Preliminary results of an international multi-modality in-silico trial for lung cancer

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Introduction

The In Silico trial investigates whether , with the same dose on the tumor, particle therapy decreases irradiation of normal tissue and therefore decreases the risk of both side effects and of secondary tumor induction. The expected outcome of the study is to identify (sub) groups of patients who might benefit from particle therapy. During the first phase of our international study multiple treatment plans will be designed for each of twenty-five lung cancer patients. A wide variety of external beam radiotherapy techniques and modalities will be used; protons and carbon ions (both passive scattered and IMPT), and photons (conformal, IMRT, Tomotherapy). Typically, each planning technique is applied by a different institute. The study will assess the benefit of using each modality and delivery technique only, assuming, e.g., uniform patient setup accuracy, breathing motion and fractionation schedules.

Materials & Methods

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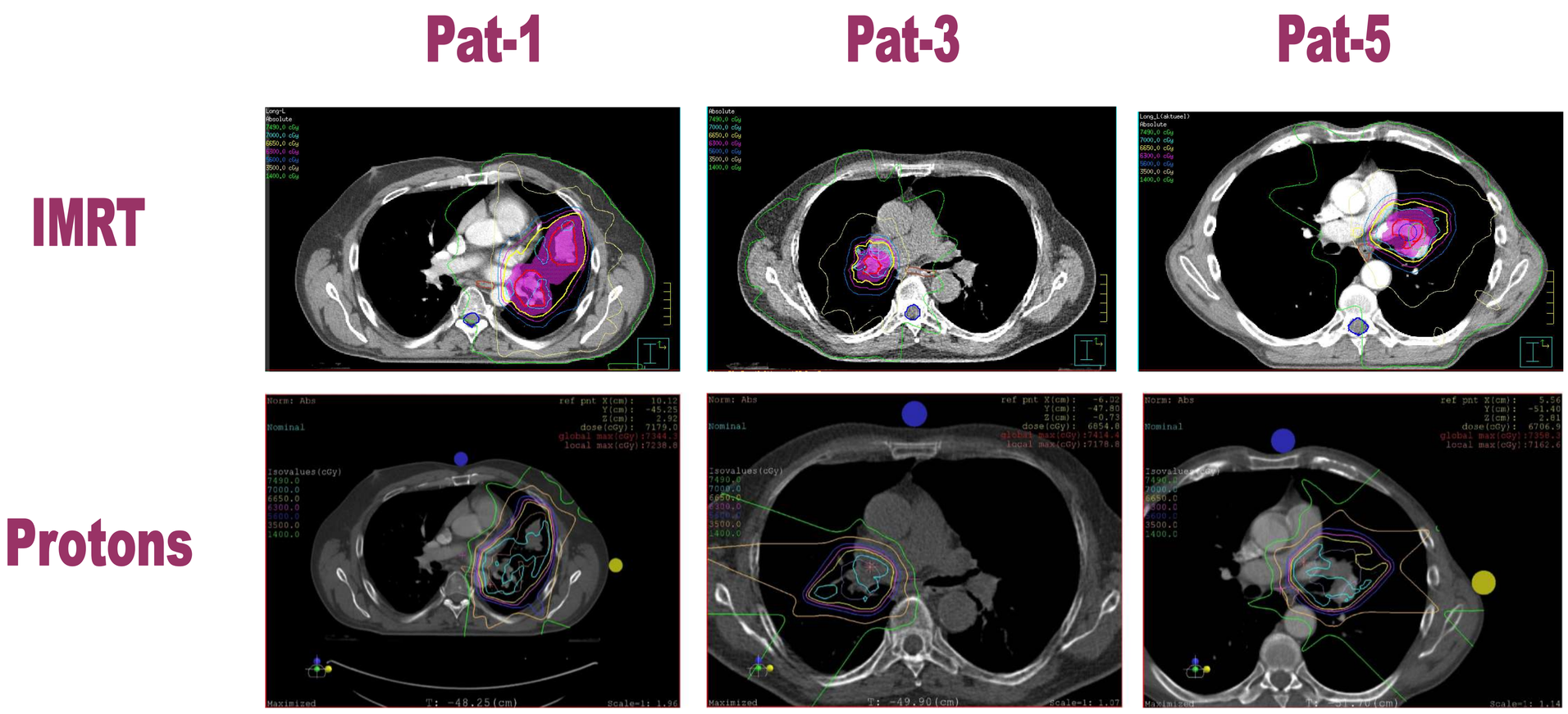

Fig 1. Example of dose distribution of IMRT and Protons calculated in three different patients. The isodose levels shown are, respectively 100, 95, 80, 50 and 20 %.

Results

Submitted treatment planning data for three patients currently only allows a comparison between IMRT (performed by NKI) and passive-scattered protons (performed by MGH). See fig 1. The IMRT plans for two patients did not fulfill the criterion that only 2 % of the PTV was allowed to receive more than 107 % of the prescribed dose. All proton and IMRT plans stayed within the dose limits for lung, esophagus and heart. See table 1. The priorities of the treatment planning were 1=spinal cord, 2=lungs, 4=esophagus, 3=plexus brachialis, 5= heart. The treatment planning took into account the motion and setup errors for protons. However, the set up errors were mistakenly dropped when the ITV was drawn for the photon plans. This resulted a smaller treatment volumes for IMRT than for protons. The correct ITV were on average +0.4, +0.2 and +0.2 cm larger in the CC, AP and LR directions. The expansion of the photon ITV leads to increasing the irradiation of the surrounding normal tissues and the results are more in favor of the protons.

Conclusion

The technical hurdles for our study have been overcome and treatment planning data is being gathered from all participating centers. We hope that the completed study will provide an indication regarding the possible benefit of particle therapy. The preliminary results demonstrate a significant reduction of mean lung dose by more then 25 %, which gives the opportunity of dose escalation at an isotoxic level.

Table 1. The dose limits and the average mean dose delivered for the Lung (lung volume was calculated as LL+LR- GTV) , the heart and the Esophagus. Doses are reported in Gy for the three patients (1,3 and 5 used for the study.

	U-limit	IMRT	Proton
Lung (MD)	19,0	12,8	8,6
Heart (MD)	60,0	4,0	0,1
Esophagus (MD)	34,0	11,4	7,3