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Laryngeal involvement in relapsing polychondritis: clinical and CT findings in 173 patients

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ABSTRACT

Introduction/objectives Relapsing polychondritis (RP) is a rare autoimmune disorder primarily affecting cartilaginous structures. We aimed to characterise the clinical features and CT findings of laryngeal involvement in RP, hypothesising that specific CT patterns correlate with clinical manifestations.

Methods We retrospectively analysed 173 patients with confirmed RP. Demographic and clinical data were collected, and laryngeal, tracheal, and bronchial CT findings were reviewed. Statistical analyses identified factors associated with laryngeal involvement and airway stenosis.

Results Notably, 66% of asymptomatic patients displayed CT evidence of airway damage, with laryngeal involvement in 41.1% (44/107), tracheal involvement in 80.9% (140/173), and bronchial involvement in 36.4% (63/107). Cricoid erosion and broadening with mucosal hyperplasia were the predominant laryngeal findings. Significant associations with laryngeal involvement included younger age at disease onset ($p<0.05$), longer disease duration ($p<0.01$) and multiorgan manifestations ($p<0.01$).

Conclusions Laryngeal involvement is common in RP patients with airway manifestations, second only to tracheal involvement. CT findings of cricoid erosion and broadening are characteristic. Vigilant clinical monitoring is recommended for RP patients with identified risk factors to facilitate early detection and management. Future research should focus on developing targeted interventions for this high-risk subgroup of RP patients.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Clinical and imaging characteristics of laryngeal involvement in relapsing polychondritis (RP) remain poorly understood, with limited data on CT findings and their clinical significance.

WHAT THIS STUDY ADDS

⇒ This large cohort study revealed that laryngeal involvement is frequent (41%) in RP, with characteristic CT findings of cricoid erosion and broadening, and is significantly associated with younger age of onset.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ These findings highlight the need for routine CT imaging in RP patients, as subclinical airway damage was common (66% in asymptomatic patients). Incorporating regular laryngeal evaluation in clinical practice may facilitate earlier detection, risk stratification and targeted management of laryngeal pathology in RP.

INTRODUCTION

Relapsing polychondritis (RP) is a rare systemic autoimmune disorder characterised by recurrent inflammation and progressive destruction of cartilaginous structures throughout the body.[1] The disease primarily affects the external ear, nose, large airways and joints but can also involve tissues rich in proteoglycans such as the eyes, inner ear, blood vessels, skin, heart, kidneys and nervous system.[2 3] Despite ongoing research, the precise aetiology and pathogenesis of RP remain elusive.

The clinical presentation of RP is notably heterogeneous, posing significant challenges for diagnosis and management. This heterogeneity contributes to high rates of misdiagnosis, disability and poor prognosis, particularly in cases with airway involvement. Consistent findings from previous clinical studies indicate that airway involvement is among the top three most commonly affected organ systems in RP.[4] Approximately half of RP patients develop airway manifestations, with nearly 50% of these cases being subclinical.[5] Notably, laryngeal involvement appears to be more prevalent in adolescent patients,[6] and the necessity for tracheostomy is not infrequent. Patients with airway involvement typically experience a more severe disease course and significant impairment in their work capacity and daily functioning.

The diagnostic process for RP is complicated by the absence of specific laboratory or pathological markers.[7] Clinicians must

rely on a combination of clinical presentation and imaging findings, with neck and chest CT scans serving as crucial diagnostic tools. Typical CT manifestations of lower airway involvement in RP include varying degrees of tracheal wall thickening, calcification, airway stenosis and air trapping.[8] However, there is a paucity of quantitative research on RP-related airway damage, and studies specifically examining the CT imaging characteristics of laryngeal involvement are particularly limited.

The study aims to address this knowledge gap by conducting a retrospective analysis of the clinical and CT imaging features of RP patients with laryngeal involvement, with particular emphasis on elucidating their clinical significance.

MATERIALS AND METHODS

This retrospective study included patients with RP evaluated at the Department of Rheumatology and Immunology, Beijing Tsinghua Changgeng Hospital, Tsinghua University School of Clinical Medicine, between 1 November 2022 and 30 December 2023. All subjects underwent standardised diagnostic procedures, including laryngeal and lung CT scans. Patients were included if they fulfilled either the 2018 Rose *et al*[9] or 1979 Damiani and Levine[10] diagnostic criteria for RP presented with or without airway involvement symptoms (hoarseness, cough, dyspnoea or exertional shortness of breath) and demonstrated RP-related upper (laryngeal) and/or lower airway changes on routine CT scans.[8] There were no restrictions on age or gender. However, patients were excluded if airway damage was attributable to other diseases such as infections, tumours, trauma or other autoimmune disorders.

The study was designed as a retrospective, single-arm case series analysis. Organ involvement was assessed according to established criteria.[11] Ophthalmologists confirmed ocular inflammation, while auricular chondritis was defined by swelling, pain and deformity of the auricle and/or external auditory canal, excluding earlobe involvement. Cochlear damage was identified by sensorineural hearing loss corresponding to abnormal otoacoustic emissions, and vestibular damage was characterised by horizontal semicircular canal dysfunction (C/P>15%). Nasal chondritis was diagnosed based on painful swelling of the nasal bridge or saddle nose deformity. Experienced rheumatologists confirmed the diagnosis of RP in all cases.

Diagnosis of RP airway involvement was based on high-resolution CT scans of the larynx and lungs, which were performed routinely, yielding soft tissue and mediastinal window images. Two rheumatologists and two radiologists reached a consensus on CT evidence of RP airway damage. Lower airway involvement was evaluated based on established criteria.[8] Laryngeal involvement was confirmed by both laryngoscopy and laryngeal CT. The imaging criteria used to define laryngeal involvement included thyroid cartilage involvement (discontinuity, irregular destruction or morphological alterations of the cartilage margin), cricoid cartilage involvement (discontinuity, irregular destruction or widening of the cartilage margin) and mucosal thickening (uniform thickening at the cricoarytenoid joint level). The severity of cricoid cartilage involvement and mucosal thickening was graded on a scale from normal to severe based on specific measurements relative to the tracheal diameter.

Statistical analyses were performed using R. Demographic data were summarised using numbers and percentages. Normally distributed data (age and Relapsing Polychondritis Disease Activity Index (RPDAI) scores) were expressed as mean±SD, while non-normally distributed data (disease duration) were presented as median values. Continuous variables were compared using independent sample t-tests, categorical variables were analysed using χ^2 tests, and median disease duration was compared using the Mann-Whitney U test. A $p<0.05$ was considered statistically significant.

RESULTS

General characteristics

The study cohort comprised 183 patients with RP who met the inclusion criteria between 1 March 2023 and 30 April 2024. There were 80 males and 103 females, yielding a male-to-female ratio of 1:1.29. Of the total cohort, 133 patients fulfilled the 2018 Rose criteria, while 50 patients met the 1979 Damiani criteria, the latter all having only one major criterion and/or fewer than two minor criteria, but with good response to treatment with glucocorticoids and immunosuppressants.

At disease onset, the mean age was 40.2±16.5 years (range: 9–88 years), and the mean age at diagnosis was 42.5±16.4 years (range: 10–88 years). The primary organs affected at onset were: airway cartilage in 70 cases (38%), auricular cartilage in 68 cases (37%), eyes in 22 cases (12%), extracranial sites in 18 cases (10%) and nasal cartilage in 5 cases (3%).

At study enrolment, the mean age was 43.6±15.9 years (range: 12–88 years), with a mean disease duration of 42.2±48.1 months (range: 0.4–216 months). The RPDAI score was 28 (range: 9–71).

Airway involvement was assessed by CT imaging in 173 patients (95% of the cohort). Of these, 141 (82%) demonstrated CT abnormalities consistent with RP. The distribution of airway involvement was as follows: 30 cases (17%) with involvement of all three regions (larynx, trachea and bronchi), 46 cases (27%) with two-region involvement (33 trachea+bronchi, 13 larynx+trachea), 65 cases (38%) with single-region involvement (64 tracheal, 1 laryngeal) and 32 cases (19%) without airway involvement. Notably, all patients with bronchial involvement also had tracheal involvement, while upper and lower respiratory tract involvement could occur independently. Tracheostomy was necessary in 27 cases (15%).

Other organ involvement included: auricular chondritis in 105 cases (57%), inflammatory eye disease in 67

cases (37%), extracranial involvement in 52 cases (28%), inner ear involvement in 50 cases (27%) and nasal chondritis in 48 cases (26%).

CT imaging findings of laryngeal airway involvement

Laryngeal CT imaging data were available for 107 (62%) of the 173 patients. Among these, 44 (41%) demonstrated CT abnormalities consistent with RP-related changes.

Cricoid cartilage involvement was identified in 42/107 (39%) cases. The observed cricoid changes included: widening in 9 cases, destruction in 24 cases and a combination of destruction and widening in 9 cases. Thyroid cartilage involvement was evident in 15 (14%) cases, with 10 cases showing destruction, 1 case showing deformity and 4 cases exhibiting both destruction and deformity. Arytenoid cartilage involvement was noted in 8/107 (8%) cases, comprising 5 cases of destruction and 3 cases with unclear changes. No epiglottic cartilage changes were observed.

Notably, all instances of thyroid and arytenoid cartilage changes were accompanied by cricoid cartilage destruction. Three cases demonstrated involvement of all three cartilages (thyroid, arytenoid and cricoid). Fifteen cases showed involvement of two cartilages (11 cases of thyroid+cricoid, 5 cases of arytenoid+cricoid). With the exception of one case involving only the thyroid cartilage, the remaining 23 cases all exhibited cricoid cartilage involvement.

Of the 44 patients with laryngeal involvement, 25 (56.8%) had moderate or severe mucosal hyperplasia, with 18 (72.0%) of these showing associated cricoid cartilage changes; the remaining 19 exhibited mild mucosal hyperplasia alongside laryngeal cartilage involvement, typically including the cricoid.

Figure 1 presents representative CT images illustrating the spectrum of RP-related laryngeal airway involvement.

Lower airway involvement

Bronchial involvement was noted in 63 out of 173 (36%) patients. Among these, 52 (83%) showed bronchial wall thickening, 19 (30.2%) had calcification and 30 (48%) presented with stenosis. Of the 19 cases with calcification, 16 (84%) also exhibited wall thickening. 16 (53%) cases with stenosis were accompanied by wall thickening. Notably, all patients with bronchial involvement also had tracheal involvement.

Tracheal involvement was identified in 140 of 173 (81%) patients. Among these cases, 112 (80%) demonstrated varying degrees of tracheal wall thickening, 86 (61%) exhibited tracheal wall calcification and 45 (32%) presented with stenosis. No instances of air trapping were observed. Of the 86 cases with tracheal wall calcification, 60 (70%) also displayed wall thickening, while 26 (30%) did not. Notably, all 45 cases (100%) with stenosis were accompanied by wall thickening.

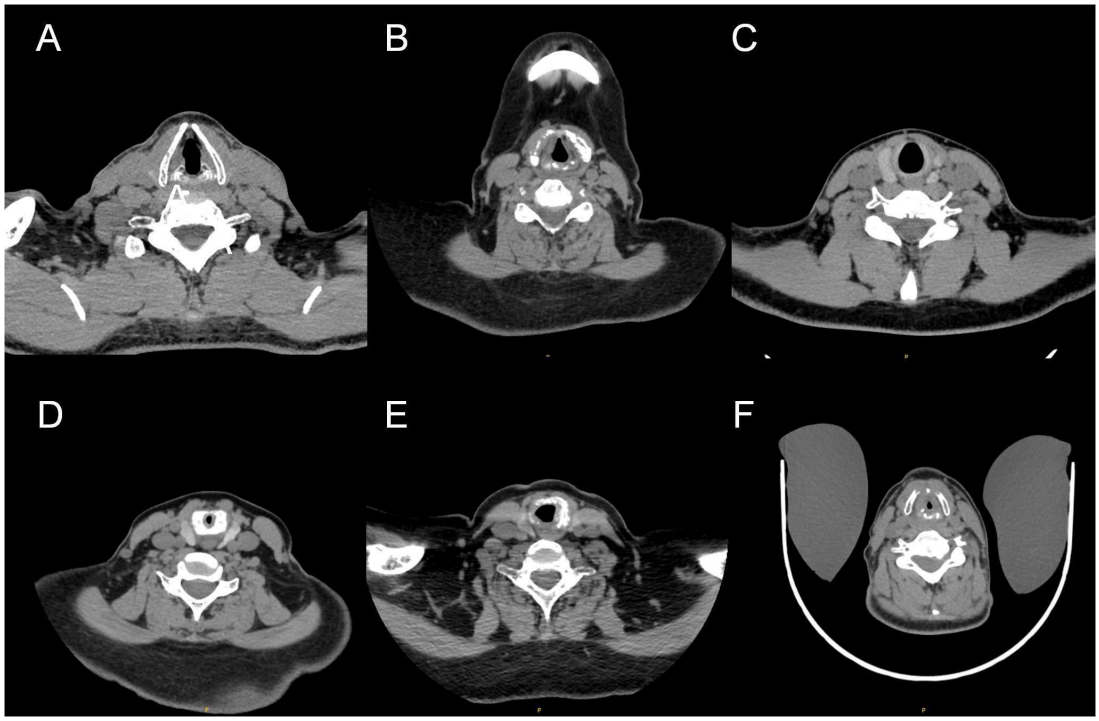

Figure 1 Representative CT images of RP-related laryngeal airway involvement. (A) Normal thyroid cartilage in a 60-year-old male with initial ocular symptoms 18 years ago. (B) Thyroid cartilage destruction in a 58-year-old female with initial cough 5 years ago. (C) Normal cricoid cartilage in a 14-year-old female with initial auricular chondritis 2 years ago. (D) Cricoid cartilage thickening with laryngeal airway stenosis and tracheostomy in a 44-year-old male with initial cough 3 years ago. (E) Cricoid cartilage destruction in the same patient as (B). (F) Significant tracheal mucosal thickening with laryngeal airway stenosis in a 51-year-old female with initial cough 1 year ago. RP, relapsing polychondritis.

Table 1 Analysis of the relationship between respiratory symptoms and clinical manifestations of RP (subset of 107 patients with complete symptom data)

Characteristics		Present (n=72)	Absent (n=35)	P value
Number (%)		72 (67)	35 (33)	–
Age at enrolment (years)		40.9±15.1	44.4±16.2	0.268
Gender (male:female)		28:44	14:21	0.446
Age at onset (years)		37.4±15.8	39.7±15.4	0.506
Median disease duration (months)		24	24	0.175
RPDAI score		33	29	0.140
Airway involvement (3:2:1:0)*		27:28:8:8	3:5:8:19	<0.001
Involvement site	Laryngeal cartilage	41	3	<0.001
	Trachea	64	22	<0.001
	Bronchi	38	8	<0.001
Involvement site	Ear	30	29	0.038
	Cochlea	22	13	<0.001
	Vestibule	25	12	0.926
Involvement site	Nasal	24	5	0.871
	Ocular	30	14	<0.001
	Extracranial	19	13	0.259

*3:2:1:0 refers to the number of airway regions involved (3 regions, 2 regions, 1 region or no involvement).
RP, relapsing polychondritis; RPDAI, Relapsing Polychondritis Disease Activity Index.

Clinical features of airway involvement

Respiratory symptoms

Of the 173 patients who underwent lung CT examinations, 107 (62%) exhibited respiratory symptoms. These symptoms were the initial manifestation in 72 (42%) cases, while 68 (39%) patients remained asymptomatic. The most common symptoms were cough (61 cases, 57%), dyspnoea (54 cases, 50%) and hoarseness (49 cases, 46%). Other symptoms, such as sore throat, pharyngeal discomfort and snoring, were noted in 10 cases (9%).

Group analysis of 107 patients with complete symptom data (table 1) yielded several significant findings. No substantial differences were observed between patients with respiratory symptoms and asymptomatic patients in terms of age at enrolment (40.9±15.1 vs 44.4±16.2 years, p=0.268), gender distribution (28:44 vs 14:21 male:female ratio, p=0.446), age at onset (37.4±15.8 vs 39.7±15.4 years, p=0.506) or median disease duration (24 months for both groups, p=0.175).

Airway involvement extent differed between groups (3:2:1:0 distribution of 27:28:8:8 vs 3:5:8:19, p<0.001). Specifically, laryngeal cartilage (41 vs 3 cases, p<0.001), tracheal (64 vs 22 cases, p<0.001) and bronchial involvement (38 vs 8 cases, p<0.001) were significantly more prevalent in patients with respiratory symptoms.

Cochlear (22 vs 13 cases, p<0.001), ocular (30 vs 14 cases, p<0.001) and ear involvement (30 vs 29 cases, p=0.038) differed between groups. No significant differences were found in nasal (24 vs 5 cases, p=0.871), vestibular (25 vs 12 cases, p=0.926) or extracranial involvement (19 vs 13 cases, p=0.259) between the respiratory-symptomatic and asymptomatic groups.

RPDAI scores were 33 in the respiratory-symptomatic group vs 29 in asymptomatic patients (p=0.140).

Interestingly, among the 68 asymptomatic patients, 45 (66%) showed CT imaging abnormalities. These included 39 cases of tracheal involvement, 9 cases of bronchial involvement and 17 cases of laryngeal involvement.

These results highlight the necessity for comprehensive airway assessment in RP patients, irrespective of respiratory symptoms. The strong association between respiratory symptoms and airway involvement extent emphasises the need for vigilant monitoring and early intervention in symptomatic patients. Moreover, the high prevalence of CT abnormalities in asymptomatic patients underscores the value of routine imaging for detecting subclinical airway involvement in RP. The significant differences in cochlear and ocular involvement between symptomatic and asymptomatic patients suggest that respiratory symptoms may indicate more widespread disease, emphasising the need for comprehensive evaluation of multiple organ systems in RP patients.

Laryngeal involvement

Analysis of 107 patients who underwent laryngeal CT evaluation (table 2) revealed several significant findings regarding laryngeal involvement in RP.

Age at enrolment was 37.2±16.0 years for patients with laryngeal involvement vs 45.4±14.3 years for those without (p=0.0076), and age at onset was 32.7±16.4 vs 42.1±14.0 years (p=0.0026). Median disease duration was

Table 2 Analysis of the relationship between laryngeal involvement and clinical manifestations of RP

Laryngeal involvement		Present (n=44)	Absent (n=63)	P value
Age at enrolment (years)		37.2±16.0	45.4±14.3	0.0076
Gender (male:female)		15:29	27:36	0.335
Age at onset (years)		32.7±16.4	42.1±14.0	0.0026
Median disease duration (months)		42	19	0.275
RPDAI score		33	30	0.069
Airway involvement (3:2:1:0)*		30:13:1:0	0:21:15:27	<0.001
Involvement site	Laryngeal cartilage	44	0	1.0
	Trachea	43	43	1.0
	Bronchi	26	21	0.645
Involvement site	Ear	20	39	0.372
	Cochlea	8	27	1.0
	Vestibule	14	23	0.068
Involvement site	Nasal	20	9	0.792
	Ocular	14	30	0.444
	Extracranial	13	19	0.444

*3:2:1:0 refers to the number of airway regions involved (3 regions, 2 regions, 1 region or no involvement).
RP, relapsing polychondritis; RPDAI, Relapsing Polychondritis Disease Activity Index.

42 months in patients with laryngeal involvement vs 19 months in those without (p=0.275). RPDAI scores were 33 in patients with laryngeal involvement vs 30 in those without (p=0.069).

Airway involvement extent differed between groups (3:2:1:0 distribution of 30:13:1:0 vs 0:21:15:27, p<0.001). All 44 patients with laryngeal involvement had laryngeal cartilage involvement by definition, with tracheal involvement in 43/44 vs 43/63 (p=1.0) and bronchial involvement in 26/44 vs 21/63 (p=0.645).

Involvement of other organ systems showed no significant differences between groups: ear (20/44 vs 39/63, p=0.372), cochlear (8/44 vs 27/63, p=1.0), vestibular (14/44 vs 23/63, p=0.068), nasal (20/44 vs 9/63, p=0.792), ocular (14/44 vs 30/63, p=0.444) and extracranial (13/44 vs 19/63, p=0.444). Gender distribution was 15:29 (male:female) in patients with laryngeal involvement vs 27:36 in those without (p=0.335).

Tracheostomy

Analysis of 107 patients who underwent laryngeal CT evaluation (table 3) revealed significant findings regarding tracheostomy in RP patients.

Age at enrolment was 35.4±17.9 years for patients requiring tracheostomy vs 43.6±14.5 years for those without (p=0.028), and age at onset was 30.7±18.7 vs . 40.1±14.4 years (p=0.013). Median disease duration was 48 months in patients with tracheostomy vs 24 months in those without (p=0.061). RPDAI scores were 33 in patients with tracheostomy vs 30 in those without (p=0.0012).

Age at enrolment was 35.4±17.9 years for patients requiring tracheostomy vs 43.6±14.5 years for those without (p=0.028), and age at onset was 30.7±18.7 vs 40.1±14.4 years (p=0.013). Median disease duration was 48 months in patients with tracheostomy vs 24 months in those without (p=0.061). RPDAI scores were 33 in patients with tracheostomy vs 30 in those without (p=0.0012).

Age at enrolment was 35.4±17.9 years for patients requiring tracheostomy vs 43.6±14.5 years for those without (p=0.028), and age at onset was 30.7±18.7 vs 40.1±14.4 years (p=0.013). Median disease duration was 48 months in patients with tracheostomy vs 24 months in those without (p=0.061). RPDAI scores were 33 in patients with tracheostomy vs 30 in those without (p=0.0012).

These findings underscore the complex nature of airway involvement leading to tracheostomy in RP. Younger age at disease onset appears to be a significant risk factor, as does more extensive airway involvement. The significantly higher RPDAI scores in patients with tracheostomy suggest that these patients have more active disease overall. The lack of significant differences in other organ system involvement indicates that the need for tracheostomy may be primarily determined by the severity of airway involvement rather than extracranial manifestations of RP.

These results emphasise the importance of thorough airway evaluation and management, particularly in younger RP patients and those with extensive airway involvement. Early detection and appropriate management of severe airway involvement could potentially prevent the need for tracheostomy and improve patient outcomes. Further research is needed to elucidate the specific mechanisms underlying the association between younger age of onset and increased risk of requiring tracheostomy in RP.

Table 3 Comparison of clinical features between patients with and without tracheostomy among 107 Cases with laryngeal CT evaluation

Tracheostomy		Present (n=21)	Absent (n=86)	P value
Age at enrolment (years)		35.4±17.9	43.6±14.5	0.028
Gender (male:female)		7:14	35:51	0.855
Age at onset (years)		30.7±18.7	40.1±14.4	0.013
Median disease duration (months)		48	24	0.061
RPDAI score		33	30	0.0012
Airway involvement (3:2:1:0)*		13:7:0:1	17:27:16:26	<0.001
Involvement site	Laryngeal cartilage	21	24	1.0
	Trachea	19	65	1.0
	Bronchi	10	38	0.64
Involvement site	Ear	9	50	1.0
	Cochlea	4	31	0.66
	Vestibule	4	33	0.652
Involvement site	Nasal	11	18	1.0
	Ocular	7	37	1.0
	Extracranial	4	28	1.0

*3:2:1:0 refers to the number of airway regions involved (3 regions, 2 regions, 1 region, or no involvement).
RPDAI, Relapsing Polychondritis Disease Activity Index.

DISCUSSION

This retrospective study of 173 patients with RP undergoing routine laryngeal and chest CT examinations revealed a high incidence of airway involvement at 82% (141/173), with tracheal involvement in 81% (140/173), laryngeal involvement in 41% (44/107) and bronchial involvement in 36% (63/173). Predominant laryngeal findings included cricoid cartilage erosion and widening (39%, 42/107), often with mucosal hyperplasia. Notably, 66% (45/68) of asymptomatic patients demonstrated CT abnormalities, indicating substantial subclinical airway damage. Patients with respiratory symptoms showed greater airway involvement extent (p<0.001), with higher rates of laryngeal (41 vs 3, p<0.001), tracheal (64 vs 22, p<0.001) and bronchial involvement (38 vs 8, p<0.001). Laryngeal involvement correlated with younger age at onset (32.7 vs 42.1 years, p=0.0026) and multiregion airway involvement (p<0.001), while tracheostomy (15%, 27/183) was associated with younger onset (30.7 vs 40.1 years, p=0.013), higher RPDAI scores (33 vs 30, p=0.0012) and extensive airway disease (p<0.001).

Airway involvement in RP involves inflammation and destruction of cartilaginous structures,[12] with prior studies reporting lower airway involvement at 20%–50%.[5 8] Hong and Kim observed 48% airway involvement in 62 patients, focusing on tracheal and bronchial regions,[5] and Behar *et al* noted tracheal thickening in 50% via CT.[8] The 82% rate in this study likely reflects systematic laryngeal and chest CT evaluation, capturing subclinical changes that may be missed by symptomatic or selective imaging.[13] Early work by Daly identified subglottic masses causing stenosis,[14] consistent with the cricoid findings here, though the present analysis provides more detailed CT patterns absent from prior reports.[15] Childs *et al* highlighted subglottic stenosis,[15] aligning with our 15% tracheostomy rate linked to laryngeal damage.

Lower airway manifestations typically include wall thickening and calcification, with stenosis as a late feature,[8] while our study delineates distinct laryngeal characteristics—cricoid erosion and widening—underscoring the necessity for targeted upper airway assessment. The 66% asymptomatic abnormality rate surpasses Hong and Kim's ~50% subclinical estimate,[5] reinforcing routine CT's diagnostic value. Pathologically, hyaline cartilage damage is similar across airways,[12] with cricoid predominance in our cohort possibly due to inflammatory hyperplasia in narrow subglottic regions.

Mechanisms like cricoid widening remain inadequately understood but could involve abnormal repair processes.[16 17] Three-dimensional CT effectively visualised cartilage and airway alterations,[18] though localisation challenges persist.[19] Younger patients and those requiring tracheostomy demonstrated more severe airway involvement, resembling paediatric RP presentations,[20] yet extracranial organ differences were not observed, suggesting airway severity primarily drives outcomes.

Historically, airway involvement accounted for ~10% of RP-related deaths,[21] yet recent improvements in prognosis[7] likely stem from earlier detection and intervention. The elevated RPDAI scores observed in patients undergoing tracheostomy (p=0.0012) and strong associations between respiratory symptoms and airway lesions (p<0.001) underscore disease severity, with cochlear (p<0.001) and ocular (p<0.001) differences implying

broader systemic involvement, although ear involvement (p=0.038) warrants further confirmation.

Overall, these findings support routine CT screening in all RP patients, given the 66% prevalence of asymptomatic airway lesions and high risk of laryngeal and lower airway compromise. Younger patients (mean onset 32.7 years for laryngeal involvement, p=0.0026) and those with extensive airway damage (p<0.001) particularly require vigilant monitoring and timely intervention to reduce tracheostomy risk (15%) and improve outcomes. Further prospective, multicentre studies are needed to refine and extend current knowledge of RP airway involvement.

Several limitations are noteworthy. The retrospective design limits causal interpretations, such as directly linking younger onset to airway involvement, and relies on existing records, which may be incomplete regarding prior treatment history. Although interventions can affect findings like mucosal hyperplasia, clinical observation suggests that structural cartilage damage often persists, potentially minimising therapy's impact on core CT findings—an area requiring more research. Selection bias may inflate the 82% airway involvement rate, as this single-centre tertiary cohort potentially overrepresents severe RP cases, highlighting the need for validation in other centres or larger international populations. Finally, while CT reveals structural changes (eg, 39% cricoid erosion), it cannot assess functional deficits or confirm RP-specific pathology without additional tools such as spirometry or histopathology. The lack of dynamic expiratory CT and pulmonary function testing (including flow-volume loops) further constrains the ability to evaluate airway dynamics comprehensively.

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Competing interests None declared.

Patient consent for publication Not applicable.

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