

An Investigational study of unacceptable monitor units in Stereotactic ablation radiotherapy (SABR) VMAT plans

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INTRODUCTION

Purpose

To investigate an erratic and unpredictable behaviour of a treatment planning system (TPS), which generate unnecessary alarmingly high monitor units (MUs) for SABR volumetric modulated arc therapy (VMAT) plans.

Background

- SABR technique is used to deliver highly precise radiation therapy treatment in small number of high dose fractions. Treatment is delivered precisely and efficiently, while patient is immobilized using dedicated site specific immobilization devices.
- Using advanced techniques e.g. IMRT/VMAT, highly conformal doses can be delivered to the target volumes, while sparing the organs at risk.
- Highly modulated treatment plans comes at the expense of high MUs.
- These increased MUs contributes to the increased in treatment time and increase in out-of field doses to the patient¹.
- Increase in out-of field dose (to normal tissues, outside the treated volume) can increase the chances of secondary cancers^{2,3}.
- Kry et al. discussed the various techniques which can be utilized to minimize the out of field doses¹. Huang et al. shows the use of optimizing planning parameters to reduce the MUs and shorten the beam-on time significantly for lung SABR plans, without compromising the plan quality⁴.

MATERIALS AND METHODS

Patient Selection

- 39 patients with different treatment sites were selected for this study (Table 1).
 - 36 plans were VMAT and three were IMRT
 - 14 plans were with standard prescriptions and 25 were SABR prescriptions.

Table 1: Treatment sites and no. of patients

Site	No. of patients	Site	No. of patients
Liver	18	Head and Neck	5
Lung	3	Prostate/pelvis	7
Spine	3	Gyne.	1
Brain	1	Shoulder	1

Treatment plans

- Treatment plans were generated using Eclipse treatment planning system (version 10.0, Varian Medical Systems, Inc, Palo Alto, CATM).
- Plan optimization and dose calculations were performed with the progressive resolution optimizer (PRO) algorithm versions PO13.6 and PO15.6 and Anisotropic Analytic Algorithm (AAA).
- For every plan, all the optimizing parameters and plan objectives were kept same except changing the optimizer.
- These plans were generated to deliver on Varian TrueBeam Linac.
- Plans were compared for plan quality (PTV coverage, OAR doses and QA passing rate) and total number of MUs to deliver the treatment.

RESULTS AND DISCUSSION

- Algorithm version PO15.6 produced an inconsistent, unpredictable increase in MUs. For 6 out 18 liver SABR VMAT plans, for similar quality plans using PO15.6 optimizer resulted in >13% increase (with a maximum increase up to 80% in come cases) in MUs as compared to PO13.6 (Figure 1).
- This increase in MUs doesn't contribution to the quality improvement of treatment plans.
- No logical justification was found for this erratic behaviour of PO15.6 optimizer, due to its non-reproducible nature.
- An unnecessary increase in MUs can result in:
 - an increase in patient's time on treatment table, increase chances of patient movement, and hence increase chances of mistreatment.
 - an increase in out of field doses to patient and increase chances of secondary cancers.
 - the increase in machine workload and waste of treatment units' valuable time and resources.

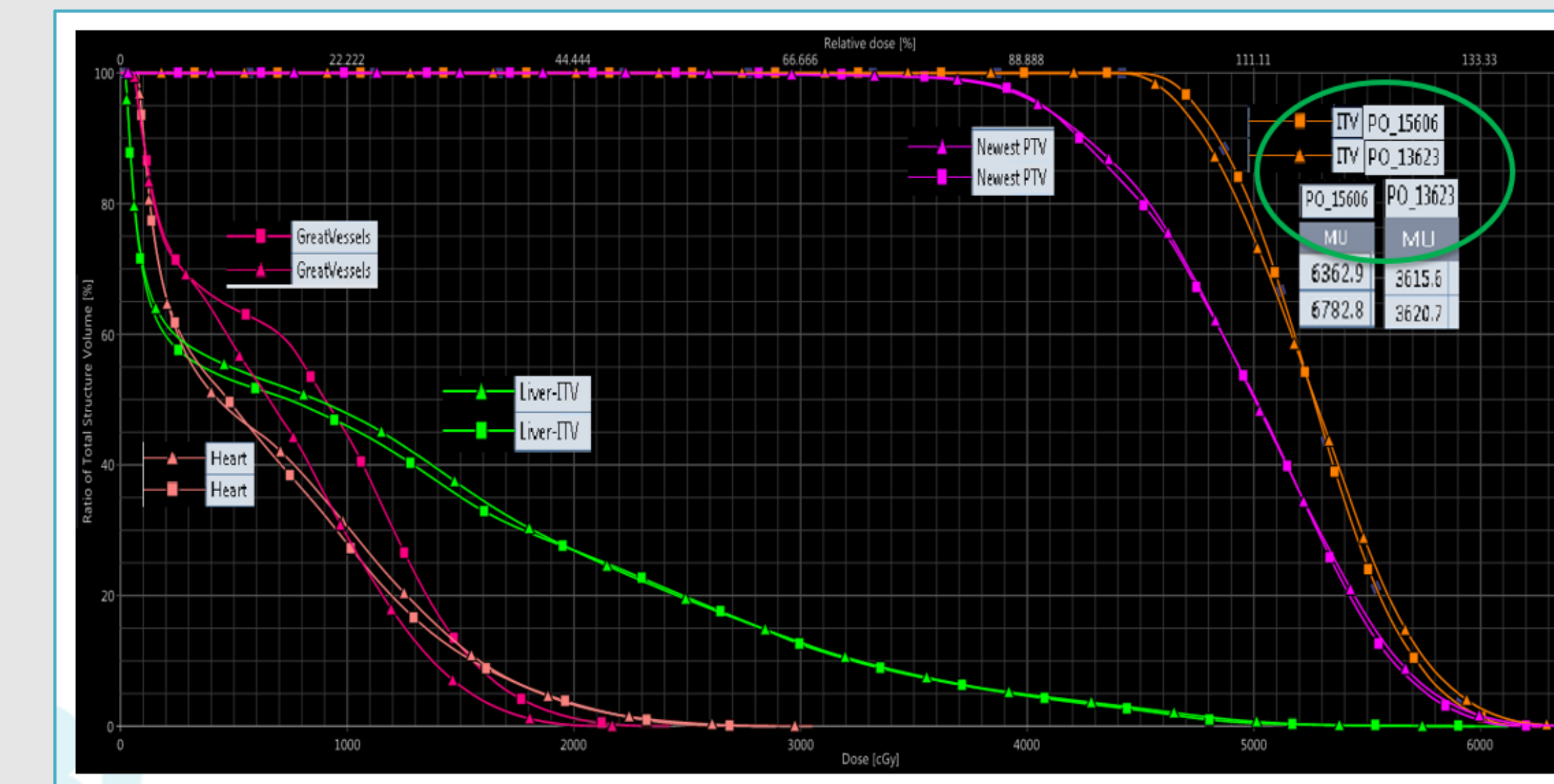


Figure 1: Dose volume histogram comparing a liver plan calculated with algorithm versions PO13.6 and PO15.6.

CONCLUSIONS

- These unreasonable increase in MUs can negatively impact the goal of SABR treatments by increasing the treatment time, reducing treatment efficiency and efficacy, and increasing out of field dose.
- Efforts and strategies should be implemented to remove any undesired MUs, while creating the quality treatment plans.

REFERENCES

- [1] Kry et. al. Med. Phys. 44 (10) 2017, e391-e 429.
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