

# Magnetic resonance imaging accuracy before surgery in children with retropharyngeal abscesses

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**Aims:** Retropharyngeal abscess (RPA) is a deep neck infection occurring in childhood. The gold standard technique for diagnosis is computerised tomography (CT) with a contrast medium. The aim of this study is to answer the question of whether magnetic resonance imaging (MRI) can be an alternative in diagnosing RPA and predicting pus drainage at surgery.

**Methods:** This is a retrospective study conducted at the paediatric emergency department of a tertiary level children hospital. The medical records of 31 children admitted to the Otorhinolaryngology and Paediatric ward, with a suspected diagnosis of RPA, were reviewed. The primary study outcome was the diagnostic accuracy of CT and MRI in predicting the amount of pus during surgery.

**Results:** Twenty-two patients (71%) underwent surgery. Among them, 18 had imaging before surgery. Eleven patients evaluated with CT scan underwent surgery: four had non-significant purulent drainage, three of them were reported to have a significant fluid collection (negative predictive value 66% and positive predictive value of 55%). Nine patients evaluated with MRI underwent surgery: four cases had non-significant purulent drainage, three of them showed a significant fluid collection at MRI (negative predictive value of 60%; positive predictive value of 56%).

**Conclusion:** MRI and CT scans showed similar accuracy in predicting successful pus drainage during surgery; therefore, it could be a valid alternative in the diagnosis of RPA in children.

**Key words:** computerised tomography; magnetic resonance imaging; retropharyngeal abscess.

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Retropharyngeal abscess (RPA), defined as suppuration of the retropharyngeal nodes, is a severe deep neck infection that can occur in childhood.

The retropharyngeal nodes drain the nasopharynx, oropharynx, nasal cavity, paranasal sinus, middle ears and prevertebral space. They are large during infancy and progressively become atrophic before puberty. Therefore, RPA is a complication of upper respiratory infections, and its incidence peak is in children younger than 6 years.

Between 2003 and 2012, its incidence was reported to have increased, from 2.98 to 4 cases per 100 000 children per year.<sup>1</sup> Febrile torticollis is the most common clinical presentation of RPA.

RPA could lead to severe complications, such as mediastinitis, airway obstruction, jugular vein thrombosis and atlanto-occipital subluxation (Grise's syndrome), which could also be life-threatening if not adequately treated.

The gold standard imaging technique for the diagnosis of RPA is a cervicothoracic computerised tomography (CT) with a contrast medium. Abnormalities suggestive of RPA are the presence of fluid-like opacities, gas collections, rim enhancement, soft

tissue swelling, obliterated fat planes, mass effect and a scalloping form or irregularity of the abscess wall.<sup>2-5</sup>

Imaging studies are also crucial for quantifying the purulent collections' dimension, better defining the need for surgery and the differential diagnosis of RPA with Kawasaki disease,<sup>6,7</sup> or calcific tendinitis.<sup>8</sup>

Although CT is the imaging of choice in most cases, evidence reports a lack of association between abnormalities suggestive of RPA and pus drainage at surgery.<sup>9</sup>

Furthermore, there are growing concerns about the harmful effect of ionising radiation in childhood<sup>10,11</sup> such that their use should be limited as much as possible.

Magnetic resonance imaging (MRI) could be an alternative to CT in patients with suspected RPA, capable of showing a focal, hyperintense retropharyngeal mass on T2-weighted images, and low-intensity on T1-weighted images with peripheral improvement after gadolinium. However, no studies have investigated its usefulness in predicting adequate pus drainage during surgery in children with imaging suggestive of RPA.

Therefore, this study aimed to compare the CT and MRI results and successful pus drainage during surgery in a series of children with RPA.

## Methods

We conducted a retrospective study at the paediatric emergency department of the tertiary level, university teaching, children's hospital, the Institute for Maternal and Child Health IRCCS Burlo

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Garofolo of Trieste, Italy. The Institutional Review Board of the Institute approved the study protocol.

We reviewed the medical records of children admitted to the Otorhinolaryngology and Paediatric ward from January 2006 to December 2016 with a suspected diagnosis of RPA.

At our Institute, children with RPA underwent surgery when imaging showed a collection size greater than 2 cm or clinically significant airway compression or in the absence of response to intravenous antibiotic treatment.

For each enrolled patient, demographical characteristics, signs, symptoms at the emergency department arrival, results of the blood tests, imaging findings, medical or surgical treatment, presence or absence of successful pus drainage during surgery, duration of the hospitalisation and complications were collected. Drainage was considered successful when at least 1 cc of pus was removed during surgery.

The primary study outcome was the diagnostic accuracy of CT and MRI in predicting the amount of pus during surgery, while the secondary objectives were to describe the main features and outcomes of this series of patients with RPA.

We decided to compare the predictive value of either modality in accurately detecting pus and not to compare the CT and MRI in patients who underwent both modalities.

## Statistical analysis

Continuous variables were expressed as mean and standard deviation, median and range; dichotomic variables were represented as frequency and percentages. Spearman correlation test was employed to assess the association between continuous variables. Fisher's tailed exact test and the Mann-Whitney test (Wilcoxon rank-sum test) were used to compare groups' differences. A *P* value of <0.05 was considered statistically significant for all statistical tests. The analysis was made with Stata/IC 14.2 (StataCorp, College Station, TX, USA).

## Results

In the 10 years considered in the study, 38 patients evaluated at the paediatric emergency department were admitted with a suspicion of RPA. The mean age of patients was 3 years ( $\pm 2$  years SD), range 4 months –10 years, with all patients except one younger than 7 years. Males were 25 (65.8%).

Among patients admitted with febrile torticollis, the diagnosis of RPA was confirmed in 31 patients (81.6%), 4 patients (10.5%) had Kawasaki disease, 2 patients had latero-cervical lymphadenitis and 1 patient a neck phlegmon. The main characteristics and outcomes of patients with a confirmed RPA are reported in Table 1.

Among 31 patients with RPA, 23 patients performed MRI or CT. Twenty-two patients (71%) underwent surgery. Among them, 18 performed imaging before surgery.

During surgery, pus drainage was reported in 12 patients (54%). Among the 10 patients (45%) with unsuccessful drainage, 6 had an imaging scan showing a fluid collection size of more than 20 mm, 1 had an airway obstruction and 3 did not perform imaging.

Table 2 shows the correlation between imaging method (CT vs. MRI) and pus drainage during surgery.

**Table 1** Characteristics and outcomes of patients with a confirmed retropharyngeal abscess (RPA)

Patients with RPA	
<i>n</i> (%)	31 (100)
Age, years, mean (SD)	3 (2)
Male sex, <i>n</i> (%)	20 (64)
Symptoms at arrival, <i>n</i> (%)	
Fever	27 (87)
Sore throat	24 (77)
Lymphadenopathy	23 (74)
Neck stiffness	20 (65)
Torticollis	16 (52)
Tonsillar asymmetry	16 (52)
Neck pain	13 (42)
Drooling	5 (16)
Headache	5 (16)
Tirage or dyspnoea	0
Blood tests at arrival, median (range)	
leucocyte, <i>n</i> /mm <sup>3</sup>	21.450 (11.640–39.270)
Neutrophils, <i>n</i> /mm <sup>3</sup>	15.500 (6.100–30.238)
PCR, mg/dL	7.5 (0.36–96.4)
ESR, mm/h	71 (4–120)
Pharyngeal bulging at fibroscopy, <i>n</i> (%)	
Imaging performed, <i>n</i> (%)	23 (74)
CT scan	12 (39)
MRI scan	13 (42)
Both CT and MRI	2 (6)
RPA features at imaging	
Abscess collection size, mm, mean (SD)	30.2 (12.73)
Abscess volume, cm <sup>3</sup> , mean (SD)	9.82 (14.13)
Airway compression or dislocation	13 (42)
Vascular nerve bundle dislocation	7 (23)
Atlanto-occipital subluxation	3 (9)
Jugular vein compression	0
Treatment	
Only medical antibiotic treatment	9 (29)
Surgery	22 (71)
Time between admission and surgery, days, mean (SD)	1.9 (1.4)
Results of the drainage at surgery	
No pus	10 (45)
Moderate amount of pus	5 (22)
Large amount of pus	6 (27)
Duration of hospital stay, mean (SD)	
Only medical treatment	6.7
Surgery	5.5
Complications, number of patients (%)	
Griesel syndrome	3
Lemierre syndrome	1
Deaths	0
Recurrence of RPA, <i>n</i> (%)	2 (6)

CT, computerised tomography; MRI, magnetic resonance imaging; SD, standard deviation.

Two children underwent both CT and MRI; they had an estimated pus collection >20 mm, and underwent surgical drainage successfully.

**Table 2** Correlations between imaging findings and purulent drainage at the surgery

	CT	MRI	CT and MRI	No imaging	Total
Surgery	9	7	2	4	22
Pus found	5	3	2	2	12
No pus found	4	4	0	2	10
No surgery	1	4	0	4	9
Total	10	11	2	8	31

CT, computerised tomography; MRI, magnetic resonance imaging.

Among the 11 patients evaluated with CT scan who underwent surgery, 4 cases had no purulent drainage, although 3 of them were expected to have a fluid collection size >20 mm. Therefore, this radiological parameter had a negative predictive value (NPV) compared to purulent drainage of 66% and a positive predictive value (PPV) of 55%. Among the nine patients evaluated with MRI who underwent surgery, four cases came out with no drainage, although three showed a fluid collection with size >20 mm. Consequently, this radiological parameter had a NPV compared to purulent drainage of 60% and a PPV of 56%.

The MRI duration was an average of 10 min. All the CT and MRI procedures were performed under deep sedation by trained and skilled paediatric anaesthetist. No complications such as relevant desaturation or the need for bag mask ventilation were observed.

As shown in Table 2, four patients underwent surgery without imaging. Patients underwent surgery without imaging because they had a clear clinical ground of RPA characterised mainly by fever, torticollis and drooling and with the evidence of pharyngeal bulging at fibroscopy. Among these, pus was drained in two patients.

## Discussion

In this series of children with RPA, the MRI and CT scan showed similar accuracy in predicting successful pus drainage during surgery. We found similar positive and negative predicted values between the two methods. We decided to consider the original radiological reports, without a specific revision for the study. This may have limited the accuracy of radiological images, but we prefer to remain adherent to what surgeons have in their hands when surgery was performed.

Some Authors raised concerns about the overestimation of pus predicted with MRI, particularly in cases of osteomyelitis,<sup>11</sup> but these results suggest that MRI does not overestimate the presence of pus in this setting, avoiding a higher rate of unnecessary surgery.

The overall accuracy of imaging in predicting successful drainage of pus during surgery was not optimal in our series, and it was worse than that reported in previous experiences with CT indicating a correlation between imaging abnormalities and surgery findings, varying from 71 to 82% for PPV and from 53 to 100% for NPV.<sup>5,12</sup>

CT scan, even when tailored for children, leads to a relevant exposure of ionising radiations, being even more detrimental in younger children, with an increased risk of developing central nervous system tumours and leukaemia.<sup>13</sup>

CT's theoretical advantage lies in its shorter execution time, widespread availability and decreased need for children sedation. CTs are more and more available in accident and emergency departments and frequently they are carried out very early after case presentation.

In many settings, getting an MRI brings more logistic difficulties compared to a CT scan. Common protocols for CT scan last only a few minutes thus decreasing the need for sedation also for young children.

For all these reasons, the use of MRI as first imaging methodology may be limited in several settings. Nevertheless, MRI may be the best way to re-image doubt cases in order to avoid a second exposure to ionising radiations.

It is evident that in the case of MRI, sedation should be guaranteed for a longer duration. In our institution, the presence of an experienced paediatric anaesthetist is mandatory, but we are aware that this is not necessarily a spread custom elsewhere. CT scan is performed without sedation in many settings. However, sedation may be considered for both CT and MRI in children with retropharyngeal abscesses, both because they are at risk of obstruction of the upper airways and because of their young age which affects the compliance during imaging. No complications were reported during sedation in any case. Remarkably most of the abscesses in these series had a high cephalic location, no child had a relevant airway compression.

The clinical and demographic characteristics of our patients are similar to those reported in other studies. Concerning surgical treatment, the percentage of patients who underwent operation was 71% similar or slightly higher to what was reported by other authors.<sup>5,12,14</sup> The decision to drain the collection was made in case of abscess size >20 mm or airway obstruction, as reported in other works.<sup>5</sup> Similarly, the decision to perform a CT scan rather than an MRI depended on the machine's availability and on the preference of the radiological consultant, not on the severity of the patient's clinical presentation.

It should be considered that the radiological criteria applied to identify an abscess may not match the surgical findings because severe inflammation may mimic an abscess on CT or MRI, and pus collection may be smaller, or absent.

Needle aspiration failure is reported in about 30% of cases in the literature. In our series, needle aspiration was never performed. Surgeons performed a small linear vertical incision of the retropharyngeal mucosa and submucosa with a 15-blade scalpel over the most bulging area of the pharynx. Drainage and exploration of the abscess cavity were performed via blunt dissection with a curved haemostatic forceps. Of the 10 cases considered a surgery failure, in 7 cases, the aspiration of pus was small, and only in 3 cases, no pus was aspirated. Of the three patients in whom no pus at all was detected, one had a CT, one underwent an MRI and the last experienced only a fibroscopy.

This study has some limitations. First of all, it is a retrospective study; therefore, further prospective series are needed to confirm our findings and focus on adverse events. Moreover, our study's restricted sample size and single-centre experience limit the generalizability of our findings.

We did not perform a radiological revision of imaging scans performed by a single radiologist blinded to the outcome of patients. This would have increased the accuracy of radiological reports. Nevertheless, we decided to maintain the variability that

arises with different radiologists to give a picture as much as possible similar to real-life. We did not collect further information about patients with surgical complications, but in our series no RPA followed an adenotonsillectomy.

## Conclusion

In this series, MRI was not inferior to CT in diagnosing the retropharyngeal abscess and avoided the administration of ionising radiation. Therefore, although it does not accurately predict the need for surgery, we think that it could be a valid alternative in the diagnosis of this increasingly frequent condition. Further studies are needed to confirm this finding.

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Baryonyx Buddies by Jackson Gliddon (age 5) from Operation Art 2021