Purpose:
To establish a radiobiological basis for gated stereotactic body radiotherapy of primary and metastatic liver cancers using volumetric arc radiotherapy in a flattening filter free (FFF) mode.

Methods:
Human cervical carcinoma, SiHa, non-small cell lung carcinoma, H460, and Chinese hamster V79 cells were irradiated in a water bath with 6MV photons from a Varian TrueBeam linear accelerator. To establish dose-response and its sensitivity to dose rate following acute irradiation, doses of 2, 4, 6, 8 and 10 Gy were delivered in FFF mode at 400 and 1200 MU/min. To investigate whether removal of the flattening filter affects cell response, doses of 5 and 10 Gy were delivered to SiHa and H460 cells in FFF and filtered modes at 400 MU/min. Finally, to assess the effect of protracting dose delivery by gating, a dose of 10 Gy was delivered to SiHa and H460 cells acutely and also over 15, 30 and 60 min.

Results:
Dose-response over doses examined was independent of dose rate in FFF mode. Differences in cell survival following irradiation in FFF and filtered modes were not significant. However a significant increase in survival for both H460 and SiHa cells was observed for 15 min split-dose irradiation compared to acute irradiation but further increase in irradiation time to 60 min did not affect cell survival.

Conclusions:
Dose rate and presence of a flattening filter showed no effect on cell survival, however, survival was significantly affected when dose delivery time was protracted to that typical of conformal field therapy. Volumetric arc based gated SBRT may be beneficial for tumor cell kill, though the gating window and duty cycle have to be balanced against the effect of dose delivery protraction.

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