IS3R Meeting Rotterdam November 2018

The True Impact of Imaging

Philippe A Grenier

Sorbonne Université – Hôpital Pitié-Salpétrière
Paris-France.

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- Beyond diagnostic accuracy, imaging has gained an impact on patient management

- In oncology, CT, MRI, and PET have played a major role in clinical staging, decision making and tumor response assessment

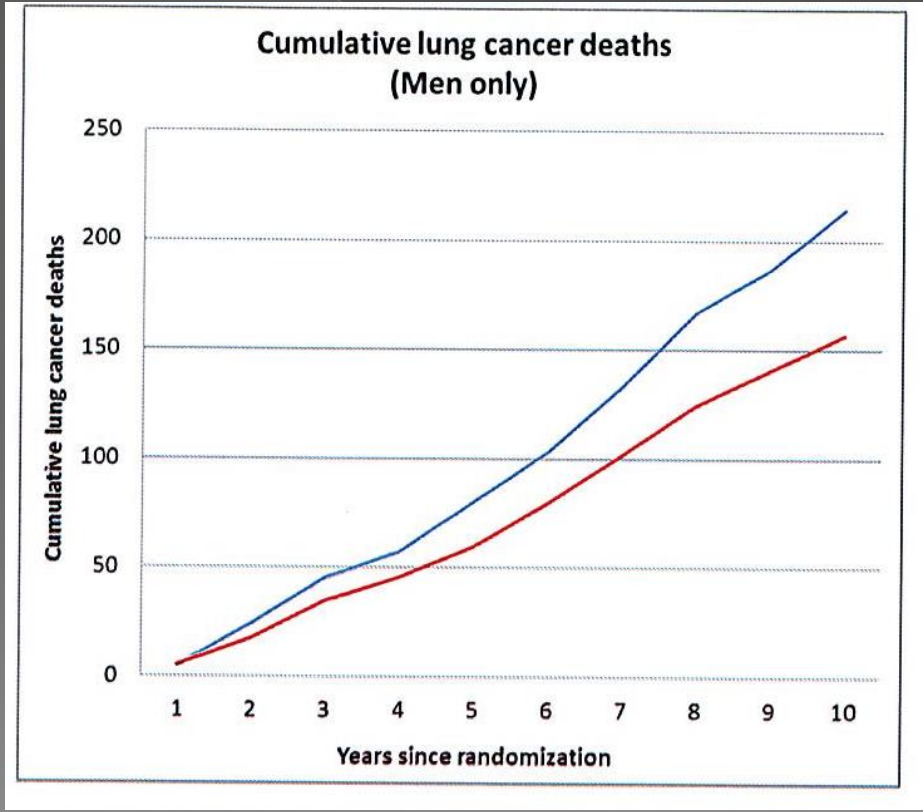
- Imaging can have also an impact on cancer mortality as demonstrated in screening trials

Nelson Trial (Belgique et Pays-Bas)

- 15.822 subjects randomized in two arms: Low Dose CT (N=7.915) and clinical surveillance (N=7.907)
- Objective: to reduce lung cancer mortality by at least 25% in CT arm after 10-year follow-up
- Participants: 50-75 yo smokers (15 cigarettes or +/day during 25 y or 10 cigarettes or +/day during 30 y and who currently smoke or quit <10 y)
- LDCT scans performed at baseline, after 1y, 3y and 5y and a half
- Evaluation of pulmonary nodules based on nodule volume and volume doubling time

Van Klaveren. N Engl J Med; 2009; 361: 2221

Nelson Trial (Belgique et Pays-Bas)



214 lung cancer deaths in the control arm vs 157 in the screen arm

Males at high risk for lung cancer have a reduced risk of dying from lung cancer of 26% compared to the male control arm (95% CI 9-40%)

In women, reductions are consistently more favourable (39-61%)

Nelson Trial (Belgique et Pays-Bas)

- With 26% reduction in lung cancer mortality the Nelson trial results overpassed those of the NLST (20%)

- Volumic nodule measurement vs diameter (NLST) allowed reduction of positif results rates (27% in NLST vs 2.2% in Nelson) and a reduction of false positive results rates (95% in NLST vs 59% in Nelson)

Performance and Cost-Effectiveness of CT Lung Cancer Screening Scenarios in a Population Based-Setting: a Microsimulation Modelling (Ontario Canada)

576 screening scenarios were examined varying by age to start and end screening, smoking eligibility criteria, and screening interval

Outcome measures: lung cancer death averted, life-year gained, percentage ever screened, costs, and overdiagnosis

The best results: annual screening between 55-75 yo for persons who smoked > 40PY, who currently smoke or quit < 10y ago yielded an incremental cost-effectiveness ratio of $33,825 per life-year gained (vs $81,000 in NLST)

Haaf. PLOS.Medecine; 2017

Lung Cancer Risk Modelling

- *PanCan Study (single arm prospective study N=7044): participants had at least a 2% 6-year risk (PanCan model)*

The incidence of cancers detected and the proportion of early stage cancers in the screened population was higher than observed in previous studies

Lancet Oncol; 2017; 18: 1523

- *Liverpool Lung Project pour l'essai UKLS*

Risk prediction model to select subjects with a 5% risk over 5 years based on personal risk factors obtained from questionnaires

Field. Trans Lung Cancer Res; 2018; 7: S114

Chronic Disease Phenotyping Using Imaging in Large Cohorts: Association with Outcomes

Interstitial Lung Abnormalities (ILA) detected on CT scans in four prospective separate cohort studies were associated with a higher risk of all-cause mortality

Framingham Heart Study (FHS): 2633 participants (7% with ILA)

Age Gene/Environment Susceptibility (AGES): 5320 (7%)

COPDGene: 2860 (8%)

COPD Longitudinnally to Identify Predictive Surrogate End-points (ECLIPSE): 1670 (9%)

Putman. JAMA; 2016; 315: 672

Chronic Disease Phenotyping Using Imaging in Large Cohorts: Association with Outcomes

COPDGene cohort

The visual presence and severity of emphysema was associated with significantly increased mortality risk *(N=3171)*

Lynch. Radiology; 2018; 288: 859

In smokers, the combined presence of ILA and emphysema was associated with higher mortality than was emphysema alone *(N=8270)*
ILA enhanced the deleterious effect of emphysema on clinical data severity and mortality

Ash. Radiology; 2018; 288: 600

Radiomics and Machine Learning in Predicting Prognosis and Developing Personalized Medecine

- With radiomics hundreds of imaging features are calculated mathematically. They represent informaton that is not intuitivelly recognizable.

- The ongoing development of artificial intelligence that employs deep learning methods accelerates the search of patterns and correlations to create predictive models based on features extracted from imaging data and corresponding clinical records

Welch. J Natl Cancer Inst; 2017; 109: djx116

Gillies. Radiology; 2016; 278: 563
Langs. Radiologe; 2018; on-line

What is the True Impact of Imaging?

There are many features suggesting an existing link between imaging and clinical outcome,……..

but it is difficult to prove it scientifically!

Comparative Effectiveness and Cost Effectiveness Research

- It may be used to improve decision making capabilities of multiple stakeholders involved in health care
- In addition to referring clinicians, health economics and other health service researchers would be important members of collaborative groups pursuing comparative effectiveness research
- There are numerous complexities in performing cogent comparison given potential variations in outcomes based on differences in demographics

Duong. Acad Radiol; 2016; 23: 18

Improvement of the Value of Imaging

- To develop and promote standardization, guidelines, lexicon, and efficient decisison support system

- To pursue a number of strategies to improve clinicians ability to interact with us:
  - *daily in patients rounds with clinicians of different specialties*
  - *videoconferencing using PACS interface,*
  - *consultation with referent physiscians or intraoperative surgeons,*
  - *participation in multidisciplinary conferences such as tumor boards,*
  - *weekly clinicoradiological conferences with the different specialties*

Duong. Acad Radiol; 2016; 23: 23