"Personalized Medicine" – Challenges & Chances for Imaging

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Increase in Workload + Costs of Imaging → "Value-based Healthcare"

Imaging Biomarker → Quantitative Imaging

Radiomics → "Big Data" + Artificial Intelligence

Potential & Innovations in Magnetic Resonance Imaging

Personalized Medicine at the University Hospital Tuebingen
Transforming Radiology: Large (functional) information in relation to „Big Data“

WEB 2.0/CLOUD

Personal Communication

Imaging Business

Decision making business

1895.................................1997.................................2025

Courtesy of Maximilian Reiser, LMU Munich

Diagnostic CT

Diagnostic MRT

Department of Radiology, UKT
"Value-based healthcare"

Commoditization in Radiology:

Surrogate Imaging, Imaging Biomarker and Radiomics as an Integral Part in Precision Medicine

Imaging Biomarkers

• can reliably be used to test medical hypotheses, cross the first gap
• becoming useful ‘medical research tools’

• Any new biomarker has to cross the gaps of technical validation,
  biological/clinical validation, and cost effectiveness
  → then it becomes a ‘clinical decision-making tool’

To generate QUANTITATIVE Imaging Biomarkers....

• ...medical images have to be within describable limits of bias and variance.
• ...imaging protocols have to be standardized across imaging centers.
• ...acquisition and reconstruction standards have to be defined.

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Inter- and intratumoral tumor heterogeneity

Do we have to biopsy every lesion?

“Intratumor heterogeneity can lead to underestimation of the tumor genomics
landscape and may present major challenges to personalized-medicine and
biomarker development.”

(Advanced) Imaging Big data Artificial intelligence

Courtesy of F. Nensa, University of Goea

Adapting to Artificial Intelligence
Radiologists and Pathologists as Information Specialists

Saurabh Jha, MBBS, MRes, MSc; Eric J. Taouli, MD


- Radiologists and pathologists need to adapt
- Artificial Intelligence will (partly) perform the information extraction from imaging data
- Radiologists/pathologists will transform to…

→ Information Specialists:
  → information processing
  → putting it into clinical context
  → communication
Why Tübingen?

Why MRI?

Tübingen: Center for Personalized Medicine (ZPM)

Scientific Advisory Board

Vorstand

Steering Board

Zentrum für Quantitative Biologie

Core Facility Proteomics

Core Facility Metabolomics

Core Facility Bioinformatics
CentraXX
Biobank / Study Mgt. / Research
data integration solution

Patient management (SAP)

Clinical Cancer Registry GTDS

Biobanking

Clinical Study center

Biobanking Pathology

Biobanking University gynecological hospital

Biobanking neuropathology

Identified an validated User (pseudonymized web-4)

Courtesy of N. Malek, Chairman, ZPM & Med. Opt., University Hospital Tuebingen

Innovations in MRI

Milestones of MRI development

1972 Lauterbur & Mansfield Basics for modern MRI

1975

1980

1983

1990

2000

2005

2010

2015

Innovations in MRI

MTR & Radiology: the Next Ten Years

The Transformation Towards Value-Driven Health Care

STANDORIZATION INNOVATION INTEGRATION

Stanford Medical Center

3 Tests

7 Tests

The British journal of radiology 81(968):601-17
Motivation

Motion Artifacts

- respiratory motion
- cardiac movement
- patient and organ movement

Motion Blur

Aliasing

Need for adaptation and motion correction strategies

Personalized Medicine:
Role of (standardized) Imaging, Quantification & Reporting

Response

Therapy

Relevance

Quantitative / Structured Data

Reading / Analysis

Image Acquisition

Patient
Role of imaging in personalized medicine

- Acquire, identify, structure and curate data
  - Radiologist as an INFORMATION SPECIALIST

- Multidisciplinary research
  - clinical partners, IT, Statisticians, data scientists

- Apply classifications to new data
  → Provide decision support

Where do we see the MAGNETOM VIDA?

- Prognosis: **Responder** for drug A
  - Patient gets drug A

- Prognosis: **Non-Responder** for drug A
  - Patient gets drug B

- Prognosis: **Severe side-effects**
  - Patient gets drug C

Modified from: Jakka and Rossbach, 2013

Thank you!