Purpose or Objective: For NSCLC patients treated with SBRT, we investigated if dose to the heart and its substructures is associated with non-cancer death.

Material and Methods: From 2006-2013 801 patients with early stage NSCLC were treated with CBCT guided SBRT (median 54 Gy in 3 fractions) in 5 institutes for whom treatment plans were available. 565 patients were analyzed after exclusion of synchronous or metachronous tumors (n=80), follow-up<1y (n=63), or death from cancer (93). An average anatomy was constructed based on 109 patients of the 5 institutes using deformable image registration. Subsequently, all patients were registered to this average anatomy and the corresponding dose distribution was deformed accordingly [1]. The heart and substructures right atrium, left atrium, right ventricle, left ventricle, superior vena cava, descending aorta and left pulmonary artery were contoured on the average anatomy. For each (sub)structure dosimetric parameters DV (V: 0 cc-max), VD (D: 0 Gy-max), EUdn (n: 0.1-10) were obtained. Associations of these dosimetric parameters with death were evaluated using univariate Cox regression. Per (sub)structure the parameter with the lowest Akaiake information criterion was selected and used in subsequent analyses. Correlations between all (sub)structures were assessed prior to inclusion in a multivariate Cox regression. Finally, the (sub)structure(s) that remained significant in the first multivariate analysis were included in a second multivariate analysis, also including: performance status, age, gender, biological dose, distance to bronchus, comorbidity index, lung-function, tumor diameter, T-stage, institute and pack years smoking.

Results: With a median follow-up of 28 months, 58% of patients were alive. 3% had a central tumor. Univariate analysis showed significant associations between the (sub)structures and death. The most predictive parameters per (sub)structure are shown in table 1. Correlations between the heart and it’s substructures was strong (average 0.7). As dose to the heart was also represented by dose to the heart substructures, heart_D0 was not included in the multivariate analysis. Maximum dose to the left atrium and dose to 2 cc of the superior vena cava were significant in the multivariate analysis (p=0.033, HR=1.012 and p=0.034, HR=1.022 respectively). Association between survival and these parameters is shown in figure 1. In the second multivariate analysis these parameters remained significantly associated with death, as well as age (p=0.001, HR=1.034), performance status(p=0.004, HR=1.138), comorbidity index (p=0.032, HR=1.125), lung-function (p=0.001, HR=0.984) and pack years smoking (p=0.004, HR=1.011).

Conclusion: For these NSCLC patients treated with SBRT we found significant associations between non-cancer death and the maximum dose on the left atrium, and to the D2cc of the superior vena cava. Consequently, heart sparing potentially improves outcome.

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Risk estimation of cardiac toxicity following craniospinal irradiation of pediatric patients.
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Purpose or Objective: Craniospinal irradiation (CSI) plays an important role in the treatment of medulloblastoma and improvement in treatment during the last decades has resulted in good prognosis. CSI is most commonly delivered with photons or a combination of photon/electrons. However, proton therapy is generally indicated as it lowers the dose to normal tissues and potentially reduces the risk of late effect. The aim of this study was therefore to compare the estimated risk of cardiac toxicity following CSI using photons, electrons and protons.

Material and Methods: CSI treatment plans including conformal photons, electrons/photons combined, double scattering protons (DS) and intensity modulated proton therapy (IMPT) were created in the Eclipse treatment planning system [Varian Medical Systems, Palo Alto, CA, USA] for six pediatric patients. The CTV included the brain and the spinal canal, for the protons the CTV was expanded to also include the entire vertebral body to prevent asymmetric growth of the skeleton. During treatment planning a setup uncertainty of 5 mm was taken into account, as well as an uncertainty in the proton range of 3.5 %. The prescribed dose for all techniques was 23.4 Gy(RBE). Dose-risk models derived from two independent pediatric patient cohorts were used to estimate the risk of cardiac toxicity. The excess Relative Risk (ERR - relative to general population) for cardiac mortality was estimated using a linear model [1], while ERR for cardiac failure and disorder were estimated using both a linear and a linear-quadratic (LQ) model. Input parameters were the mean heart dose, and the parameters (with 95 % Confidence Interval (CI)) displayed in Table I. The Relative Risk (RR) was