Optimising Radiotherapy

Improving outcome and reducing side-effects

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Overview

The Benefits of Providing External Beam Radiotherapy in Low- and Middle-income Countries


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It is not only about getting there faster...

2D Planning  
3D Planning  
IMRT / VMAT  

Improved tumour control  

Increased risk!
It is also about getting there safely...

This what we want to avoid: severe late side-effects

- Skin necrosis
- IQ decline after brain RT (children)
- Growth deformities
- Osteoradionecrosis
- Radiation-induced malignancies

Quality Assurance is key!
Cancer of the prostate
How treatment fields have evolved

The aim of modern radiotherapy: to deliver an effective dose to the tumour – with as low a dose to normal tissue as possible.
We need to *kill* cancer cells **AND** *protect* normal cells

- Lead cut-out
- Lead blocks
- Multi-leaf collimator
- Shield normal tissue

**A BALANCE BETWEEN**
- Tumour control
- Accurate and reproducible positioning

**Complications**

**BETWEEN**

**Computerised planning**
2-Dimensional Planning

Cobalt-60 machine

Radiation fields (shaped with lead blocks)

Field drawn in on Xrays

Hand-drawn 2 D plan

Until “recently” world-wide ...
(Still used in many LMI countries)
3-Dimensional Conformal Radiotherapy

The aim of modern radiotherapy techniques:

- **Highest** possible dose to the tumour & **lowest** possible dose to normal tissue

Visualising the target area accurately is key...

- Sophisticated planning tools
- Reconstruction in all planes
- Multiple beams
- Different planes
- Beam shapers
- Highly skilled staff

- Cobalt-60 teletherapy
- Linear Accelerator (6MV Xrays)
Cancer of the prostate
Outcomes of 2D vs 3D planning

**Tumour control improves with increasing dose**

**Complications decrease with 3D radiotherapy**

Zelefsky, IJROBP 1999
Dearneley et al, Lancet 1999
The Next Step …

**Intensity Modulated RT & Arc Therapy (VMAT)**

- Sophisticated computer software works out the beam arrangement
  - gives the optimal dose to the tumour
  - while keeping the dose to normal structures within tolerance
- The beam shaper now also filters (modulates) the beam
- The machine rotates around the patient during treatment – which can take as little as two minutes

Higher dose and tighter margins than previously possible

Shorter treatment time – therefore more patients treated per day
ARC Therapy (VMAT)
ARC Therapy (VMAT)
Modern Radiotherapy requires a TEAM of highly skilled people

A treatment plan is only as good as it’s quality assurance
Stereotactic Radiosurgery

- High dose of radiation
- Single dose
- Small target
- Brain & eye tumours
Stereotactic Body Radiotherapy

Single / multiple tumours

Infra-red cameras & X-rays localise points on skeleton

Computer ensures patient is accurately positioned for treatment
Brachytherapy

Sealed radioactive sources (radio-isotopes) placed adjacent to, or into, a tumour

- Dose around the applicator (tumour) is **high**
- Dose a short distance from the applicator (healthy organs) is **low**
- Can combine with Xrays / surgery

Cervix cancer

Skin cancer

Prostate cancer

Sarcoma

Remote after-loader
Head & neck cancers

Eye cancers

Tumour of the soft palate

Radioactive iodine orbital implant

2 years later

Radioactive iodine eye plaque

Also used to treat cancer of the oesophagus, bronchus
We have come a long way ...