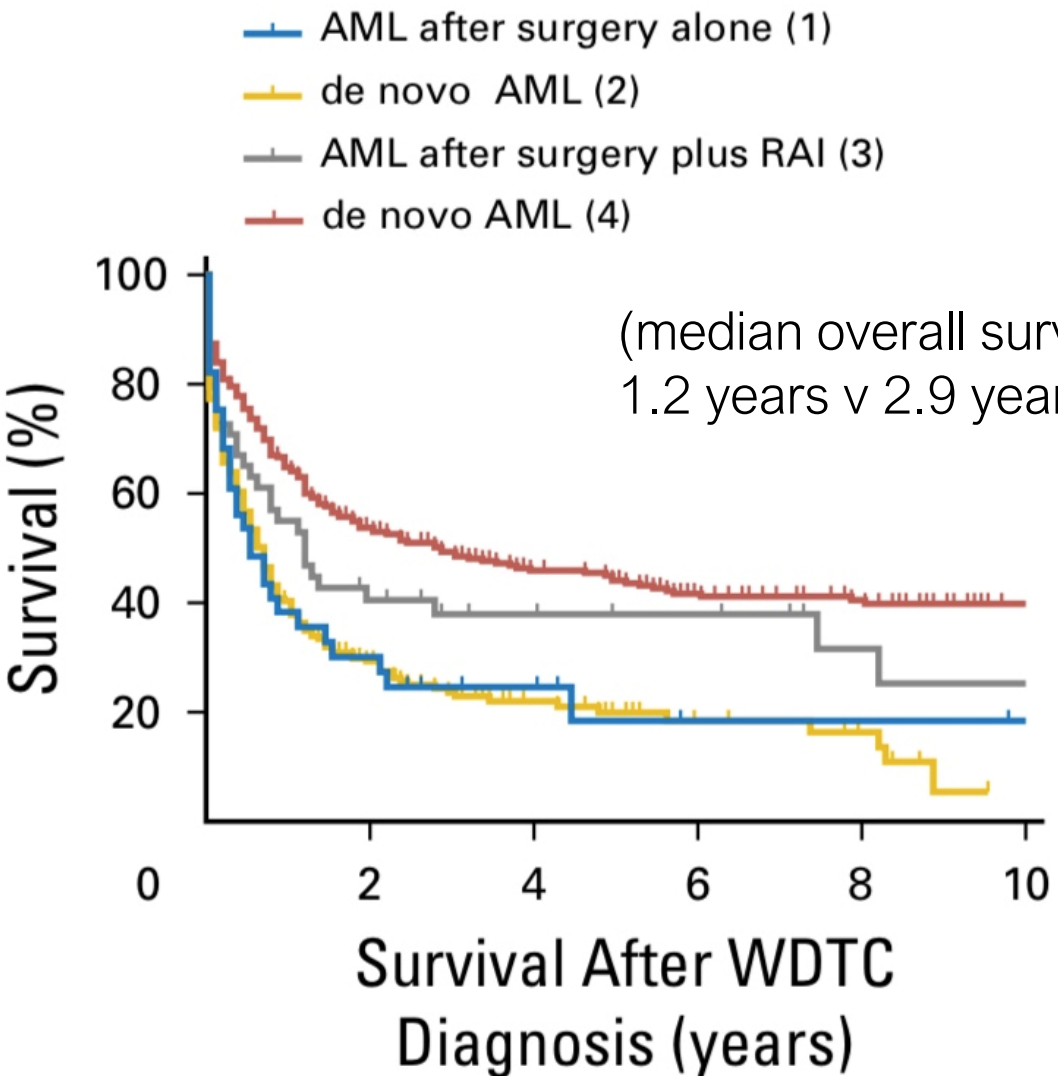
Covariable	AML	CML	SHMs combined
	HR (95% CI) P	HR (95% CI) P	HR (95% CI) P
RAI vs. no radiation	1.79 (1.13 to 2.82) .012	3.44 (1.87 to 6.36) < .001	1.43 (1.20 to 1.69) .001

Molenaar et al, Journal of Clinical Oncology 2017



(8.0 years v 31.0 years; P = .001).

Molenaar et al, Journal of Clinical Oncology 2017



(median overall survival, 1.2 years v 2.9 years; P = .06).

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Adjuvant radioactive iodine should be monitored for myeloid malignancies.

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Retrospective study.

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- Adverse effects impact quality of life and lethal.
- Use radioactive iodine judiciously and weighed against the benefits.

Each one of us can make a difference.
Together we make change

Barbara Mikulski


Thank you