

CT Analysis of Retropharyngeal Abnormality in Kawasaki Disease

Kyungmin Roh, MD, Sun Wha Lee, MD, Jeonghyun Yoo, MD

All authors: Department of Radiology, School of Medicine, Ewha Womans University, Seoul 158-710, Korea

Objective: To retrospectively compare the imaging characteristics of retropharyngeal density and associated findings for Kawasaki disease with those for non-Kawasaki disease, and identify the distinguishing features which aid the CT diagnosis of Kawasaki disease with retropharyngeal low density.

Materials and Methods: Among the enhanced neck CT performed in children less than 8-years old with clinical presentation of fever and cervical lymphadenopathy over a 6-year period, only cases with retropharyngeal low density (RLD) were included in this study. The 56 cases of RLD were divided into two groups; group A included cases diagnosed as Kawasaki disease (n = 34) and group B included cases diagnosed as non-Kawasaki disease (n = 22). We evaluated the CT features including the thickness of RLD and its extent into the deep neck spaces, as well as soft tissue change in the adjacent structure. We also scored the extent of RLD into the deep neck spaces and the soft tissue changes in the adjacent structure.

Results: The thickness of RLD was greater in group A than in group B (group A, 6.0 ± 2.1 ; group B, 4.6 ± 1.5 , $p = 0.01$). The score of the RLD extent into the deep neck spaces was significantly greater in group A than in group B (group A, 2.3 ± 1.3 ; group B, 0.8 ± 1.0 , $p < 0.01$). Also, the score of the adjacent soft tissue changes was greater in group A than in group B (group A, 2.0 ± 1.1 ; group B, 1.0 ± 1.0 , $p < 0.01$).

Conclusion: If children present with fever and cervical lymphadenopathy that display retropharyngeal low density with extension into more deep neck spaces as well as changes in more adjacent soft tissue, the possibility of Kawasaki disease should be considered.

Index terms: Kawasaki disease; Retropharyngeal edema; CT

INTRODUCTION

The retropharyngeal space is a distinct space along the midline of the extracranial portion of the head and neck which extends from the skull base to the upper

mediastinum. Because it is close to the airway and is a potential conduit for spreading disease, retropharyngeal diseases are assumed to be a significant contributor of disease. Various abnormalities such as inflammation, tumors, and post-traumatic lesions can be seen in the retropharyngeal space (1).

CT imaging is a widely used modality for the diagnosis of retropharyngeal disease and evaluation of its extent. Retropharyngeal space infection occurs in 96% of cases involving children. Retropharyngeal low density without rim enhancement indicates retropharyngeal cellulitis, whereas circumferential rim enhancement is the hallmark of an abscess (2). However, fluid collection in the retropharyngeal space without enhancement on CT has been reported in other diseases, mimicking retropharyngeal cellulitis (1).

Received March 15, 2011; accepted after revision July 7, 2011.

Corresponding author: Sun Wha Lee, MD, Department of Radiology, School of Medicine, Ewha Womans University, 911-1 Mok-dong, Yangcheon-gu, Seoul 158-710, Korea.

• Tel: (822) 2650-5173 • Fax: (822) 2650-5302

• E-mail: sonic323@ewha.ac.kr

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

There are few reported cases of Kawasaki disease presenting as retropharyngeal low density (3-10). Occasionally, Kawasaki disease initially presents with clinical symptoms and signs and radiologic features pertaining to retropharyngeal cellulitis including fever, non-specific cervical lymphadenopathy, and retropharyngeal low density. Because the treatments of the two diseases are quite different, distinguishing them is important. However, there is paucity in the literature describing a retropharyngeal lesion of Kawasaki disease.

The purpose of this study was to retrospectively compare the imaging characteristics of retropharyngeal low density and associated findings in Kawasaki disease with those of non-Kawasaki disease, and identifying the distinguishing features that aid in the CT diagnosis of Kawasaki disease with retropharyngeal low density.

MATERIALS AND METHODS

Patients

Institutional Review Board approval for viewing images and medical records of patients undergoing CT was obtained before initiating this study, which was compliant with the Health Insurance Portability and Accountability Acts (HIPAA). The requirement for written informed consent was waived. Medical records of children less than 8-year-old with clinical presentation of fever and cervical lymphadenopathy, including 608 consecutive enhanced neck CT at our institution from January 2005 to September 2010, were evaluated. Among them, 75 cases with retropharyngeal low density (RLD) were retrospectively included in this study. The RLD refers to the more than five contiguous sections in the retropharyngeal space (10). The 19 cases with rim enhancing RLD suggestive of retropharyngeal abscess were excluded. Demographic information, clinical presentation, and CT findings of 56 children were reviewed retrospectively. The clinical impressions at the time of CT examinations included cervical lymphadenopathy (n = 39), deep neck infection (n = 14), Kawasaki disease (n = 2), and neck edema (n = 1).

The 56 cases of RLD (35 boys, 21 girls; age range, 5 months-8 years; mean, 4.1 years) were divided into two groups; group A was diagnosed as Kawasaki disease (n = 34) and group B diagnosed as non-Kawasaki disease (n = 22). No additional clinical symptoms aside from fever and cervical lymphadenopathy were evident at the time of the CT examinations. Diagnosis of Kawasaki disease is based

on symptoms and signs presented after CT examinations. Diagnoses were made using the following parameters; fever for more than 5 days and four of the following five findings 1) non-purulent conjunctivitis, 2) changes in the lips or oral cavity, 3) polymorphous exanthem, 4) erythema with later desquamation of the extremities, and 5) at least one cervical lymph node greater than 1.5 cm. Patients with fever for more than 5 days and < 4 principal features was diagnosed as Kawasaki disease when a coronary aneurysm was detected (11). For the 22 cases diagnosed as non-Kawasaki disease, some were actually infectious mononucleosis (n = 1), conjunctivitis (n = 1), tonsillitis (n = 1), acute pharyngitis (n = 2), otitis media (n = 2), and cervical lymphadenopathy with an unknown etiology. Six patients from group A and six patients from group B underwent a follow-up neck CT after 6.2 days (2-12 days), respectively.

CT Technique

The enhanced neck CT examinations were performed with 16 and 64 multi-detector CT scanners (SOMATOM Sensation 16, Siemens Medical Solutions, Germany and SOMATOM Sensation 64, Siemens Medical Solutions, Germany) with a 3 mm interval from the skull base to the lower trachea. Scan parameters were 100 kV tube voltage and 70 mA tube current. Sagittal reconstructed images were obtained (the Syngo, Software version 2006A, Siemens Medical solutions, Germany).

Analysis of CT Parameters in Two Groups

One experienced pediatric radiologist and a third year radiology resident analyzed the CT images in consensus and blinded to diagnosis.

The RLD refers to the more than five contiguous sections in the retropharyngeal space (10). The thickness (maximal AP diameter) and axial extent of RLD were also assessed. The extension of retropharyngeal low density to deep neck spaces refers to an increased density compared with corresponding contralateral deep neck space on the three continuous axial images. The anatomic distribution was classified as carotid space, parapharyngeal space, anterior and posterior cervical space, submandibular space, and perivertebral space (6, 12).

The increased thickness and enhancement of the sternocleidomastoid muscle, as well as platysma muscle and linear increased density of the subcutaneous fat layer compared with the corresponding contralateral structure

were assessed as adjacent soft tissue change.

We scored the extent of RLD into the deep neck spaces according to the number of involved deep neck spaces (scoring: 0-6). Score 0 indicated no involvement of deep neck space and score 6 indicated involvement of all deep neck spaces including the carotid space, parapharyngeal space, anterior and posterior cervical space, submandibular space, and perivertebral space. We also scored the soft tissue changes of adjacent structure according to the number of structures involved (scoring: 0-3). Score 0 indicated no involvement of adjacent structures and score 3 indicated involvement of sternocleidomastoid muscle, platysma muscle, and a subcutaneous fat layer.

Statistical Analysis

Results are presented as the mean \pm standard deviation. Comparison of age and RLD thickness for groups A and B were performed using the Mann-Whitney *U* test. The score of the RLD extent into the deep neck space and adjacent soft tissue change were also compared with the Mann-Whitney *U* test. Group comparison of sex and enhancing pattern of lymph nodes were assessed by Pearson's Chi-squared test.

All statistical analyses were performed using the SPSS software (version 12.0, SPSS). A *p* value of less than 0.05 was considered to indicate statistical significance.

RESULTS

There was no significant difference for age (group A, 4.3 ± 1.9 ; group B, 3.9 ± 2.3 , $p = 0.393$) and sex ratio (group A, 2.0:1; group B, 1.2:1, $p = 0.323$) between the two groups. The retropharyngeal low density without rim enhancement was seen in all patients, extending from level C1 to C6, but absent below level C7.

All 34 patients (100%) in group A and nine (41%) of 22 patients in group B demonstrated extension of RLD into the deep neck space, which was unilateral. There were a maximum of six involved deep neck spaces (Fig. 1).

Thirty (88%) of 34 patients in group A and 12 (54%) of 22 patients in group B showed adjacent soft tissue change (Figs. 2-4).

The RLD and associated soft tissue lesion decreased or disappeared in 12 follow-up neck CTs. The clinical symptoms were also improved in all patients (Figs. 1, 4).

The thickness of RLD was statistically greater in group A than in group B (group A, 6.0 ± 2.1 ; group B, 4.6 ± 1.5 , $p = 0.01$) (Table 1).

The score of RLD extent into the deep neck spaces, was significantly greater in group A than in group B (group A, 2.3 ± 1.3 ; group B, 0.8 ± 1.0 , $p < 0.01$) (Fig. 1) (Table 1).

The score of the adjacent soft tissue changes were also greater in group A than in group B (group A, 2.0 ± 1.1 ; group B, 1.0 ± 1.0 , $p < 0.01$) (Fig. 2) (Table 1).

DISCUSSION

The retropharyngeal space is bounded by middle and deep layers of the deep cervical fascia and alar fascia. Also, it consists of lymph nodes and fat extending from the base of the skull to the level of T3 and the fascial "trap door" found at the T3 vertebral body, which serves as a potential conduit from the retropharyngeal space to the danger space (12).

The retropharyngeal space runs along the midline of the deep neck space, and clinical evaluation has a very limited role for the diagnosis of retropharyngeal disease. Therefore, CT imaging is a widely used modality for diagnosis of retropharyngeal disease and evaluation of its extent. Various abnormalities such as inflammation, tumor, and post traumatic lesions can be seen in retropharyngeal space.

Among the types of retropharyngeal inflammation, retropharyngeal low density without rim enhancement indicates retropharyngeal cellulitis. Whereas, the circumferential rim of enhancement is the hallmark of an abscess. Jugular vein occlusion, compression or ligation, radiation therapy, longus coli tendinitis, and Kawasaki disease can cause retropharyngeal low density (1, 3-10, 13, 14). In our study, the majority of the 34 (61%) of 56 patients with retropharyngeal low density were diagnosed as Kawasaki disease.

Kawasaki disease, which is known as an acute febrile mucocutaneous lymph node syndrome, is a systemic vasculitis (15). First described in 1967 by Kawasaki, the disease predominantly affects infants and children younger than five years of age. Most diagnoses of Kawasaki disease were based on clinical criteria. However, patients with only fever and cervical lymphadenopathy at the initial examination may be misdiagnosed with a deep neck infection and the diagnosis of Kawasaki disease can be delayed. Early treatment of Kawasaki disease with intravenous immunoglobulin reduces the possibility of a coronary artery aneurysm, which is a complication of Kawasaki disease. Therefore, making a timely and accurate diagnosis is clinically important (16, 17). In our study, only

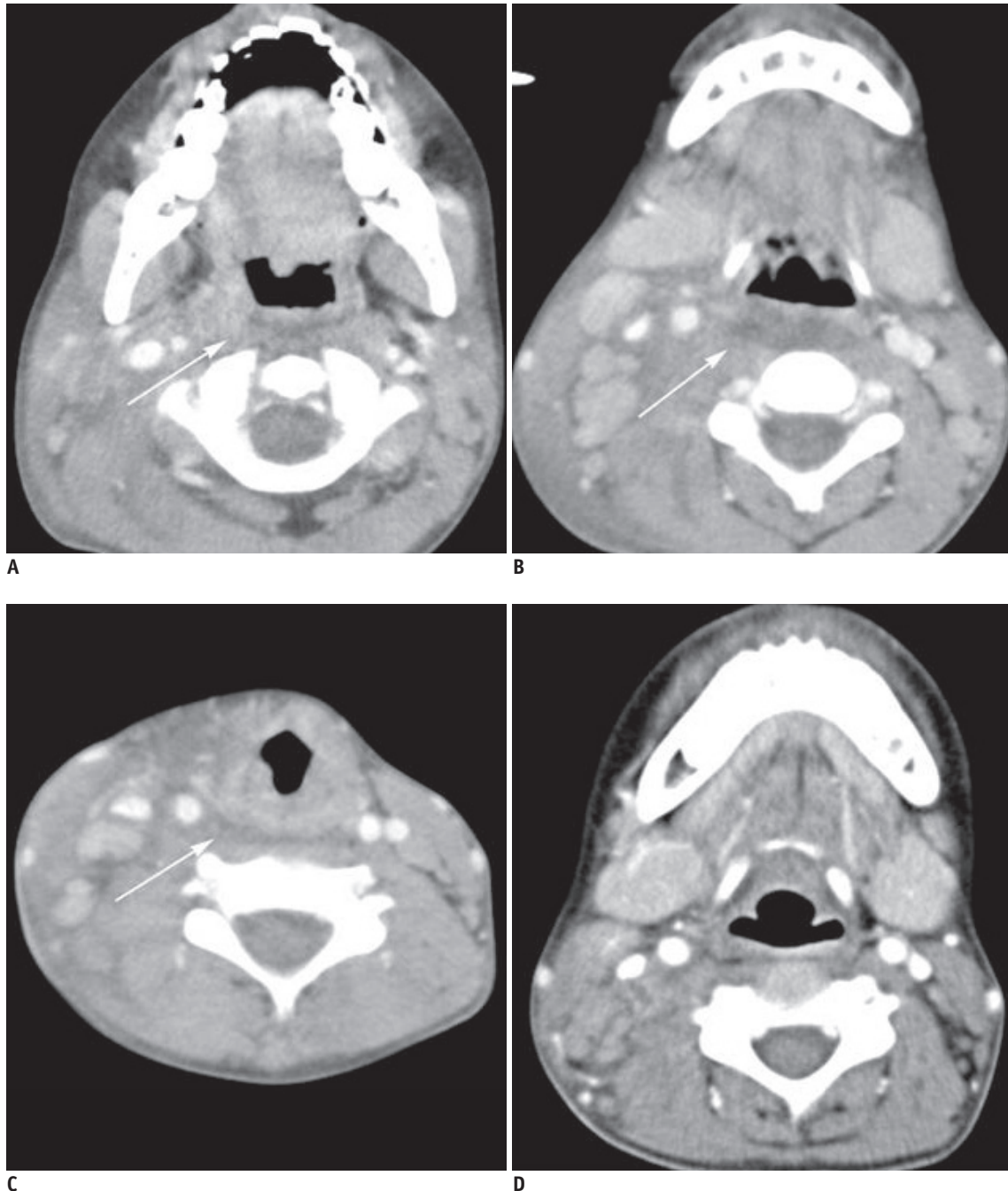


Fig. 1. Kawasaki disease in 6-year-old boy.

CT images (A-C) show retropharyngeal low density without rim enhancement (arrows), which extends to right parapharyngeal, carotid, posterior and anterior cervical, as well as submandibular and perivertebral spaces (score: 6). In addition, there are multiple enlarged cervical lymph nodes and swelling of right sternocleidomastoid, as well as platysma muscles and subcutaneous tissue (score: 3). Retropharyngeal low density and associated soft tissue lesions are dramatically improved on follow-up CT after immunoglobulin therapy (D).

one patient underwent a CT study with the first impression of Kawasaki, whereas the first impressions of the other patients were cervical lymphadenopathy.

Because of a general lack of routine neck CT imaging in Kawasaki disease, CT findings of Kawasaki disease have not been systematically studied. CT findings of rare

cases of Kawasaki disease with atypical clinical symptoms suspicious of deep neck infection have been reported. The main finding was retropharyngeal low density without rim enhancement; examples include a retropharyngeal abscess, retropharyngeal cellulitis, and retropharyngeal edema (3-10). Langley et al. (10) reported a case of Kawasaki disease

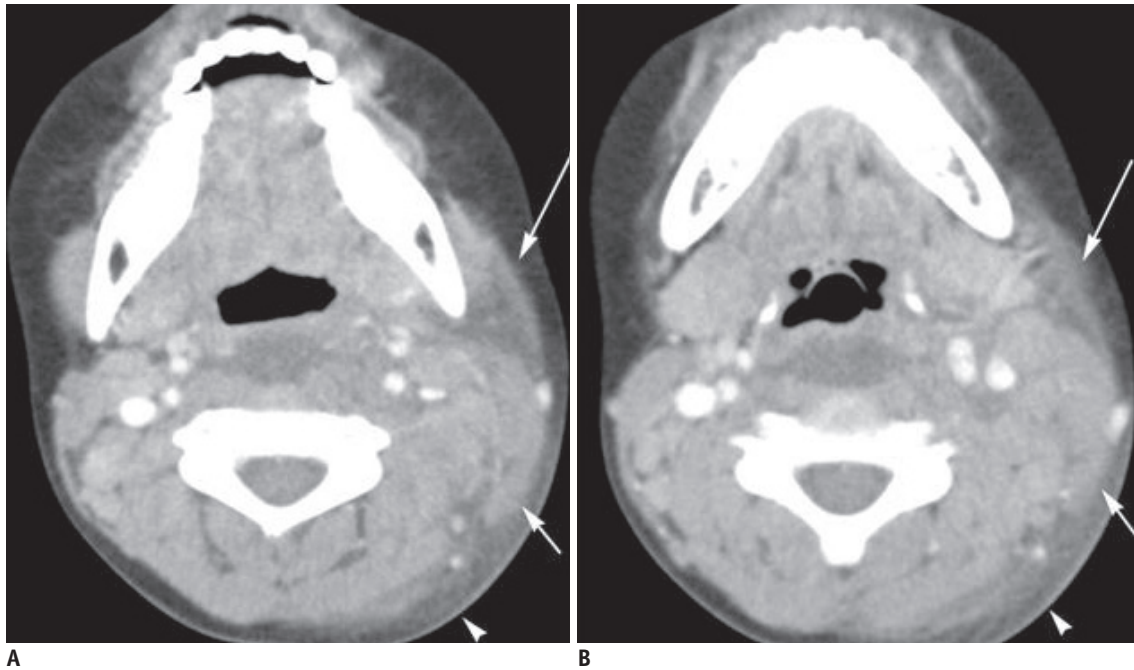


Fig. 2. Kawasaki disease in 5-year-old boy.

A, B. CT demonstrates diffuse swelling of left sternocleidomastoid muscle (arrows), platysma muscles (long arrows), and infiltration of adjacent subcutaneous tissue layer (arrowheads) of left posterolateral neck (score: 3), in addition to retropharyngeal low density with extension to left deep cervical spaces (score: 3) and cervical lymphadenopathy.

Table 1. Statistical Analysis of CT Parameters in Group A (Kawasaki disease) and Group B (non-Kawasaki disease)

	Group A (n = 34)	Group B (n = 22)	P value [†]
CT parameters			
A-P diameter of RLD (mm)	6.0 ± 2.1	4.6 ± 1.5	0.01
Scoring of RLD extent (0-6)	2.3 ± 1.3	0.8 ± 1.0	< 0.01
Scoring of adjacent soft tissue change (0-3)	2.0 ± 1.1	1.0 ± 1.0	< 0.01

Note.— Values are presented as mean ± standard deviation. Comparisons between group A and group B were performed by Mann-Whitney *U* test[†] and Pearson Chi² test* (*p* < 0.05). A-P = anteroposterior, RLD = retropharyngeal low density

and previously reported sporadic cases, and found that the 11 cases of retropharyngeal low density did not respond to antibiotics and confirmed sterile conditions in the surgical drainage (3, 5, 7, 9). After treatment with immunoglobulin under the diagnosis of Kawasaki disease, all patients showed clinical improvement (3-10). In this study, 34 patients with retropharyngeal low density clinically improved after immunoglobulin treatment. In six cases with a follow up CT, a significant decrease or complete improvement of retropharyngeal low density was observed. The exact pathophysiology of retropharyngeal low density in Kawasaki disease is unknown. However, considering the operative findings and sterile culture for the surgical drainage and a dramatic response to immunoglobulin treatment, inflammation and edema was considered as the main mechanism (10). Kawasaki disease initially involves

capillaries, arterioles and venules, and progresses towards microvascular permeability, causing extravascular albumin leakage and edema (18). In this study, the thickness of the retropharyngeal low density in group A was significantly greater than in group B. The vasculitis of microvessels with tissue edema and inflammation is considered as the major pathophysiology of extensive retropharyngeal low density in Kawasaki disease. Retropharyngeal lesions can spread to T3. One case in the study by Langley et al. (10) showed extension of the retropharyngeal low density to the thoracic outlet. In this study, retropharyngeal low density was located throughout levels C1 to C6 without extension to the mediastinum.

It is well known that a deep neck infection may invade another deep neck space. Similarly, a retropharyngeal lesion may also invade another deep neck space. Park et al. (16)

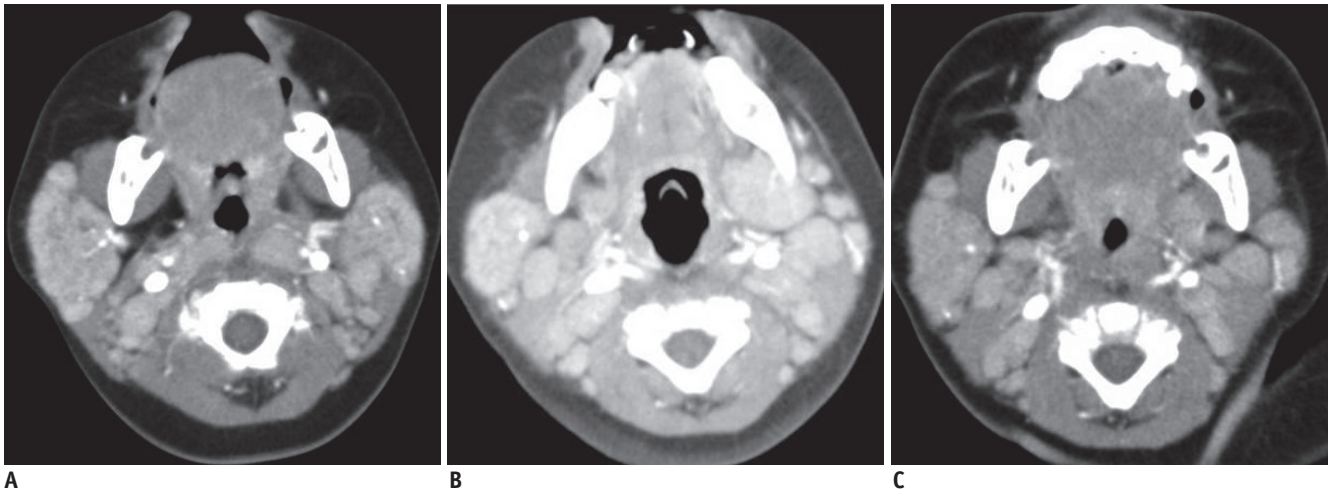


Fig. 3. Infectious mononucleosis in 1-year-old boy.

A, B. CT images show enlarged cervical lymph nodes in both neck and retropharyngeal low density without enhancing rim, which is not extended to deep neck space (score: 0). Adjacent soft tissue is not involved (score: 0). **C.** Retropharyngeal low density is improved on follow-up CT after antibiotic therapy.

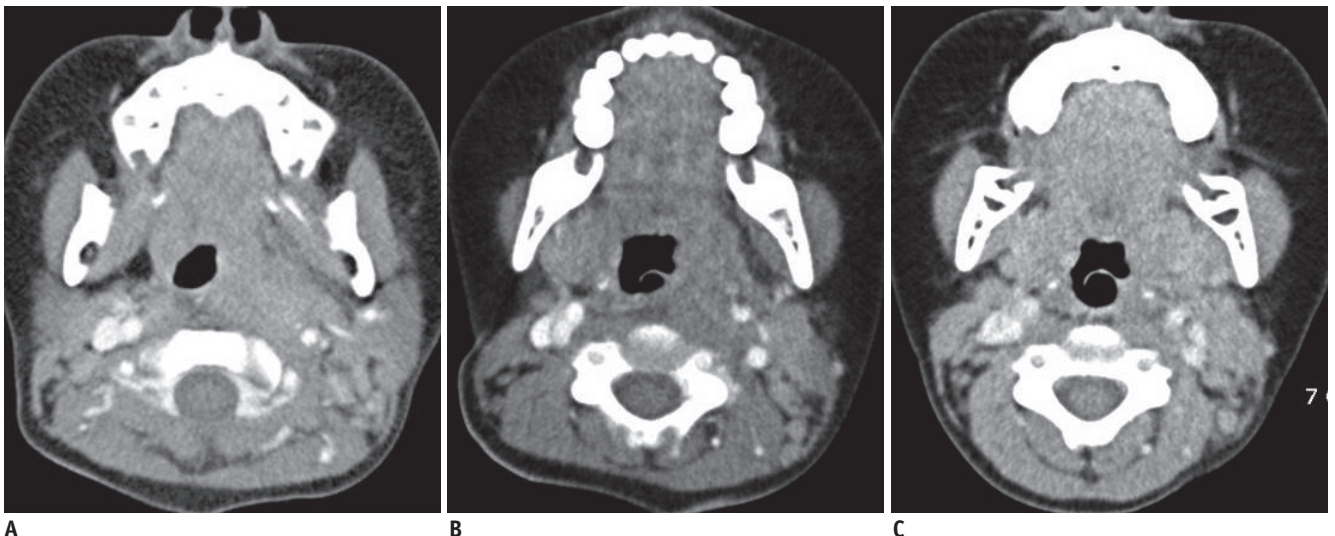


Fig. 4. Lymphadenitis of undetermined etiology in 4-year-old boy.

A, B. CT shows retropharyngeal low density extending to left parapharyngeal and carotid spaces (score: 2) and swollen left sternocleidomastoid muscle (score: 1), in addition to multiple enlarged cervical and retropharyngeal nodes, and palatine tonsil. **C.** Retropharyngeal low density is improved on follow-up CT after antibiotic therapy.

reported retropharyngeal low density extending to deep neck space. Unlike our study, the study by Park et al. (6) did not evaluate the anatomic location. All 35 patients with Kawasaki disease in our study showed a spread to the deep neck space, with the extension of retropharyngeal low density in group A being significantly more extensive than in group B.

In a previously published literature of retropharyngeal low density in Kawasaki disease, the adjacent soft tissue changes were not evaluated. In this study, sternocleidomastoid muscle, platysma, and subcutaneous fat were assessed. Group A showed significantly more frequent

changes in soft tissue than in group B.

The extension of retropharyngeal low density to deep neck space and adjacent soft tissue changes improved after immunoglobulin therapy, and extension to deep neck space and adjacent soft tissue changes are estimated to be due to inflammation and edema caused by Kawasaki disease.

Retropharyngeal infections occur simultaneously with tonsillitis, otitis media or an upper respiratory tract infection, which are caused by streptococcus pyogenes and staphylococcus aureus (19). CT findings of retropharyngeal cellulitis are retropharyngeal low density without rim enhancement associated with loss of fat density of the

deep neck. In this study, 22 control patients (group B) selected for comparison to Kawasaki disease patients. The clinical diagnoses for patients in Group B included cervical lymphadenitis, infectious mononucleosis, conjunctivitis, tonsillitis, acute pharyngitis, and otitis media. Clinically, they all showed improvement after antibiotic treatment, with the retropharyngeal low density of CT also decreasing or disappearing completely.

The limitations of this study are that neck CTs are not generally performed for diagnosis of Kawasaki Disease, the neck CTs are performed selectively for Kawasaki disease with fever and cervical lymphadenopathy only without the typical symptoms to exclude deep neck infection. All patients with Kawasaki disease have not been included in this study. However, considering the probability that a neck CT will also be performed in atypical Kawasaki disease patients, our neck CT finding of Kawasaki disease could facilitate the diagnosis of Kawasaki disease. Only sporadic case reports totaling 15 cases of retropharyngeal lesion in Kawasaki disease were described. We analyzed 34 relatively large retropharyngeal lesions in Kawasaki disease, as well as the adjacent soft tissue findings. Moreover, the extension of retropharyngeal lesion was compared with those of retropharyngeal cellulitis. To the best of our knowledge, this is the first study comparing the imaging characteristics of retropharyngeal abnormalities in Kawasaki disease with those in non-Kawasaki disease, in addition to identifying the distinguishing features that aid in the CT diagnosis of Kawasaki disease with retropharyngeal abnormalities. Our study suggests that retropharyngeal low density in Kawasaki disease is edema caused by Kawasaki disease and it is improved by the treatment associated with Kawasaki disease. This study may provide better insight in the pathophysiology and treatment of Kawasaki disease, thereby reducing unnecessary antibiotic treatment and invasive surgical treatment for retropharyngeal edema.

In conclusion, if children presenting with fever and cervical lymphadenopathy that display retropharyngeal low density extending into deeper neck spaces, as well as changes in adjacent soft tissue, the possibility of Kawasaki disease should be considered.

REFERENCES

- Davis WL, Harnsberger HR, Smoker WR, Watanabe AS. Retropharyngeal space: evaluation of normal anatomy and diseases with CT and MR imaging. *Radiology* 1990;174:59-64
- Elden LM, Grundfast KM, Vezina G. Accuracy and usefulness of radiographic assessment of cervical neck infections in children. *J Otolaryngol* 2001;30:82-89
- Gross M, Eliashar R, Attal P, Sichel JY. Radiology quiz case 2: Kawasaki disease (KD) mimicking a retropharyngeal abscess. *Arch Otolaryngol Head Neck Surg* 2001;127:1507, 1508-1509
- Hester TO, Harris JP, Kenny JF, Albernaz MS. Retropharyngeal cellulitis: a manifestation of Kawasaki disease in children. *Otolaryngol Head Neck Surg* 1993;109:1030-1033
- Homicz MR, Carvalho D, Kearns DB, Edmonds J. An atypical presentation of Kawasaki disease resembling a retropharyngeal abscess. *Int J Pediatr Otorhinolaryngol* 2000;54:45-49
- Park AH, Batchra N, Rowley A, Hotaling A. Patterns of Kawasaki syndrome presentation. *Int J Pediatr Otorhinolaryngol* 1997;40:41-50
- Pontell J, Rosenfeld RM, Kohn B. Kawasaki disease mimicking retropharyngeal abscess. *Otolaryngol Head Neck Surg* 1994;110:428-430
- Rooks VJ, Burton BS, Catalan JN, Syms MJ. Kawasaki disease presenting as a retropharyngeal phlegmon. *Pediatr Radiol* 1999;29:875-876
- Stamos JK, Corydon K, Donaldson J, Shulman ST. Lymphadenitis as the dominant manifestation of Kawasaki disease. *Pediatrics* 1994;93:525-528
- Langley EW, Kirse DK, Barnes CE, Covitz W, Shetty AK. Retropharyngeal edema: an unusual manifestation of Kawasaki disease. *J Emerg Med* 2010;39:181-185
- Newburger JW, Takahashi M, Gerber MA, Gewitz MH, Tani LY, Burns JC, et al. Diagnosis, treatment, and long-term management of Kawasaki disease: a statement for health professionals from the Committee on Rheumatic Fever, Endocarditis and Kawasaki Disease, Council on Cardiovascular Disease in the Young, American Heart Association. *Circulation* 2004;110:2747-2771
- Harnsberger HR, Salzman KL, Osborn AG, Carrasco CR, Ross JS. *Suprahyoid and infrahyoid neck*. In: Macdonald AJ, ed. *Diagnostic and surgical imaging anatomy. Brain, head & neck, spine*, 2nd ed. Salt Lake City: AMIRSYS, 2006:186-193
- Mukherji SK, Mancuso AA, Kotzur IM, Mendenhall WM, Kubilis PS, Tart RP, et al. Radiologic appearance of the irradiated larynx. Part I. Expected changes. *Radiology* 1994;193:141-148
- Mihmanli I, Karaarslan E, Kanberoglu K. Inflammation of vertebral bone associated with acute calcific tendinitis of the longus colli muscle. *Neuroradiology* 2001;43:1098-1101
- Kawasaki T, Kosaki F, Okawa S, Shigematsu I, Yanagawa H. A new infantile acute febrile mucocutaneous lymph node syndrome (MLNS) prevailing in Japan. *Pediatrics* 1974;54:271-276
- Newburger JW, Takahashi M, Beiser AS, Burns JC, Bastian J, Chung KJ, et al. A single intravenous infusion of gamma globulin as compared with four infusions in the treatment of acute Kawasaki syndrome. *N Engl J Med* 1991;324:1633-1639
- Zhang T, Yanagawa H, Oki I, Nakamura Y, Yashiro M, Ojima T, et al. Factors related to cardiac sequelae of Kawasaki disease. *Eur J Pediatr* 1999;158:694-697

CT Analysis of Retropharyngeal Abnormality in Kawasaki Disease

18. Terai M, Honda T, Yasukawa K, Higashi K, Hamada H, Kohno Y. Prognostic impact of vascular leakage in acute Kawasaki disease. *Circulation* 2003;108:325-330
19. Vural C, Gungor A, Comerci S. Accuracy of computerized tomography in deep neck infections in the pediatric population. *Am J Otolaryngol* 2003;24:143-148