



Magnetic resonance imaging (MRI) features of cataracts in pediatric and young adult patients

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Background: The goal of this study is to systematically evaluate the magnetic resonance imaging (MRI) signal characteristics and size of cataracts that may be encountered in pediatric and young adult patients.

Methods: A retrospective analysis of the MRI features with cataracts in a series of cases, including characterization of signal intensity on T2-weighted and T1-weighted sequences, as well as measuring the thickness of the lens.

Results: Among nine cataracts in seven patients, three lenses were thickened and hyperintense on T2-weighted sequences, presumably related to osmotic effects. The rest of the lenses were either normal in size and signal characteristics, such as in the cases of neurofibromatosis type 2 or small in cases of microphthalmos, with signal characteristics related to calcifications.

Conclusions: There are several different types of cataracts that can occur in pediatric and young adult patients, which may or may not be conspicuous on MRI. The findings in this study can serve as a guide for what abnormalities of the lens may be encountered on MRI.

Keywords: Magnetic resonance imaging (MRI); cataract; lens; T2 signal; radiology; pediatric

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Introduction

Cataracts are uncommon in the pediatric and young adult population and can be classified as congenital if present within the first year of life, developmental if present after infancy, or traumatic. Early diagnosis and treatment are crucial to prevent irreversible stimulus-deprivation amblyopia. Although the diagnosis of cataracts is usually based on slit lamp examination (1,2), an abnormal appearance of the intraocular lens can sometimes be observed on diagnostic imaging. However, there is rather sparse literature regarding the with reports limited to osmotic cataracts in animal models on magnetic resonance imaging (MRI) and traumatic cataracts on computed tomography (CT) (3,4). The purpose of this study is to systematically evaluate the MRI signal characteristics and

size of cataracts that may encountered in pediatric and young adult patients.

Methods

The study protocol was approved by our institutional review board (IRB19-0911) and written informed consent was waived due to the low risk nature of this study. The imaging database at our institution was retrospectively searched for patients under the age of 21 years with a reported clinical history of cataracts and available MRI before cataract removal during a 10-year interval. The MRI protocol details are listed in *Table 1*. The signal characteristics of the cataracts were qualitatively assessed on T2-weighted and T1-weighted sequences and the thickness of the lens through the midpoint was measured on axial T2-

Table 1 MRI protocol details

MRI protocol	Slice thickness	Field of view	Matrix size	Sequence parameters
Orbits	3 mm	160 mm	256×256	STIR: TR, 2,700 ms; TE, 58 ms; TI, 150 ms T1: TR, 410 ms; TE, 10 ms
Brain	4 mm	200 mm	320×320	T2 spin echo: TR, 8,000 ms; TE, 120 ms T2 FLAIR: TR, 13,000 ms; TE, 140 ms; TI, 2,800 ms T1 spin echo: TR, 600 ms; TE, 10 ms

MRI, magnetic resonance imaging; STIR, short tau inversion recovery; FLAIR, fluid attenuated inversion recovery; TR, repetition time; TE, echo time; TI, inversion time.

Table 2 Patient demographics, clinical history, and MRI findings

Case	Age (years)	Gender	Clinical history	Lens thickness (mm)	Signal intensity on T2-weighted sequences	Signal intensity on T1-weighted sequences
1	8	Male	Left orbit rhabdomyosarcoma treated with chemotherapy with proton radiotherapy; radiation-induced partial, but dense left cataract	5	High	Slightly high centrally
2	7	Female	Left cataract. Neurofibromatosis type 1 without neurological symptoms and no history of radiation exposure or trauma	6	High	Slightly low
3	20	Female	Right cataract. cerebral palsy, developmental delay, ischemic stroke, multiple seizures	6	High	Slightly low
4	12	Male	Right cataract, bilateral retinal hamartomas. Neurofibromatosis type 2	3	Normal low	Normal intermediate
5	7	Female	Bilateral posterior subcapsular cataracts. Neurofibromatosis type 2	3 bilaterally	Normal low bilaterally	Normal intermediate bilaterally
6	8	Female	Congenital microphthalmia with intraocular calcifications, including in the right lens with cataract	2	Heterogeneous, mainly low	Heterogeneous, partly high
7	1	Male	Bilateral cataracts, microcornea, aniridia, and anteriorly dislocated right lens, glaucoma associated with anterior segment anomaly; septo-optic dysplasia	1 bilaterally	Normal low bilaterally	Normal intermediate bilaterally

MRI, magnetic resonance imaging.

weighted images. The images were reviewed by a board-certified radiologist with certificate of added qualification in neuroradiology.

Results

A total of nine cataracts in seven patients with corresponding MRIs were identified. The patient demographics, clinical history, and MRI findings are

included in *Table 2*. There were three cases in which the lens was thickened, which were all presumably acquired. In those cases, there was also high signal on T2-weighted sequences (*Figure 1*). The corresponding signal characteristics on T1-weighted sequences were slightly hypointense in two cases and mildly hyperintense centrally in the case of radiation-induced cataract. The rest of the cases were presumably all congenital or developmental in nature and featured normal lens sizes in cases with globes of normal size or thin lenses

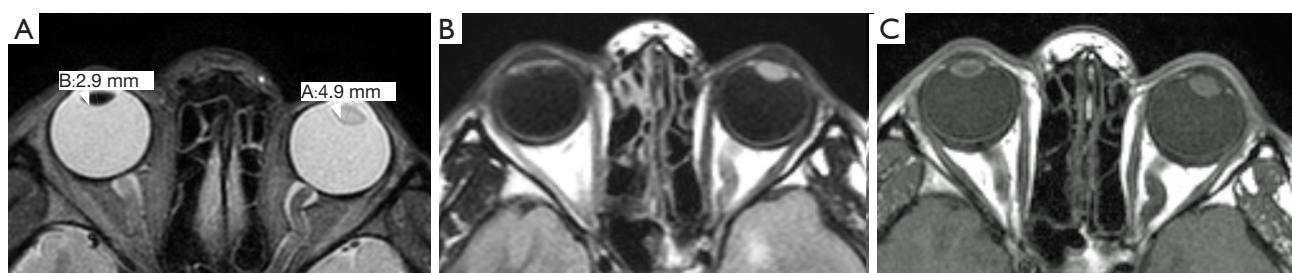


Figure 1 The patient (case 1) has a history of radiation-induced left cataract. The MRI obtained approximately 3 years after radiation therapy demonstrates high signal and thickening of the left lens on the axial STIR (A) and T2-weighted FLAIR (B) sequences. There is also mild high T1 signal within the central portion of the left lens (C). MRI, magnetic resonance imaging; STIR, short tau inversion recovery; FLAIR, fluid attenuated inversion recovery.



Figure 2 The patient (case 4) has a history of neurofibromatosis type 2 with a right cataract. The right lens displays normal signal and size on the axial STIR (A) and T1-weighted (B) MRI sequences. MRI, magnetic resonance imaging; STIR, short tau inversion recovery.

in cases with microphthalmia and microcornea. Likewise, the signal characteristics were normal on T1-weighted and T2-weighted sequences, such as in the patients with neurofibromatosis type 2 (Figure 2) or influenced by the presence of underlying calcifications.

Discussion

This study indicates that MRI features of cataracts in pediatric and young adult patients vary depending upon the particular type. The most striking finding in this series is the high signal on T2-weighted sequences and

thickening of the lens in presumably acquired cases of traumatic cataracts. Disruption of the lens capsule can lead to increased permeability and influx of water and sodium into the lens substance. Furthermore, several osmotic cataract models and human diabetic lenses can display changes observable on MRI attributable to increased hydration (4). This may account for the high signal on T2-weighted sequences, low signal on T1-weighted sequences, and swelling of the lenses observed in this report. There may be additional intraocular findings pertaining to trauma, such as retinal detachment (5), which was observed in case 3 of this series, along with hypoattenuation of the lens on the corresponding CT (3).

Radiation-induced cataracts result from a complex process involving multiple pathways including damage to the lens extracellular matrix, proteins or membrane lipids, and DNA with alteration of gene and protein expression causing altered lens protein functions and morphology, mainly affecting the posterior subcapsular portion of the lens (6). The high signal on T2-weighted sequences and swelling of the lens with radiation-induced cataract in this study may be attributable increased hydration, analogous to traumatic cataracts, while the high signal on the T1-weighted sequence may be related to changes in protein content.

Although the eye and ocular adnexa are frequently involved in patients with neurofibromatosis type 1 (NF1), such as Lisch nodules, plexiform neurofibromas and optic gliomas (7), there is no well-established association with cataracts. Interestingly, the patient with NF1 in this report did not have other orbital abnormalities and the cause of the cataract in this patient may have been unrelated to NF1. On the other hand, neurofibromatosis 2 is associated with early onset plaque-like posterior subcapsular or capsular cataracts

and cortical cataracts (8,9). However, these cataracts are not discernible on MRI, as suggested by the cases in this series.

Microphthalmos is often accompanied by congenital cataracts (10). As noted in this series, in addition to a small lens, such congenital cataracts can contain calcifications. On MRI, calcification can manifest with various signal intensities on conventional spin echo T1- or T2-weighted images, which makes it difficult to identify definitively as calcium (11).

Conclusions

There are several different types of cataracts that can occur in pediatric and young adult patients, which may or may not be conspicuous on MRI. The findings in this study can serve as a guide for what abnormalities of the lens may be encountered on MRI.

Acknowledgments

None.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Ethical Statement: The study protocol was approved by our institutional review board (IRB19-0911) and written informed consent was waived due to the low risk nature of this study.

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