Analysis of True Time Burden when Adding Anesthesia and Contrast to Pediatric MRI: An Institutional Experience

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Objective

- Administration of anesthesia and gadolinium-based contrast agents adds significant time and resources to MRI exams
- Anesthesia has well-documented risks in pediatric patients
- The long-term risks of gadolinium-based contrast use in pediatric patients remains unknown
- Recent studies have demonstrated that MRI may be performed for a variety of clinical indications (e.g., sacroiliitis, IBD, MSK infection) without the need for contrast
- Non-sedated MRI has been shown to successful in pediatric age groups for acute brain, abdominal, and MSK imaging
- The present study sought to examine the time burden of anesthesia and IV contrast in pediatric MRI at our institution
- It is critical to understand this burden in order to mitigate workflow disruptions, overutilization of resources, costs, and, most importantly, risk to patients

Methods

- A retrospective analysis of all pediatric MRI exams (body, MSK, neuro) requiring anesthesia and/or IV contrast performed at a tertiary children's hospital system from January 1, 2018 to December 31, 2019 was conducted
- Data were gathered from 4 clinical sites

Contrast

- 4,233 contrast-enhanced MRI exams were identified
- The following timepoints were recorded: exam start, contrast administration, and exam end
- Contrast burden was calculated as the elapsed time between contrast administration and exam end and expressed as a proportion of total exam time
- Observed exam times were stratified by MRI type and compared to expected times published in MRI protocol manuals using one-sample *t*-tests

Anesthesia

- 6,247 MRI exams requiring anesthesia were identified and grouped into those requiring general anesthesia (GA, *n* = 5,252) and conscious sedation (CS, *n* = 995)
- The following timepoints were recorded: preoperative start time, anesthesia induction, and time out of MRI room
- The anesthesia encounter was defined as the elapsed time between anesthesia induction and time out of MRI room and expressed as a proportion of total exam time

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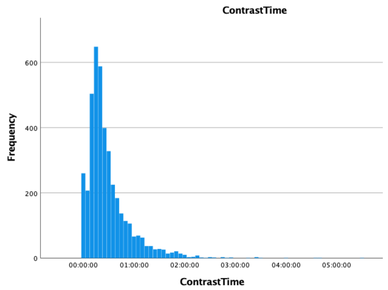
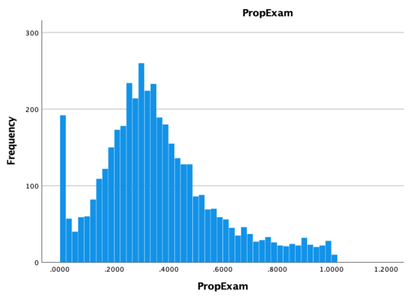
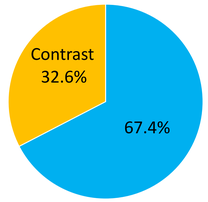
Results

Contrast Burden







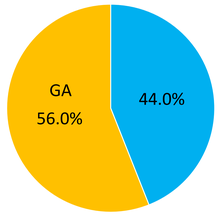
- Mean total exam time for contrast-enhanced exams was 1 hour 19 minutes (SD = 41 minutes, Range: 2 minutes to 13 hours 8 minutes)
- Mean contrast burden was 29 minutes (SD = 26 minutes, Range: 0 minutes to 5 hours 32 minutes)
- On average, 32.6% of exam time was attributed to contrast administration (SD = 21.4%)

Exam Type	*N*	Expected Exam Time (hh:mm:ss)	Mean Observed Exam Time (hh:mm:ss)	Excess Exam Time (hh:mm:ss)	*t*	*p*
Brain	1,881	0:30:57	1:05:11	0:34:14	33.70	< 0.001
Spine	249	1:21:50	1:20:13	0:01:36	-0.55	0.59
Ankle Osteomyelitis	23	0:31:31	1:26	0:54:39	9.69	< 0.001
Hip Osteomyelitis	6	0:33:13	1:04:28	0:33:15	4.24	0.008
Pelvis Osteomyelitis	123	0:37:09	1:13:39	0:36:30	11.56	< 0.001
Knee Tumor	37	0:33:08	1:20:38	0:47:30	9.27	< 0.001
Long Bone Tumor	19	0:35:07	1:41:56	1:06:49	5.41	< 0.001
Enterography	79	1:00:00	1:22:45	0:22:45	5.01	< 0.001
Neck	63	0:25:00	1:07:48	0:42:48	10.50	< 0.001
Weighted Mean		0:37:13	1:08:27	0:31:33	35.92	<0.001

- Overall, mean observed exam times were statistically significantly longer than expected exam times, $t(2,479) = 35.92$, $p < 0.001$, $d = 0.72$
- The average MRI exam ran 31 minutes 33 seconds longer than expected
- Except for spine MRI, all exam types ran significantly longer than expected (*p*s < 0.001)

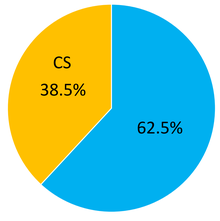
General Anesthesia Burden

- Mean total exam time for GA exams was 3 hours 43 minutes
- Mean GA burden was 2 hours 26 minutes
- On average, 56.0% of exam time was attributed to the GA encounter (SD = 19.2%)



Conscious Sedation

- Mean total exam time for CS exams was 2 hours 21 minutes
- Mean CS burden was 54 minutes
- On average, 38.5% of exam time was attributed to the CS encounter



Discussion

- Administration of IV contrast accounted for approximately 1/3 of MRI exam times, adding 1 hour and 19 minutes, on average
- All types of contrast-enhanced MRIs had observed exam times that were significantly longer than expected
- GA accounted for the majority of MRI exam encounters, adding 2 hours and 26 minutes, on average
- CS accounted for 38.5% of MRI exam encounters, adding 54 minutes, on average
- Contrast has been demonstrated to be unnecessary for a growing body of clinical indications
- Many children are able to comply with MRI without the need for anesthesia
- Optimizing the use of contrast and sedation would tremendously improve radiology workflow
- Judicious use of MRI protocols based on these data would offer very large cost savings for health systems
- Gadolinium-based contrast agents have been shown to accumulate in soft tissue for indeterminate periods of time with unknown clinical consequences
- Anesthesia poses known risks to pediatric patients

Selected References

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