Proton radiotherapy for left-sided breast cancer in patients with pectus excavatum anatomy

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Background and aim

What is pectus excavatum anatomy?

Indented chest wall

Short distance sternum to vertebrae

Why is pectus excavatum anatomy challenging for radiotherapy?

Wide tangents photon therapy covering whole breast+IMN gives large inclusion of organs at risk

In this project we investigate whether more advanced treatment options, in particular proton therapy, can provide a solution for this patient group.

Conclusions

- Pectus excavatum is a challenging anatomy for standard tangential photon radiotherapy
- VMAT improves plan quality, but not enough
- With proton therapy, target coverage is achieved with good sparing of organs at risk for all patients
- With proton therapy, there is a high degree of treatment plan consistency between patients
- For this subgroup of breast cancer patients the benefit from proton therapy is so large that it should be considered as an immediate indication for referral

Study setup

Five patients were included
- Previously treated for cancer in the left breast
- Presenting with visual confirmation of pectus excavatum anatomy

Treatment plans compared for three planning strategies (Eclipse 13.7)
- Tangential fields plus few patch fields
- VMAT plans with two arcs with separate isocenters medially and laterally
- Proton plans (pencil beam scanning) with two anterior fields

Plan objectives were:

- Prescription dose: 50 Gy in 25 fractions
- Target dose (PTV): between 95% and 107%
- Heart: $V_{40Gy} < 5\%$ and $V_{20Gy} < 10\%$
- LAD: $V_{20Gy} = 0\%$ and $V_{10Gy} < 5\%$
- Ipsilateral lung: $V_{20Gy} < 25\%$ and mean dose <18Gy

Results

Dashed lines: single patient DVHs
Solid lines: average DVHs

Additional factors to be considered:
- Risk of high skin dose when using 1-2 proton fields
- Robustness of proton plan towards setup uncertainties
- Interplay effects as result of breathing motion during pencil beam scanning
- Swelling or other anatomical changes which may happen during the course of radiotherapy
- Potential effects of increased LET at the distal edge of Bragg peaks near the heart and LAD