Step Towards the Implementation of Volumetric Modulated Arc Therapy (VMAT) Technique for Total Body Irradiation (TBI)

SNF

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BACKGROUND & AIM

Haematologic malignancies, 2022

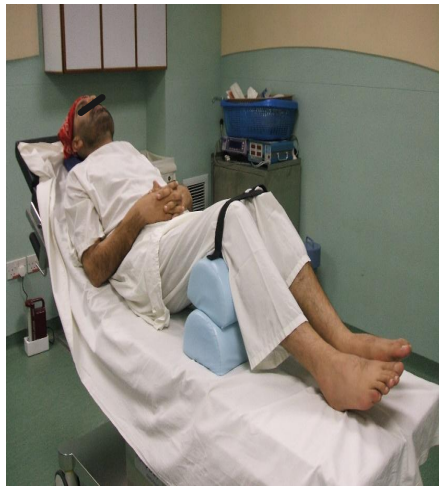
6.6%

of all cancer cases

7.2%

of cancer deaths

Conventional TBI



- Extended SSD (3–5 m)
- Single large AP/PA field
- Dose inhomogeneity, limited OAR sparing

VMAT-based TBI

- Improved target coverage
- Reproducible delivery
- Effective OAR sparing

IMRT, VMAT and helical tomotherapy all show improved dose distribution

AIM

Implement VMAT for TBI and evaluate

- **PTV coverage**
- **Homogeneity index**
- **OAR sparing**
- **EPID dosimetric verification**

Sources: Sun et al. 2025 (GLOBOCAN 2022); Wills et al. 2016; Lo Greco et al. 2025; Ouyang et al. 2017; Hui et al. 2024

METHODS

5

patients previously treated with TBI (90–106 cm)

5–6

isocenters with overlapping arcs for uniform junctions

13–14

VMAT arcs, 6 MV photons

12 Gy / 8 fx

prescription dose

HFS + FFS

two plans in Eclipse 15.6

3%/3 mm

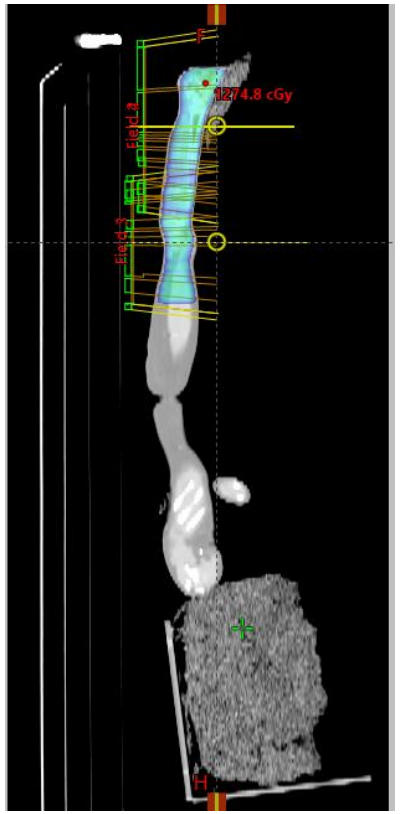
EPID portal dosimetry QA, >95% pass

PTV: body minus 5 mm, excluding lens, lungs, kidneys
OARs: lungs, kidneys, lens

HFS plan

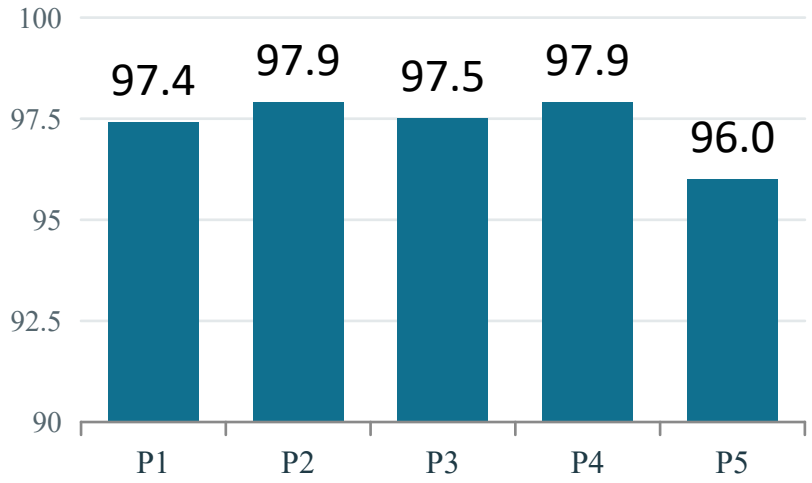


FFS plan



Sources: Seravalli et al. 2024 (PTV definition); Hoeben et al. 2022 (prescription); Miften et al. 2018, AAPM TG-218 (gamma criteria)

RESULTS



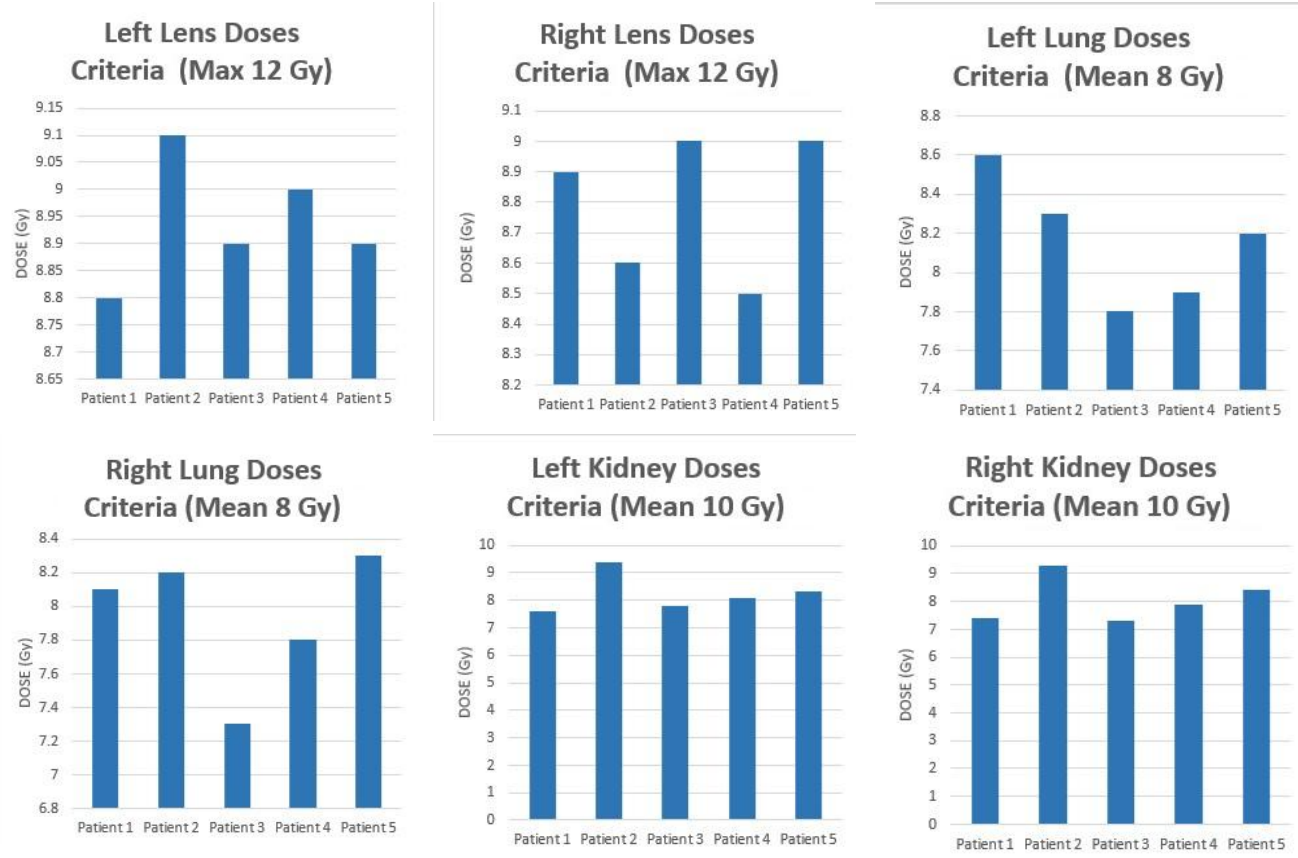
0.19–0.24

Homogeneity index

99–100%

EPID gamma pass rate (3%/3 mm)

OAR doses per patient vs. ESTRO-ACROP criteria



Criteria: PTV, Seravalli et al. 2024 and ICRU 83; OAR, Hoeben et al. 2022 (ESTRO-ACROP/SIOPE); gamma, Miften et al. 2018. P1–P5 = patients 1–5.

DISCUSSION

Clinically acceptable PTV coverage with controlled dose at junctions

EPID portal dosimetry confirmed delivery accuracy of multi-isocenter VMAT

Limitations

- Dual (HFS and FFS) plans required
- Longer planning and delivery time
- QA limited to EPID portal dosimetry
- Delivery constrained by tabletop
- Small cohort (feasibility phase)

Future work

- Rotatable tabletop integration
- Larger patient cohort
- Independent MU verification
- Dosimetric comparison with conventional TBI

SUMMARY

96–97.9%

PTV receiving ≥90% of prescribed dose

0.19–0.24

Homogeneity index across 5 patients

99–100%

EPID gamma pass rate (3%/3 mm)

VMAT-based TBI planning and EPID QA are feasible