RCM 5898
Ferramentas quantitativas e funcionais em radiologia torácica e cardiovascular, incluindo inteligência artificial e radiômica

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Introdução

- A disciplina de radiologia e diagnóstico por imagem evoluiu sobremaneira nos últimos anos
- Exames de imagem deixaram de ser somente qualitativos e diagnósticos = informações quantitativas e funcionais, de gravidade de doença, biomarcadores prognósticos e resposta ao tto
- Inteligência artificial, "Big Data", aprendizado de máquina e aprendizado profundo estão mudando a medicina
- Principais ferramentas = CAD, Recuperação baseada em conteúdo e Radiômica!

Objetivos

- Discutir o papel dos métodos quantitativos e funcionais no tórax
- Métodos quantitativos em vias aéreas (DPOC), DIP, doença vascular pulmonar
- Apresentar o papel da radiômica do câncer de pulmão
- Comentar sobre o futuro da inteligência artificial em radiologia
- Apresentar nossos trabalhos (feitos e em andamento)

Imagem quantitativa e funcional | Doenças torácicas

- Imagem: análise in vivo do tipo e distribuição (regional) das alterações: vias aéreas, parênquima pulmonar, vasculatura, arcabouço ósseo ….
- Fenótipos → melhor caracterização → estratificação de risco / escolha terapêutica
- Avaliação da gravidade e progressão da doença → intervenção terapêutica mais precoce e precisa → Medicina de precisão
- Futuro próximo: passar da análise subjetiva / qualitativa para análise objetiva / quantitativa

Imagem quantitativa e funcional | Vias aéreas

- DPOC e asma …. Doenças bronquiectásicas (FC)
- Boa correlação com provas funcionais. Mais acurado que análise visual. Prognóstico!
- Volumes e densidades pulmonares, volume e índice de enfisema
- Limiar detecção enfisema = - 950 UH
- Calibre, espessura e densidade das vias aéreas
- Retenção aérea = -950 < > -856 UH na expiração

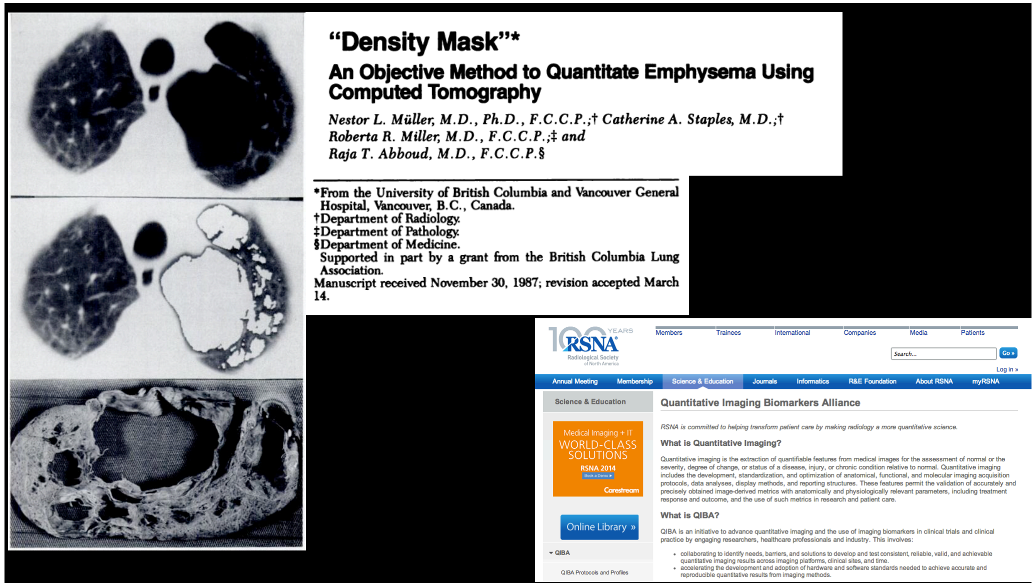
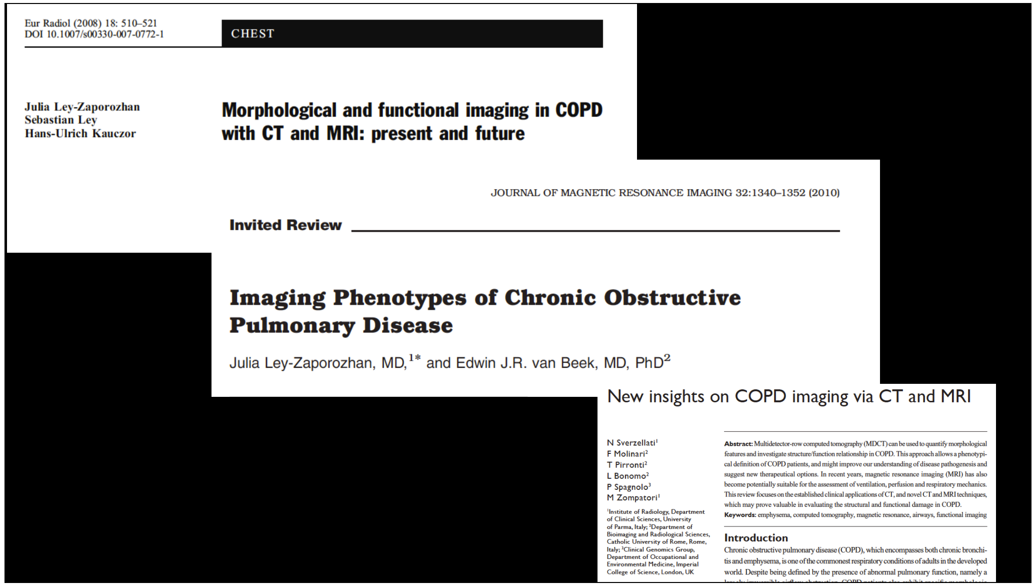


Imagem quantitativa e funcional | DPOC

- > Índice de enfisema = pior função, > risco de neoplasia, > risco de mortalidade geral
- IE > 35% e/ou AWT > 1,75mm = maior risco de exacerbações
- Distribuição do enfisema e morbimortalidade: padrões com predomínio nos lobos inferiores tem piores provas funcionais e pior prognóstico
- Enfisema central tem mais efeito na Dco que o periférico
- Deficiência de @1 Antitripsina: CTq é preditor de sobrevida (FDA approved)



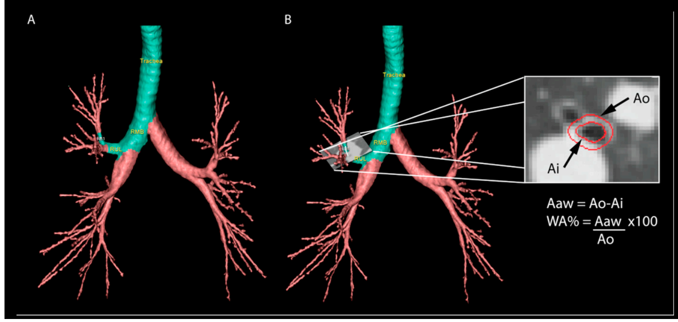
PULMONARY PERSPECTIVE

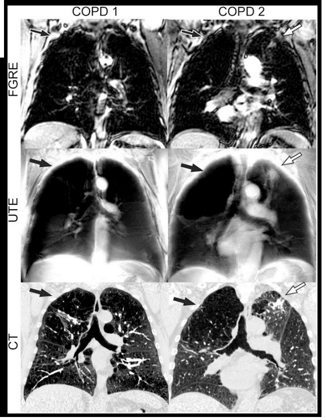
Using Pulmonary Imaging to Move Chronic Obstructive Pulmonary Disease beyond FEV_1

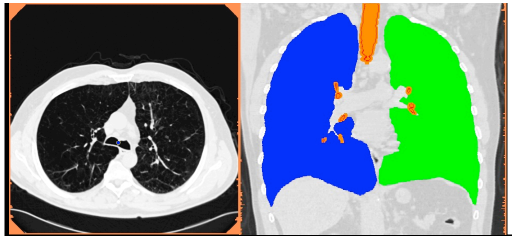
Harvey O. Coxson[1,2], Jonathon Leipsic[1,2], Grace Parraga[3,4,5], and Don D. Sin[2,6]

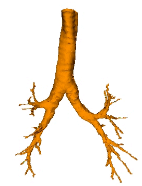
[1]Department of Radiology, Vancouver General Hospital, Vancouver, British Columbia, Canada; [2]James Hogg Research Centre, The University of British Columbia, Vancouver, British Columbia, Canada; [3]Imaging Research Laboratories, Robarts Research Institute, [4]Department of Medical Biophysics, and [5]Department of Medical Imaging, Western University, London, Ontario, Canada; and [6]Division of Respirology, Department of Medicine, The University of British Columbia, Vancouver, British Columbia, Canada

Am J Respir Crit Care Med Vol 190, Iss 2, pp 135–144, Jul 15, 2014









Tiffeneau = 30,3% / VEF1 = 0,88l (39%)
VR = 5,4l (254%) / Dco = 23,1%

```
Results for Search Region : Lung
----------------------------
#Lungvoxel: 14947516
Right-Left-Ratio: 1.1300
Lungvolume (cm^3): 8233.724 (1133.75 g)
#Voxel labeled as Lung and Bronchialtree: 39582
#Trachevoxel: 260092
Tracheavolume (cm^3) in ROI of Lung: 143.27
#Slices with Lung: 295
#Emphysemvoxel: 7287767 (6719146 + 568621) / 4014.41 cm³ / 40144.10 cm²
#Emphysemcluster: 164200 = 567 + 1064 + 14122 + 10413 +(138034)
#Emphysemvoxel = Sum of Voxel in each Class: 7287767 = 6345762 + 165113 + 558895 + 77490 + (140507)
EI (%) [... = ... in Class3 + ... in Class2 ... ]: 48.76 = 42.45 + 1.10 + 3.74 + 0.52 + (0.94)
Size of largest Emphysemcluster (cm^3): 2320.77
MLD (sd) / MLD(-200) (sd) / MLD(-500) (sd) / 15th Percentile / 10th / 5th: -883.38 (172.87) / -896.42 (139.30) / -916.65 (92.14) / -989.00 / -995.00 / -1003.00
#Emphysemvoxel / #Lungenvoxel (Voxelindex VI)(%): 48.76
Bullae Index (3D) / ET: 6.83 / 0.82
Emphysema Typ I (0 means no bullae): 33.09
Emphysema Typ II (0 means no peripher e-voxel, %): 27.60
Emphysema Typ III (0 means no panlobulaer e-voxel, %): 28.22
Diagnose for Search Region: severe centrilobular emphysema / severe panlobular emphysema /
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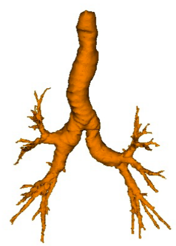
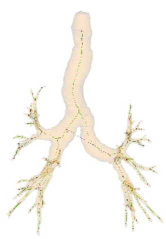
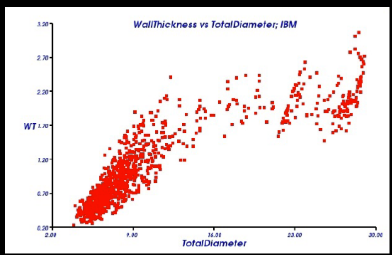
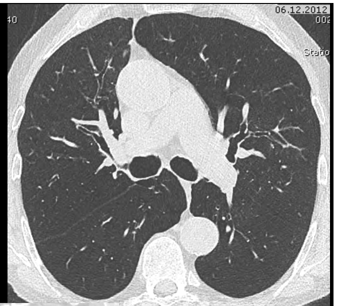




Tiffeneau = 40,0% / VEF1 = 1,2l (35%)
VR = 7,1l (255%)
EI = 4,2% - WT (2-4a geração) = 2,0mm

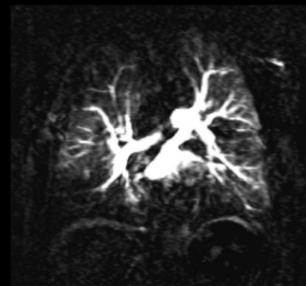




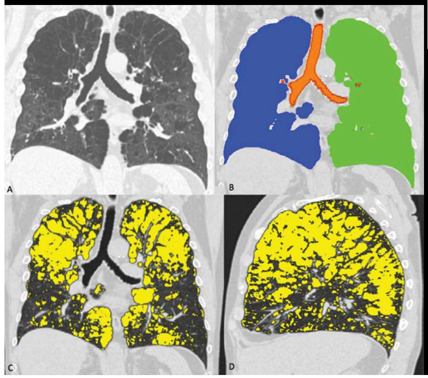
Imagens de ventilação com ³He em paciente com DPOC grave

Coronal T2 em paciente com hiperinsuflação

Imagens de perfusão com Gd em paciente com DPOC grave



MRI of the Lung. H-U. Kauczor



ORIGINAL ARTICLE • *ARTIGO ORIGINAL*

Endobronchial valves in severe emphysematous patients: CT evaluation of lung fissures completeness, treatment radiological response and quantitative emphysema analysis*

Valvas endobrônquicas em pacientes com enfisema grave: avaliação por TC da completude das fissuras pulmonares, resposta radiológica ao tratamento e análise quantitativa do enfisema

Marcel Koenigkam-Santos[1], Wagner Diniz de Paula[2], Daniela Gompelmann[3], Hans-Ulrich Kauczor[4], Claus Peter Heussel[5], Michael Puderbach[6]

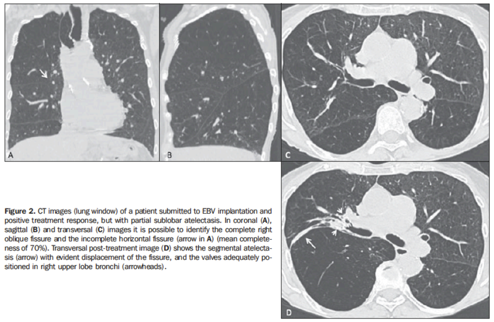


Figure 2. CT images (lung window) of a patient submitted to EBV implantation and positive treatment response, but with partial sublobar atelectasis. In coronal (**A**), sagittal (**B**) and transversal (**C**) images it is possible to identify the complete right oblique fissure and the incomplete horizontal fissure (arrow in **A**) (mean completeness of 70%). Transversal post-treatment image (**D**) shows the segmental atelectasis (arrow) with evident displacement of the fissure, and the valves adequately positioned in right upper lobe bronchi (arrowheads).

Brazilian Journal of Medical and Biological Research (2019) 52(5): e8233, http://dx.doi.org/10.1590/1414-431X20198233
ISSN 1414-431X Research Article

1/8

Biomass smoke COPD has less tomographic abnormalities but worse hypoxemia compared with tobacco COPD

A.C. Meneghini[1], M. Koenigkam-Santos[2], M.C. Pereira[3], P.R. Tonidandel[3], J. Terra-Filho[2†], F.Q. Cunha[4], M.B. de Menezes[2], and E.O. Vianna[2]

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[3]Departamento de Clínica Médica, Faculdade de Ciências Médicas, Universidade Estadual de Campinas, Campinas, SP, Brasil
[4]Departamento de Farmacologia, Faculdade de Medicina de Ribeirão Preto, Universidade de São Paulo, Ribeirão Preto, SP, Brasil

Table 5. High resolution computed tomography findings according to chronic obstructive pulmonary disease groups.

Variable	Non-smoker group	Tobacco smoker group	P value
Descriptive evaluation (thoracic radiologist)			
Emphysema	4 (25%)	12 (80.0%)	<0.02
Centrilobular emphysema	4 (25%)	12 (80.0%)	<0.01
Paraseptal emphysema	2 (12.5%)	7 (46.7%)	>0.05
Panlobular emphysema		2 (13.3%)	
Air trapping	4 (25.0%)	3 (20.0%)	>0.50
Bronchiectasis	7 (43.7%)	2 (13.3%)	>0.05
Quantitative evaluation (Yacta software)			
Lung volume (cm^3)	4368.2 ± 1358.2	5152.8 ± 1124.8	0.09
Volume of emphysema (cm^3)	173.3 ± 814.6	577.1 ± 641.6	0.09
Emphysema index (%)	2.7 ± 4.4	17.5 ± 28.7	0.07
Lung mean density (HU)	–787.3 ± 4.4	–821.3 ± 32.8	0.02
Relative bronchial wall thickness 3rd-8th generation (%)	31.6 ± 26.9	52.7 ± 15.8	0.01
Pi10	0.34 ± 0.1	0.44 ± 0.25	0.18
Measured bronchi (n)	25.7 ± 14.1	24.8 ± 24.8	0.90

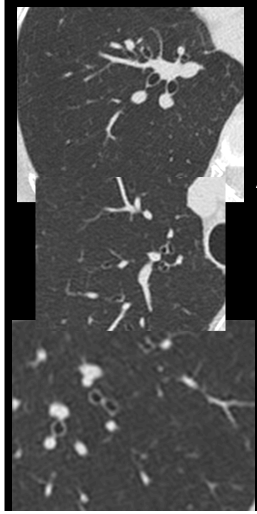
Data are reported as means ± SD or number and percentage. Statistical analysis was done with Fisher's exact test or Wilcoxon test. HU: Hounsfield units; Pi10: normalized thickness of the bronchial wall.

Imagem quantitativa e funcional | Asma e bronquiectasias (FC)

Centro de Ciências das Imagens e Física Médica da Faculdade de Medicina de Ribeirão Preto da Universidade de São Paulo

- Asma: hiperreatividade, inflamação e remodelamento das vias aéreas
- qCT: brônquios mais espessos e densos → asma persistente grave, grau de obstrução do fluxo aéreo, nº de crises
- Fibrose cística: bronquiectasias, impactações, atelectasias, enfisema
- qCT: > número de brônquios analisados, diâmetro, área e espessura de parede maiores (correlação com função), pacientes + velhos com enfisema

AVALIAÇÃO TOMOGRÁFICA DE ASMÁTICOS DE DIFÍCIL CONTROLE: CORRELAÇÕES ENTRE CLÍNICA, RADIOLOGIA E FUNÇÃO PULMONAR



Asma bem controlada

x

Asma difícil controle

Biblioteca Digital USP — Teses e Dissertações

Início

Dissertação de Mestrado

DOI	https://doi.org/10.11606/D.17.2019.tde-05082019-114241
Documento	Dissertação de Mestrado
Autor	Silva, Izabela Maria Elias (Catálogo USP)
Nome completo	Izabela Maria Elias Silva
E-mail	E-mail
Unidade da USP	Faculdade de Medicina de Ribeirão Preto
Área do Conhecimento	Clínica Médica
Data de Defesa	2019-06-03
Imprenta	Ribeirão Preto, 2019
Orientador	Menezes, Marcelo Bezerra de - (Coorientador) (Catálogo USP) Vianna, Elcio dos Santos Oliveira - (Coorientador) (Catálogo USP)
Banca examinadora	Menezes, Marcelo Bezerra de (Presidente) Labadessa, Ivana Gonçalves Cetlin, Andrea de Cassia Vernier Antunes Muglia, Valdair Francisco
Título em português	Tomografia quantitativa de tórax: comparações entre asmáticos de difícil controle, asmáticos bem controlados e indivíduos sem doença respiratória e correlações com parâmetros espirométricos

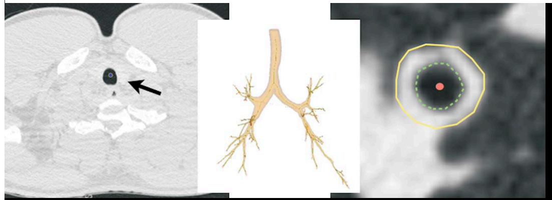
Serviços: Trabalhos decorrentes, Estatísticas, Visitas, Downloads, Como citar, Formato MARC, Formato OAI DC

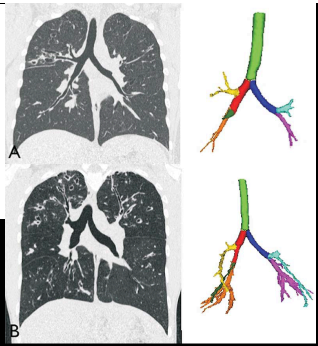
Quantitative computed tomography analysis of the airways in patients with cystic fibrosis using automated software: correlation with spirometry in the evaluation of severity*

Análise quantitativa por tomografia computadorizada das vias aéreas, usando programa automático, em pacientes com fibrose cística: avaliação da gravidade em correlação com a espirometria

Marcel Koenigkam Santos[1], Danilo Lemos Cruvinel[2], Marcelo Bezerra de Menezes[3], Sara Reis Teixeira[4], Elcio de Oliveira Vianna[5], Jorge Elias Júnior[6], José Antonio Baddini Martinez[5]

Koenigkam-Santos M, Cruvinel DL, Menezes MB, Teixeira SR, Vianna EO, Elias Júnior J, Martinez JAB. Quantitative computed tomography analysis of the airways in patients with cystic fibrosis using automated software: correlation with spirometry in the evaluation of severity. Radiol Bras.





EUROPEAN RESPIRATORY *journal*
FLAGSHIP SCIENTIFIC JOURNAL OF ERS

Correlation between functional and morphological airways indexes in bronchiectasis subjects

Jessica Perossi, Daniele Santos, Larissa Perossi, Ricardo Moroli, Mayte Assunção, Leticia Simoni, Jose Antonio Baddini-Martinez, Marcel Koenigkam Santos, Ada Clarice Gastaldi

European Respiratory Journal 2019 54: PA1257; **DOI:** 10.1183/13993003.congress-2019.PA1257

Imagem quantitativa e funcional | Doença intersticial pulmonar

- TCAR tem ↑ correlação com patologia … função e prognóstico!
- ATS/ERS 2018: "gold standard" é o diagnóstico multidisciplinar e não a biópsia
- PIU / FPI e faveolamento = pior prognóstico
- qCT: volumes e densidades pulmonares (percentis, histograma) = correlação com função e prognóstico
- Análise de textura: permite identificar os padrões

Radiology

Alan C. Best, MS
Anne M. Lynch, MD, MSPH
Carmen M. Bozic, MD
David Miller, PhD
Gary K. Grunwald, PhD
David A. Lynch, MB

Index terms:
Computed tomography (CT), comparative studies, 60.12118
Computed tomography (CT), image

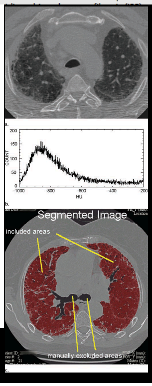
Quantitative CT Indexes in Idiopathic Pulmonary Fibrosis: Relationship with Physiologic Impairment[1]

PURPOSE: To determine whether measurements of skewness, kurtosis, and mean lung attenuation on thin-section computed tomographic (CT) histograms in pa-

TABLE 7
Residual Prediction Error (Σ) and R^2 Values for the Prediction of FVC

Manufacturer No. and Variable	Σ Value	R^2 Value	P Value
1			
MLA	11.92	0.3168	<.01
Skewness	12.00	0.3074	<.01
Kurtosis	11.61	0.3518	<.01
All	11.35	0.3986	<.01
2			
MLA	16.63	0.0971	.03
Skewness	16.47	0.1153	.02
Kurtosis	15.91	0.1738	<.01
All	15.66	0.2350	<.01
All others			
MLA	14.40	0.2047	.03
Skewness	13.28	0.3238	<.01
Kurtosis	11.75	0.4710	<.01
All	11.04	0.5750	<.01

Note.—MLA = mean lung attenuation.



Radiology

ORIGINAL RESEARCH ■ THORACIC IMAGING

Idiopathic Pulmonary Fibrosis: Physiologic Tests, Quantitative CT Indexes, and CT Visual Scores as Predictors of Mortality[1]

Alan C. Best, MD, MS
Jiangfeng Meng, MD, MPH
Anne M. Lynch, MD, MSPH
Carmen M. Bozic, MD
David Miller, PhD
Gary K. Grunwald, PhD
David A. Lynch, MD

Purpose: To retrospectively evaluate quantitative computed tomographic (CT) indexes, pulmonary function test results, and visual CT scoring as predictors of mortality and to describe serial changes in quantitative CT indexes over 12 months in patients with idiopathic pulmonary fibrosis (IPF).

Materials and Methods: Institutional review board approval and informed consent were obtained at all participating institutions. One hun-

Table 1

Comparison of Baseline Physiologic and CT Measures between Patients Deceased and Those Alive at Follow-up

Baseline Variable	Deceased Mean ± SD	Deceased n	Alive Mean ± SD	Alive n	P Value
Pulmonary function test result					
FVC*	56.0 ± 13.9	35	60.8 ± 15.9	131	.105
TLC*	61.3 ± 14.8	35	66.9 ± 15.1	131	.051
Quantitative CT index					
MLA (HU)	−690 ± 48	31	−704 ± 62	114	.244
Skewness	0.85 ± 0.32	31	1.01 ± 0.39	114	.036
Kurtosis	−0.068 ± 0.65	31	0.41 ± 1.02	114	.002
CT visual score					
Fibrosis (%)	21.3 ± 4.9	33	17.9 ± 5.7	114	.002
GGO (%)	10.7 ± 9.3	33	11.6 ± 9.5	114	.632
Emphysema (%)	1.41 ± 2.33	33	1.88 ± 4.94	114	.437

Note.—Overall, 35 patients died during follow-up and 132 survived. SD = standard deviation.
* Values expressed as a percentage of predicted patient performance.

Contents lists available at SciVerse ScienceDirect
European Journal of Radiology
journal homepage: www.elsevier.com/locate/ejrad
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CT analysis of the effect of pirfenidone in patients with idiopathic pulmonary fibrosis

Tae Iwasawa[a,*], Takashi Ogura[b], Fumikazu Sakai[c], Tetsu Kanauchi[d], Takanobu Komagata[a], Tomohisa Baba[b], Toshiyuki Gotoh[e], Satoshi Morita[f], Takuya Yazawa[g], Tomio Inoue[h]

[a] Department of Radiology, Kanagawa Cardiovascular and Respiratory Center, Yokohama, Japan
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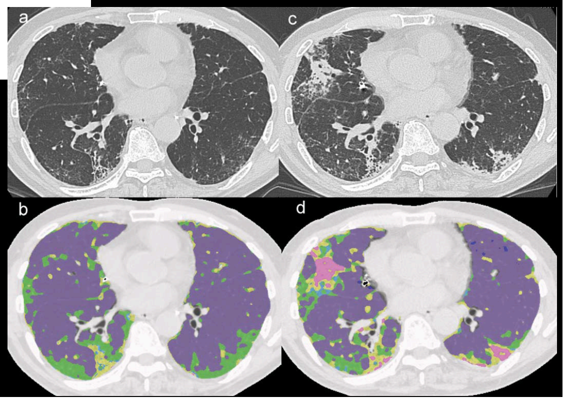
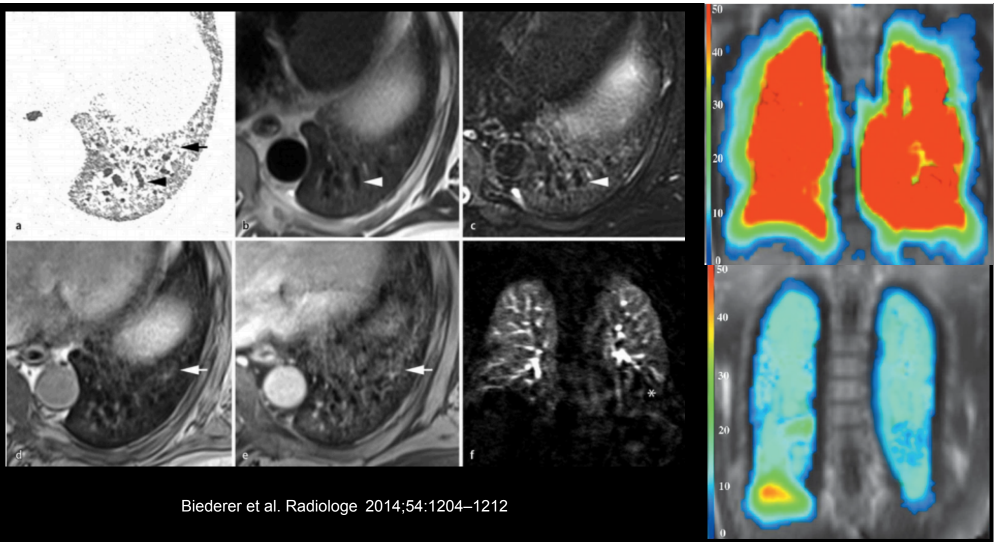
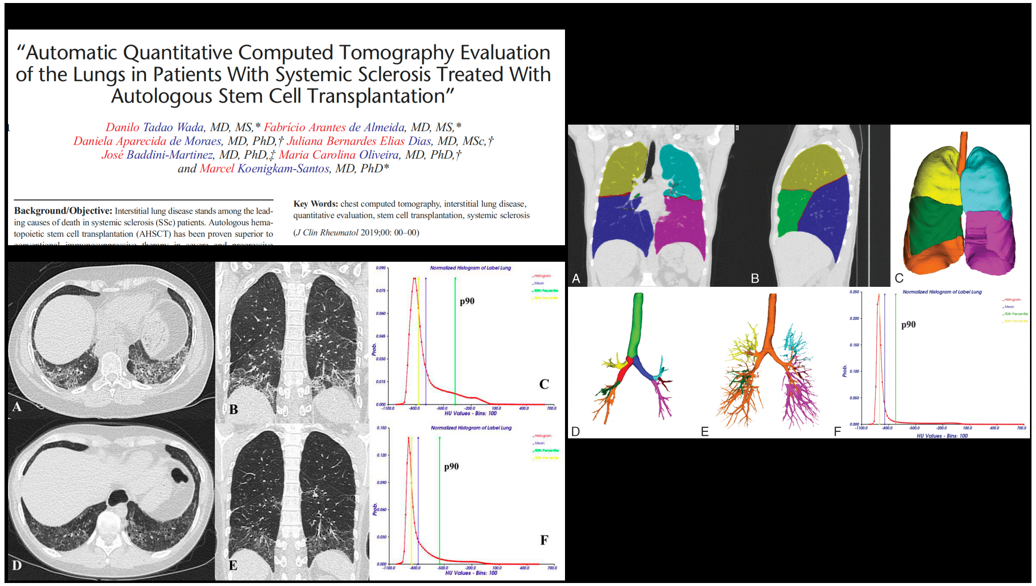




Biederer et al. Radiologe 2014;54:1204–1212

Ohno et al. MRM 2002; 47:1139–1144



"Automatic Quantitative Computed Tomography Evaluation of the Lungs in Patients With Systemic Sclerosis Treated With Autologous Stem Cell Transplantation"

Danilo Tadao Wada, MD, MS,* Fabrício Arantes de Almeida, MD, MS,* Daniela Aparecida de Moraes, MD, PhD,† Juliana Bernardes Elias Dias, MD, MSc,† José Baddini-Martinez, MD, PhD,‡ Maria Carolina Oliveira, MD, PhD,† and Marcel Koenigkam-Santos, MD, PhD*

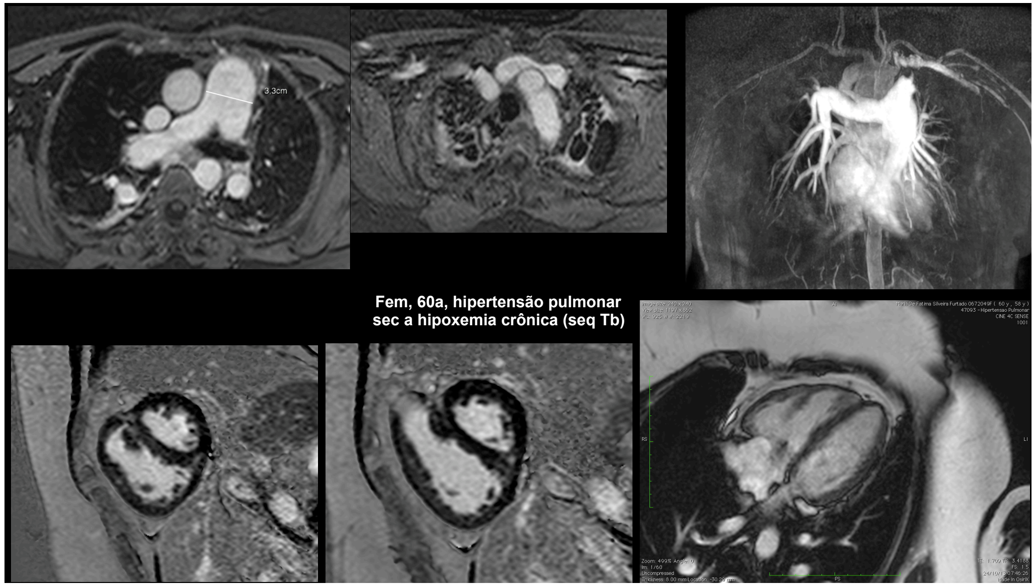
Background/Objective: Interstitial lung disease stands among the leading causes of death in systemic sclerosis (SSc) patients. Autologous hematopoietic stem cell transplantation (AHSCT) has been proven superior to

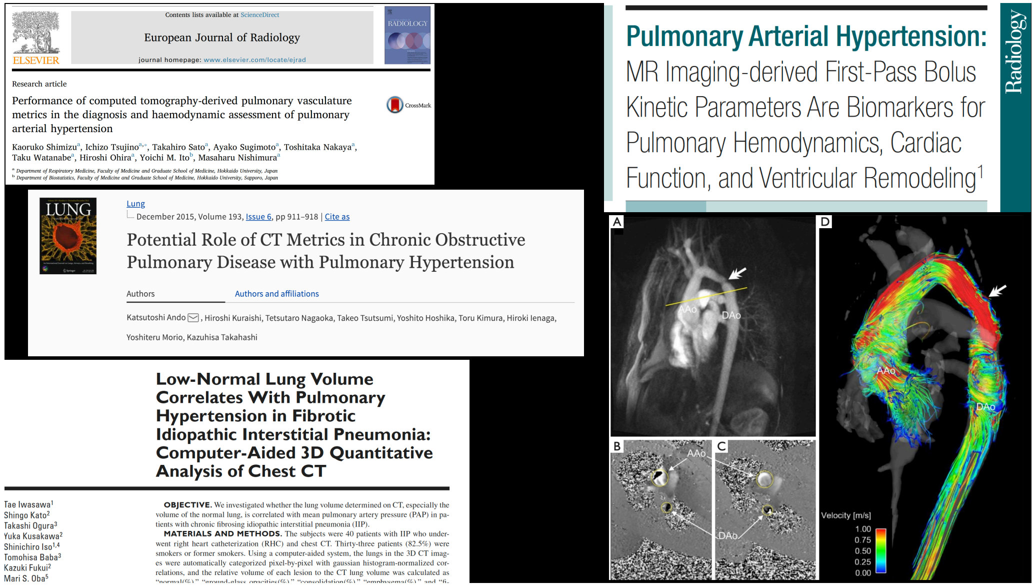
Key Words: chest computed tomography, interstitial lung disease, quantitative evaluation, stem cell transplantation, systemic sclerosis

(J Clin Rheumatol 2019;00: 00–00)

Imagem quantitativa e funcional | Doença vascular pulmonar

- Hipertensão arterial pulmonar, TEP agudo e crônico, doença vascular em DPOC e FPI
- Volume pulmonar e vascular, área dos vasos periféricos
- Análise hemodinâmica por imagem - TC e RM: realce, perfusão, fluxo (4D)
- Correlação com pressão da artéria pulmonar e resistência vascular pulmonar (cate D), função cardíaca D, prognóstico, estratificação de risco (TEP agudo)


3,3cm
Fem, 60a, hipertensão pulmonar
sec a hipoxemia crônica (seq Tb)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European Journal of Radiology
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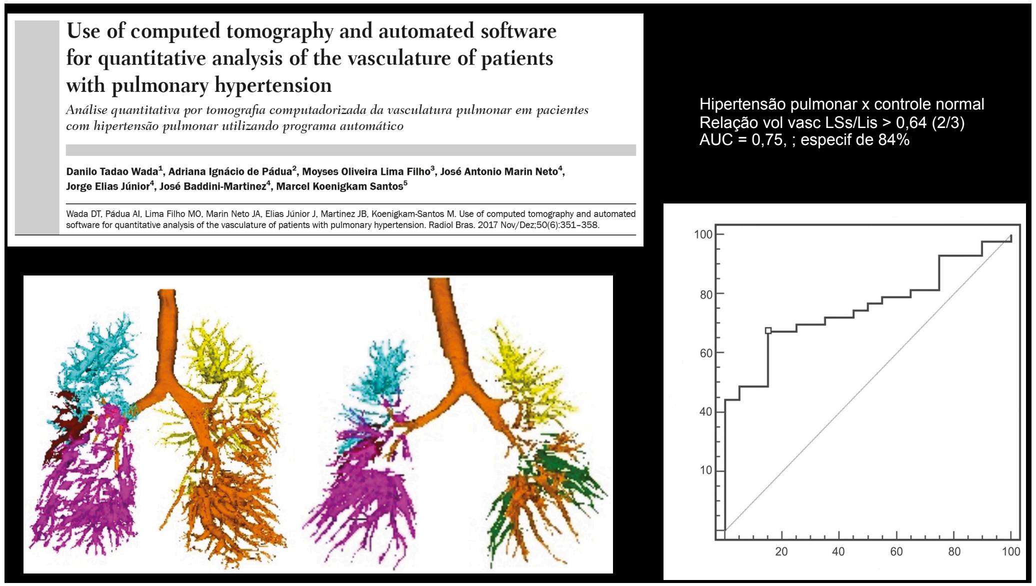
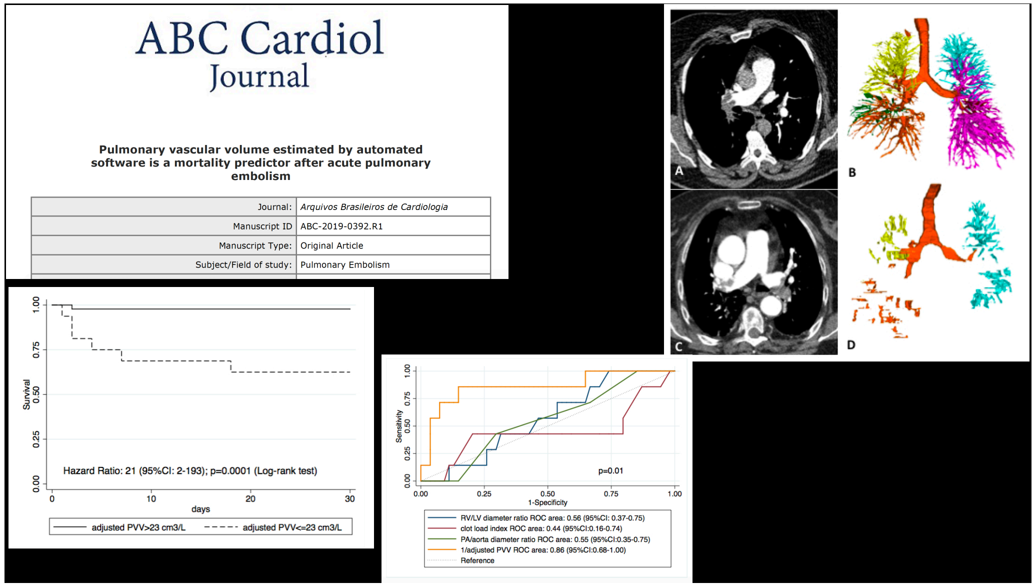
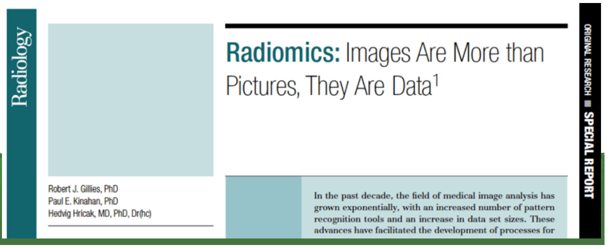
ELSEVIER
Research article
Performance of computed tomography-derived pulmonary vasculature metrics in the diagnosis and haemodynamic assessment of pulmonary arterial hypertension
Kaoruko Shimizu, Ichizo Tsujino, Takahiro Sato, Ayako Sugimoto, Toshitaka Nakaya, Taku Watanabe, Hiroshi Ohira, Yoichi M. Ito, Masaharu Nishimura
LUNG
Lung
December 2015, Volume 193, Issue 6, pp 911–918 | Cite as
Potential Role of CT Metrics in Chronic Obstructive Pulmonary Disease with Pulmonary Hypertension
Authors
Authors and affiliations
Katsutoshi Ando, Hiroshi Kuraishi, Tetsutaro Nagaoka, Takeo Tsutsumi, Yoshito Hoshika, Toru Kimura, Hiroki Ienaga, Yoshiteru Morio, Kazuhisa Takahashi
Low-Normal Lung Volume Correlates With Pulmonary Hypertension in Fibrotic Idiopathic Interstitial Pneumonia: Computer-Aided 3D Quantitative Analysis of Chest CT
Tae Iwasawa
Shingo Kato
Takashi Ogura
Yuka Kusakawa
Shinichiro Iso
Tomohisa Baba
Kazuki Fukui
Mari S. Oba
OBJECTIVE. We investigated whether the lung volume determined on CT, especially the volume of the normal lung, is correlated with mean pulmonary artery pressure (PAP) in patients with chronic fibrosing idiopathic interstitial pneumonia (IIP).
MATERIALS AND METHODS. The subjects were 40 patients with IIP who underwent right heart catheterization (RHC) and chest CT. Thirty-three patients (82.5%) were smokers or former smokers. Using a computer-aided system, the lungs in the 3D CT images were automatically categorized pixel-by-pixel with gaussian histogram-normalized correlations, and the relative volume of each lesion to the CT lung volume was calculated as
Radiology
Pulmonary Arterial Hypertension:
MR Imaging-derived First-Pass Bolus Kinetic Parameters Are Biomarkers for Pulmonary Hemodynamics, Cardiac Function, and Ventricular Remodeling
A
D
B
C
AAo
DAo
Velocity [m/s]
1.00
0.75
0.50
0.25
0.00


Use of computed tomography and automated software for quantitative analysis of the vasculature of patients with pulmonary hypertension
Análise quantitativa por tomografia computadorizada da vasculatura pulmonar em pacientes com hipertensão pulmonar utilizando programa automático
Danilo Tadao Wada, Adriana Ignácio de Pádua, Moyses Oliveira Lima Filho, José Antonio Marin Neto, Jorge Elias Júnior, José Baddini-Martinez, Marcel Koenigkam Santos
Wada DT, Pádua AI, Lima Filho MO, Marin Neto JA, Elias Júnior J, Martinez JB, Koenigkam-Santos M. Use of computed tomography and automated software for quantitative analysis of the vasculature of patients with pulmonary hypertension. Radiol Bras. 2017 Nov/Dez;50(6):351–358.
Hipertensão pulmonar x controle normal
Relação vol vasc LSs/LIs > 0,64 (2/3)
AUC = 0,75, ; especif de 84%
100
80
60
40
10
20
40
60
80
100


ABC Cardiol
Journal
Pulmonary vascular volume estimated by automated software is a mortality predictor after acute pulmonary embolism
Journal: Arquivos Brasileiros de Cardiologia
Manuscript ID ABC-2019-0392.R1
Manuscript Type: Original Article
Subject/Field of study: Pulmonary Embolism
Survival
Hazard Ratio: 21 (95%CI: 2-193); p=0.0001 (Log-rank test)
days
adjusted PVV>23 cm3/L
adjusted PVV<=23 cm3/L
Sensitivity
1-Specificity
p=0.01
RV/LV diameter ratio ROC area: 0.56 (95%CI: 0.37-0.75)
clot load index ROC area: 0.44 (95%CI:0.16-0.74)
PA/aorta diameter ratio ROC area: 0.55 (95%CI:0.35-0.75)
1/adjusted PVV ROC area: 0.86 (95%CI:0.68-1.00)
Reference
A
B
C
D

Radiômica | Definição

- Sufixo –ômica: termo originado na biologia molecular para descrever a caracterização detalhada de moléculas como o DNA (genômica) e as proteínas (proteômica)
- Radiômica = extração massiva de características quantitativas (atributos) das imagens médicas para o auxílio diagnóstico e busca por biomarcadores prognósticos


Radiology

ORIGINAL RESEARCH ■ SPECIAL REPORT

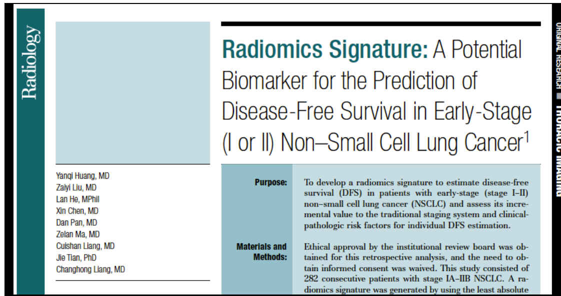
Radiomics: Images Are More than Pictures, They Are Data[1]

Robert J. Gillies, PhD
Paul E. Kinahan, PhD
Hedvig Hricak, MD, PhD, Dr(hc)

In the past decade, the field of medical image analysis has grown exponentially, with an increased number of pattern recognition tools and an increase in data set sizes. These advances have facilitated the development of processes for

Radiômica | Oncologia

- Recentes avanços nas terapias-alvo / imunoterapia = necessidade de abordagem de análise robusta e precisa das imagens médicas
- Medicina diagnóstica / complementar → Abordagem multidisciplinar e individualizada do paciente oncológico
- Radiômica: ferramenta não-invasiva, rápida e de baixo-custo, podendo ser usada nas imagens da rotina clínica
- Câncer de pulmão: o mais letal
- Correlação com tipo histológico, mutações, estadiamento, prognóstico


Radiology

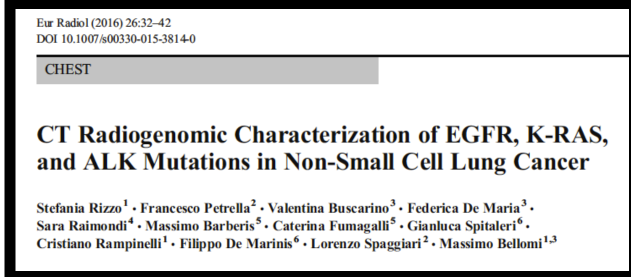
ORIGINAL RESEARCH ■ THORACIC IMAGING

Radiomics Signature: A Potential Biomarker for the Prediction of Disease-Free Survival in Early-Stage (I or II) Non–Small Cell Lung Cancer[1]

Yanqi Huang, MD
Zaiyi Liu, MD
Lan He, MPhil
Xin Chen, MD
Dan Pan, MD
Zelan Ma, MD
Cuishan Liang, MD
Jie Tian, PhD
Changhong Liang, MD

Purpose: To develop a radiomics signature to estimate disease-free survival (DFS) in patients with early-stage (stage I–II) non–small cell lung cancer (NSCLC) and assess its incremental value to the traditional staging system and clinical-pathologic risk factors for individual DFS estimation.

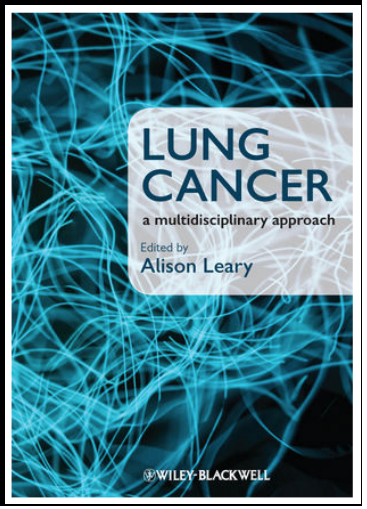
Materials and Methods: Ethical approval by the institutional review board was obtained for this retrospective analysis, and the need to obtain informed consent was waived. This study consisted of 282 consecutive patients with stage IA–IIB NSCLC. A radiomics signature was generated by using the least absolute


Eur Radiol (2016) 26:32–42
DOI 10.1007/s00330-015-3814-0

CHEST

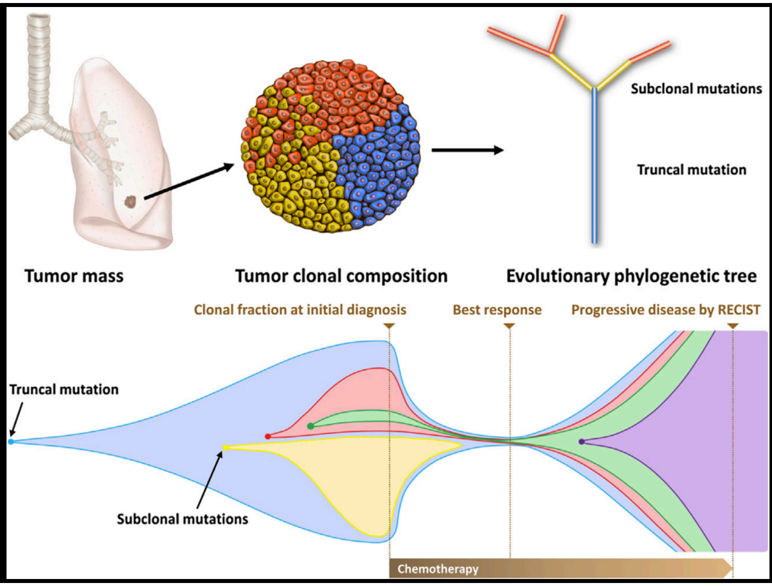
CT Radiogenomic Characterization of EGFR, K-RAS, and ALK Mutations in Non-Small Cell Lung Cancer

Stefania Rizzo[1] · Francesco Petrella[2] · Valentina Buscarino[3] · Federica De Maria[3] · Sara Raimondi[4] · Massimo Barberis[5] · Caterina Fumagalli[5] · Gianluca Spitaleri[6] · Cristiano Rampinelli[1] · Filippo De Marinis[6] · Lorenzo Spaggiari[2] · Massimo Bellomi[1,3]



Radiômica | Oncologia

- Câncer: "doença genética" relacionada ao acúmulo de mutações levando a proliferação celular patológica
- Heterogeneidade histológica (regiões com # vascularização, inflamação, invasão) = heterogeneidade genética / clonal = heterogeneidade na imagem!
- Tumores policlonais (# mutações em # células) = boa resposta inicial mas com posterior progressão, recorrência, resistência a quimioterápicos
- Variabilidade inter e intrapacientes e inter e intratumoral

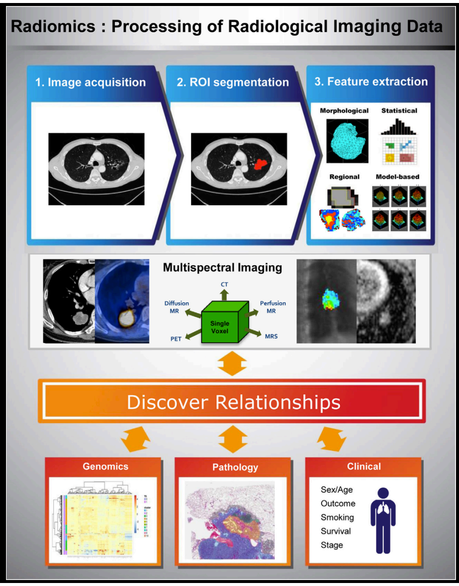


Lee et al. EJR 2016

Radiômica | Metodologia

- Analisar de maneira quantitativa a complexidade espacial / estrutural do tumor
- Correlação clínica - patológica - genética - prognóstica
- Identificar as áreas relacionadas a transformação, progressão e resistência ao tratamento
- TC, RM e PET-CT / PET-RM
- Segmentação: manual, semi ou automática
- Extração dos atributos da imagem: cor (níveis de cinza), textura e forma
- Análise computadorizada: IA, machine learning, deep learning

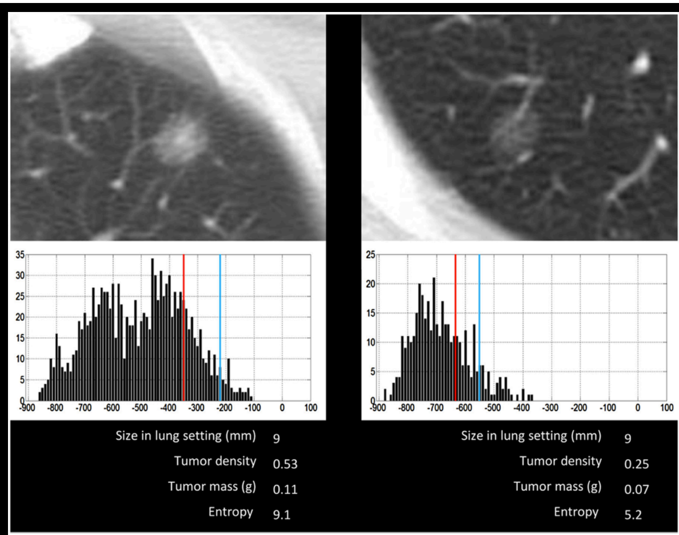
Marcel Koenigkam Santos | RCM 5898



Etapas da análise radiômica:

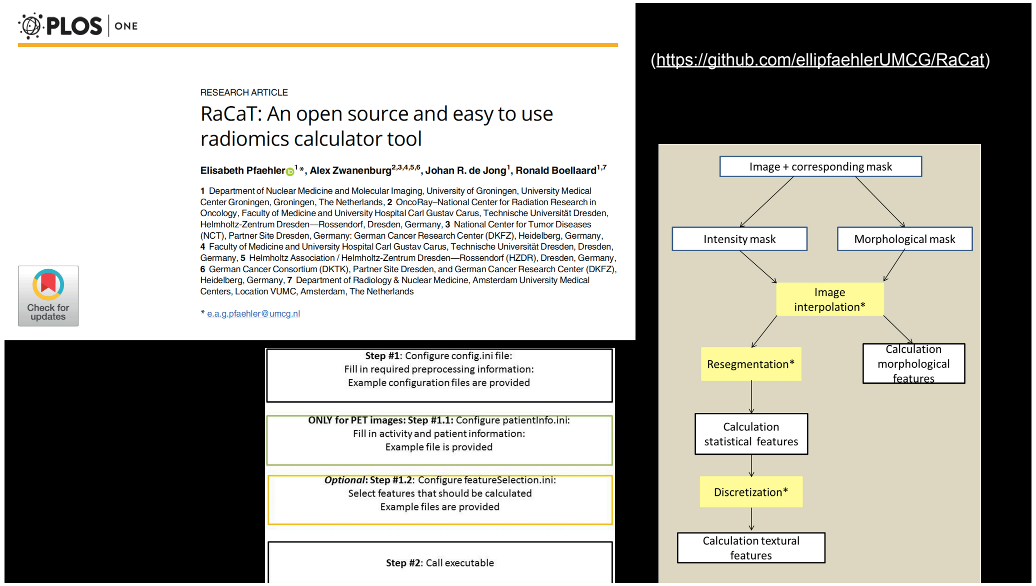
1. Aquisição da imagem
2. Segmentação da lesão ("separação anatômica")
3. Extração computadorizada dos atributos de imagem (dezenas a centenas)
4. Correlação matemática das múltiplas variáveis relacionadas aos atributos com os dados clínicos, patológicos e genéticos

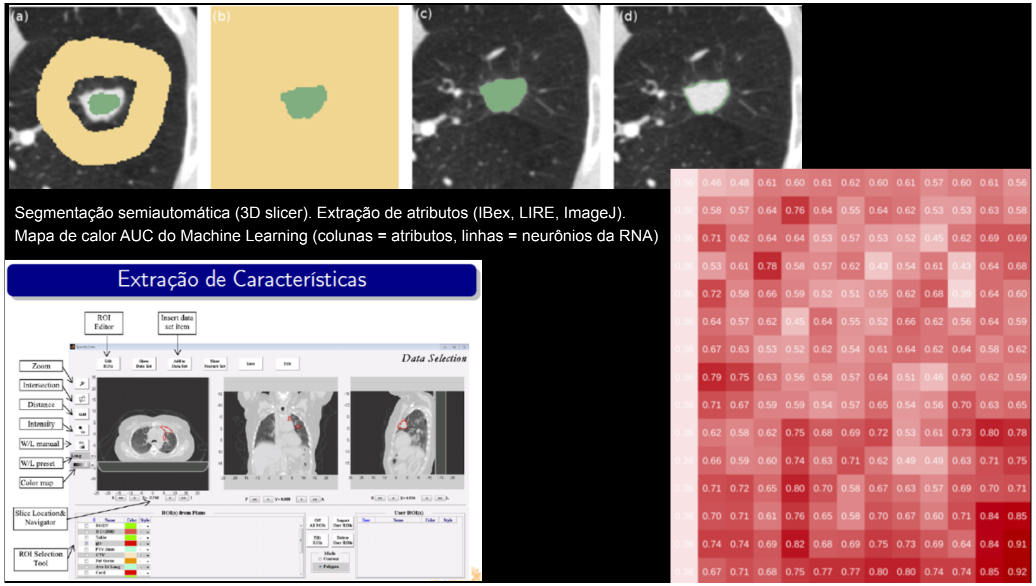
Lee et al. EJR 2016

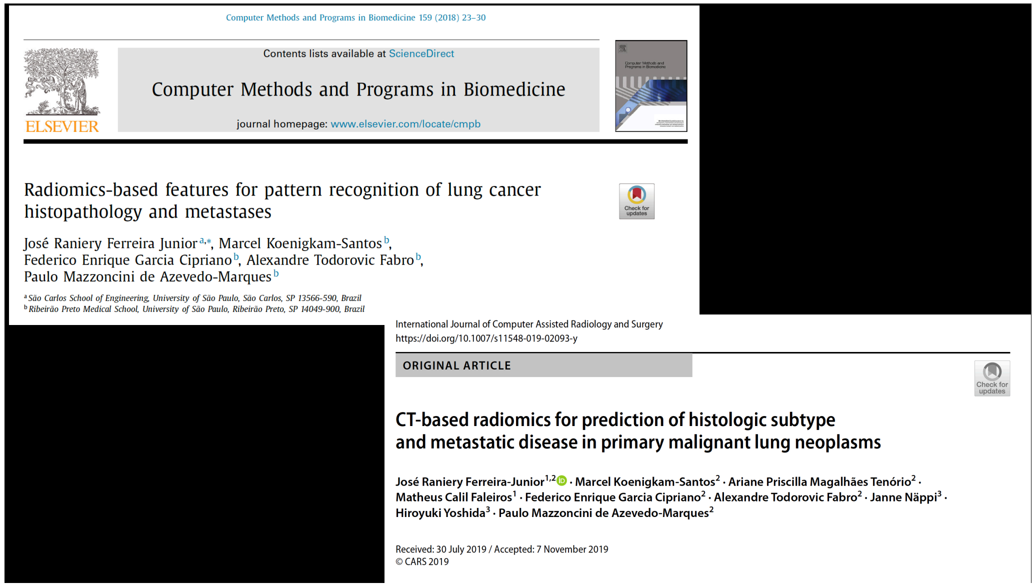


adenocarcinoma invasivo x adenocarcinoma in situ

Lee et al. EJR 2016


PLOS | ONE
RESEARCH ARTICLE
RaCaT: An open source and easy to use radiomics calculator tool
Elisabeth Pfaehler[1]*, Alex Zwanenburg[2,3,4,5,6], Johan R. de Jong[1], Ronald Boellaard[1,7]
1 Department of Nuclear Medicine and Molecular Imaging, University of Groningen, University Medical Center Groningen, Groningen, The Netherlands, 2 OncoRay–National Center for Radiation Research in Oncology, Faculty of Medicine and University Hospital Carl Gustav Carus, Technische Universität Dresden, Helmholtz-Zentrum Dresden—Rossendorf, Dresden, Germany, 3 National Center for Tumor Diseases (NCT), Partner Site Dresden, Germany: German Cancer Research Center (DKFZ), Heidelberg, Germany, 4 Faculty of Medicine and University Hospital Carl Gustav Carus, Technische Universität Dresden, Dresden, Germany, 5 Helmholtz Association / Helmholtz-Zentrum Dresden—Rossendorf (HZDR), Dresden, Germany, 6 German Cancer Consortium (DKTK), Partner Site Dresden, and German Cancer Research Center (DKFZ), Heidelberg, Germany, 7 Department of Radiology & Nuclear Medicine, Amsterdam University Medical Centers, Location VUMC, Amsterdam, The Netherlands
* e.a.g.pfaehler@umcg.nl
Check for updates
(https://github.com/ellipfaehlerUMCG/RaCat)
Image + corresponding mask
Intensity mask
Morphological mask
Image interpolation*
Resegmentation*
Calculation morphological features
Calculation statistical features
Discretization*
Calculation textural features
Step #1: Configure config.ini file:
Fill in required preprocessing information:
Example configuration files are provided
ONLY for PET images: Step #1.1: Configure patientInfo.ini:
Fill in activity and patient information:
Example file is provided
Optional: Step #1.2: Configure featureSelection.ini:
Select features that should be calculated
Example files are provided
Step #2: Call executable


a)
(b)
(c)
(d)
Segmentação semiautomática (3D slicer). Extração de atributos (IBex, LIRE, ImageJ).
Mapa de calor AUC do Machine Learning (colunas = atributos, linhas = neurônios da RNA)
Extração de Características
ROI Editor
Insert data set item
Data Selection
Zoom
Intersection
Distance
Intensity
W/L manual
W/L preset
Color map
Slice Location& Navigator
ROI Selection Tool


Computer Methods and Programs in Biomedicine 159 (2018) 23–30
Contents lists available at ScienceDirect
Computer Methods and Programs in Biomedicine
journal homepage: www.elsevier.com/locate/cmpb
ELSEVIER
Radiomics-based features for pattern recognition of lung cancer histopathology and metastases
José Raniery Ferreira Junior[a,*], Marcel Koenigkam-Santos[b], Federico Enrique Garcia Cipriano[b], Alexandre Todorovic Fabro[b], Paulo Mazzoncini de Azevedo-Marques[b]
[a] São Carlos School of Engineering, University of São Paulo, São Carlos, SP 13566-590, Brazil
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International Journal of Computer Assisted Radiology and Surgery
https://doi.org/10.1007/s11548-019-02093-y
ORIGINAL ARTICLE
CT-based radiomics for prediction of histologic subtype and metastatic disease in primary malignant lung neoplasms
José Raniery Ferreira-Junior[1,2] · Marcel Koenigkam-Santos[2] · Ariane Priscilla Magalhães Tenório[2] · Matheus Calil Faleiros[1] · Federico Enrique Garcia Cipriano[2] · Alexandre Todorovic Fabro[2] · Janne Näppi[3] · Hiroyuki Yoshida[3] · Paulo Mazzoncini de Azevedo-Marques[2]
Received: 30 July 2019 / Accepted: 7 November 2019
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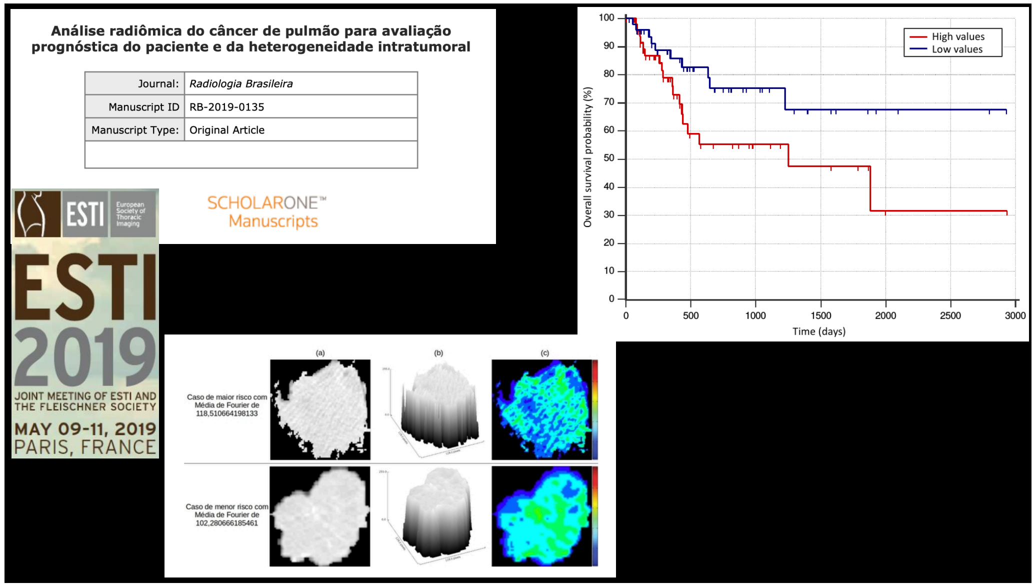
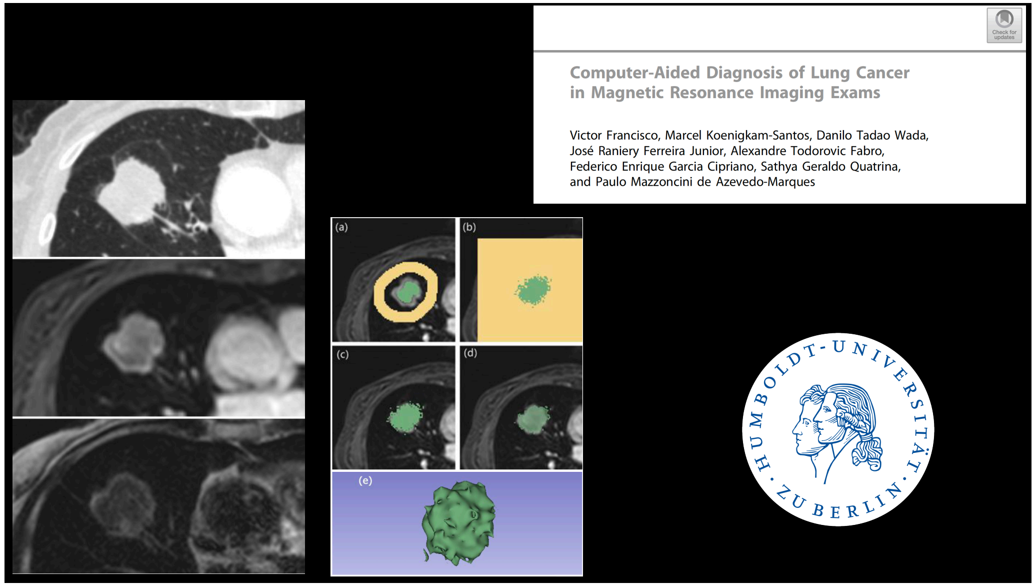
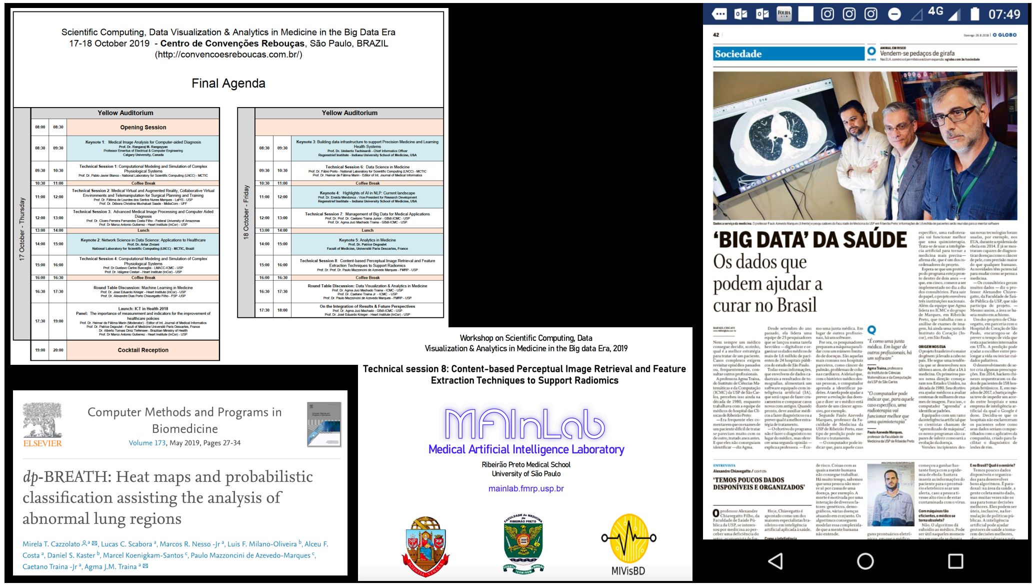

Análise radiômica do câncer de pulmão para avaliação prognóstica do paciente e da heterogeneidade intratumoral
Journal: Radiologia Brasileira
Manuscript ID RB-2019-0135
Manuscript Type: Original Article
SCHOLARONE™ Manuscripts
ESTI European Society of Thoracic Imaging
ESTI 2019
JOINT MEETING OF ESTI AND THE FLEISCHNER SOCIETY
MAY 09-11, 2019 PARIS, FRANCE
High values
Low values
Overall survival probability (%)
Time (days)
(a)
(b)
(c)
Caso de maior risco com Média de Fourier de 118,510664198133
Caso de menor risco com Média de Fourier de 102,280666185461






http://dx.doi.org/10.1590/0100-3984.2019.0049

Inteligência artificial, aprendizado de máquina, diagnóstico auxiliado por computador e radiômica: avanços da imagem rumo à medicina de precisão

Artificial intelligence, machine learning, computer-aided diagnosis, and radiomics: advances in imaging towards to precision medicine

Marcel Koenigkam Santos[1,a], José Raniery Ferreira Júnior[2,3,b], Danilo Tadao Wada[1,c], Ariane Priscilla Magalhães Tenório[3,d], Marcello Henrique Nogueira Barbosa[3,e], Paulo Mazzoncini de Azevedo Marques[3,f]

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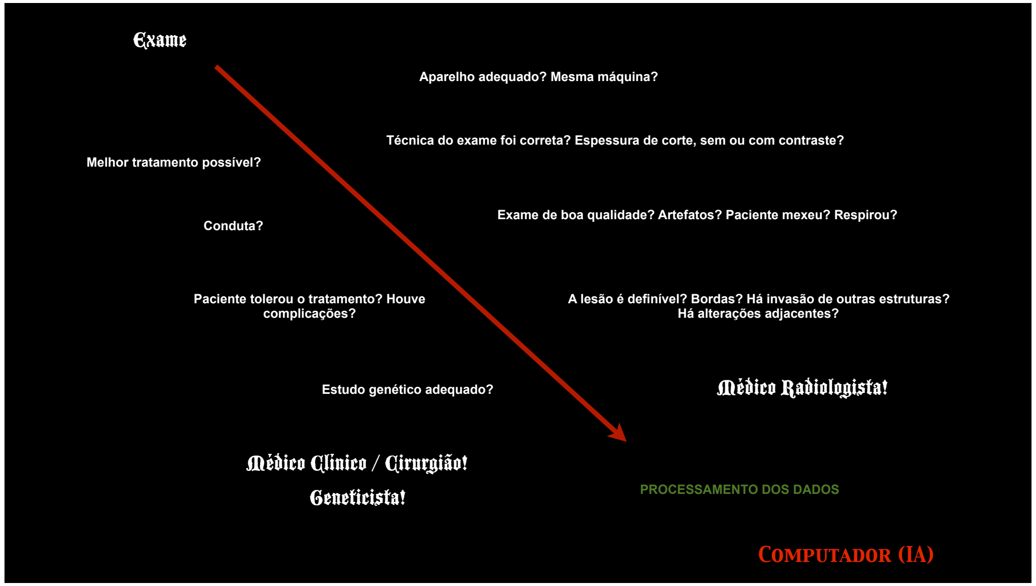

Conclusões

- Exames de imagem deixaram de ser somente qualitativos e diagnósticos = informações quantitativas, de gravidade de doença, biomarcadores prognósticos e resposta ao tto!
- Volumes e densidades pulmonares, quantificação de enfisema, medidas das vias aéreas, análise da textura pulmonar, volume vascular pulmonar, fluxo, perfusão e ventilação por RM
- Radiômica do câncer de pulmão = medicina personalizada = medicina do futuro (agora!)
- Inteligência artificial vêm para ajudar a radiologia = “inteligência aumentada"
- Temos vários trabalhos feitos e em andamento!

Obrigado!

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