

Teaching Case

Pregnancy discovered during radiation of an atypical meningioma

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Introduction

The inadvertent or intentional radiation of a pregnant patient is unusual. In many cases, radiation can be delayed or avoided, especially when known in advance. Minimizing fetal risks presents several technical challenges. In a review of the available literature on the risk of congenital malformations and intellectual disabilities in persons radiated in utero, the American Association of Physicists in Medicine task force established a threshold of 10 cGy, above which the incidence of fetal malformation is statistically different from the nonirradiated population. We illustrate the techniques used to minimize fetal dose.

Case description

In this case, we describe a 26-year-old white woman previously in good health, who presented with grand mal seizures. Magnetic resonance imaging (MRI) of the brain demonstrated a 4 cm mass in the parietal lobe (Fig. 1A). She eventually underwent a parietofrontal craniotomy with subtotal resection, which revealed a World Health Organization grade II atypical meningioma. There was noticeable

signal change suspicious for residual disease (Fig. 1B) and the patient was offered adjuvant radiotherapy.

Her original radiation treatment plan consisted of partial brain radiation using intensity modulated radiation therapy (IMRT) with 6 mV photons and simultaneous integrated boost using 6 noncoplanar beams (Fig. 2A). A dose of 54 Gy in 1.8 Gy/fraction would be delivered to the surgical cavity, whereas the residual disease would receive to 60 Gy in 2 Gy/fraction. On May 29, 2013, a urine pregnancy test performed immediately before computed tomography (CT) simulation was negative.

The patient had received 14 fractions by July 8, 2013, when she revealed to the staff that she was late with her menstrual cycle. A quantitative β -human chorionic gonadotropin test measured 10,293 mIU/mL. An ultrasound revealed a 6-week-old fetus likely conceived within a few days of the original CT simulation. Radiation treatments were immediately halted and she was referred to a maternal-fetal specialist. Meanwhile, a special physics consultation was ordered and a calculation of the dose received up to this point was performed. The estimated fetal dose from the CT simulation was <0.001 cGy and considered negligible. An anthropomorphic phantom of the thorax/abdomen/pelvis with a simulated uterus was constructed and an ionization chamber was placed inside. The total dose and the absorbed dose per fraction were calculated (Table 1); the fetus likely received 2.31 cGy.

In consultation with a maternal-fetal specialist, it was conveyed to the patient that there was a small risk of congenital malformations and intellectual disability associated with radiation during pregnancy; however, it was

Conflicts of interest: None.

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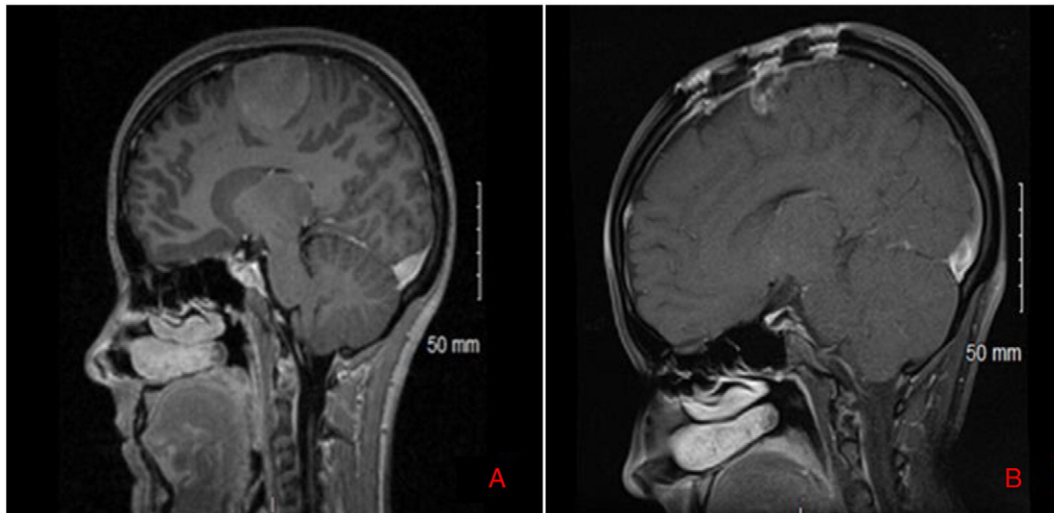


Figure 1 Magnetic resonance imaging. (A) Preoperative. (B) Postoperative day 5.

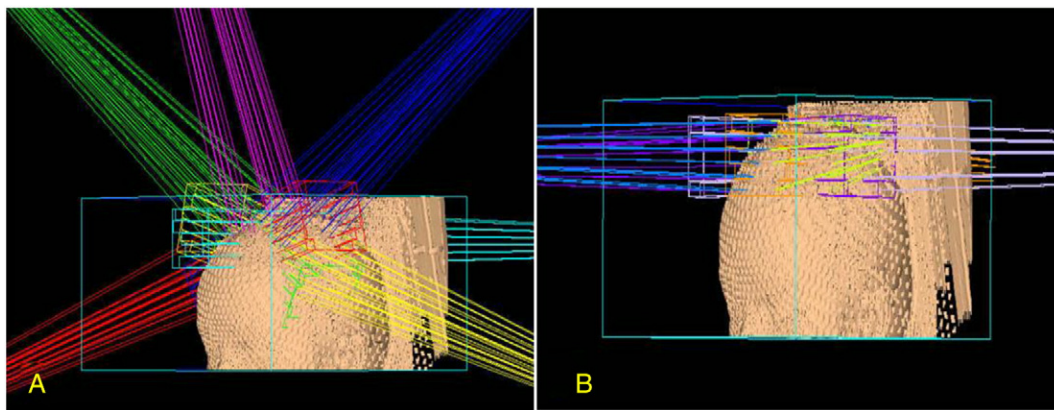


Figure 2 Intensity modulated radiation therapy. (A) Original 6 beam noncoplanar plan. (B) Revised plan with coplanar beams.

likely associated with a threshold effect at around 10 cGy. A termination of pregnancy was not recommended at projected radiation doses less than 10 cGy. Ultimately, she decided to continue the pregnancy and treatment.

The patient was replanned, and the prior dose to the fetus was calculated. The IMRT plan was modified to 5 coplanar beams for the remaining 16 fractions (Fig. 2B). This was done to eliminate any primary beams being directed at the pelvis

that would add to fetal exposure. A mobile pelvic shield was constructed consisting of a metal frame that accommodated several lead bricks that would be wheeled over the patient during treatment to reduce exposure from scatter (Figs. 3 and 4). Phantom dosimetry measurements were taken with this new plan with and without shielding. The total dose over the remaining 16 fractions would be 0.373 cGy for a total of 2.68 cGy for the entire course of treatment (Table 2).

The patient completed treatment on August 1, 2013, without any complications. Follow-up MRI scans has not shown any recurrence in the area treated or any new areas of tumor. The patient has been seizure free since her surgery. In March 2014, the patient gave birth to a baby girl. No obvious signs of congenital defects were apparent at the time of birth. The child is currently 3 years old with no medical history and normal cognitive development.

Discussion

Planning and delivering radiation in the midst of pregnancy is technically challenging for staff and takes an

Table 1 Measurement of absorbed dose of the 6 noncoplanar beams used in the original plan

Gantry angle (°)	Table angle (°)	Measured dose per fraction (cGy)
270	330	0.003
70	90	0.118
90	345	0.012
90	30	0.007
270	15	0.02
180	0	0.005
Total dose per fraction		0.165
Total dose for 14 fractions		2.31

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