Pediatric Pulmonology 29:382–388 (2000)

Pulmonary Renal Syndrome in Childhood: A Report of Twenty-One Cases and a Review of the Literature

Rodo O. von Vigier, MD,[1] Stefan A. Trummler, MD,[1] Regula Laux-End, MD,[1] Marie J. Sauvain, MD,[1,2] Anita C. Truttmann, MD,[1] and Mario G. Bianchetti, MD[1]*

Summary. In adults, the term *specific pulmonary renal syndrome* describes disorders with pulmonary and glomerular manifestations and includes Wegener's granulomatosis, Goodpasture disease, and systemic lupus erythematosus. *Nonspecific pulmonary renal syndrome* refers to either pulmonary disease complicating glomerular disease, or glomerular diseases following pulmonary disease. Since little is known regarding pulmonary renal syndrome in childhood, we reviewed the charts of 21 pediatric patients with pulmonary renal syndromes treated by the Department of Pediatrics, University of Bern between 1991 and 1998; we also reviewed the pediatric literature that deals with *specific pulmonary renal syndromes.*

Specific pulmonary renal syndrome was noted in 3 children with systemic vasculitis (Wegener granulomatosis, N = 2; microscopic polyangiitis, N = 1) and 2 with systemic lupus erythematosus. *Nonspecific pulmonary renal syndrome* was observed in 12 patients with pulmonary edema (N = 9), pulmonary thromboembolism (N = 2), and pulmonary infection (N = 1) complicating the course of a glomerular disease, and in 4 children with a pulmonary disease followed by a glomerular disease. Review of the literature disclosed 52 cases of *specific pulmonary renal syndrome* other than systemic lupus erythematosus: Wegener granulomatosis (N = 28), Goodpasture disease (N = 13), and Henoch-Schönlein purpura (N = 11). In addition, hemolytic uremic syndrome complicated pneumococcal pneumonia in 32 cases.

We conclude that *pulmonary renal syndromes* need to be looked for in childhood. Apart from Wegener granulomatosis, Goodpasture disease, and systemic lupus erythematosus, Henoch-Schönlein purpura and hemolytic-uremic syndrome occasionally have both pulmonary and renal features. **Pediatr Pulmonol. 2000; 29:382–388.**

Key words: Goodpasture syndrome; hemolytic-uremic syndrome; kidney disease; pulmonary disease; Schönlein-Henoch purpura; vasculitis; Wegener granulomatosis.

INTRODUCTION

In adults, the term *pulmonary renal syndrome* is used to indicate the coexistence of severe pulmonary and renal disease in individuals without any concomitant destructive pulmonary disease. The term *specific pulmonary renal syndrome* describes disorders associating pulmonary (hemoptysis; lung hemorrhage; infiltrates or nodules) and glomerular manifestations and includes Wegener granulomatosis (or related systemic vasculitides such as microscopic polyangiitis and Churg-Strauss syndrome), Goodpasture disease, and systemic lupus erythematosus. The term *nonspecific pulmonary renal syndrome* refers either to pulmonary edema, pulmonary thromboembolism, or pulmonary infection complicating the course of glomerular disease, or to glomerular diseases following pulmonary disease, mostly an infection.[1–10]

Little is known regarding pulmonary renal syndrome in childhood. This might well be related to the fact that Wegener granulomatosis, microscopic polyangiitis, Churg-Strauss disease, Goodpasture disease, and systemic lupus erythematosus are rather rare in this age group. On the other hand, it is tempting to assume that some diseases primarily seen in children such as Henoch-Schönlein purpura or hemolytic-uremic syndrome might present with pulmonary and renal features.

We report on 21 pediatric patients with specific or nonspecific pulmonary renal syndromes, diagnosed and treated by the Department of Pediatrics, University of

[1]Department of Pediatrics, University of Bern, Bern, Switzerland.

[2]Department of Rheumatology, University of Bern, Bern, Switzerland.

*Correspondence to: M.G. Bianchetti, M.D., Kinderklinik, Inselspital, CH-3010 Bern, Switzerland. E-mail: mario.bianchetti@insel.ch

Received 22 July 1999; Accepted 27 October 1999.

TABLE 1—Clinical and Laboratory Findings in 3 Pediatric Patients With Specific Pulmonary Renal Syndrome Including Systemic Vasculitides and Circulating Antineutrophil Cytoplasmic Autoantibodies, but Without Circulating Antinuclear Autoantibodies

Patient	Case 1 (female)	Case 2 (male)	Case 3 (female)
Current age, years	8.2	14	18
Age at diagnosis, years	5.3	10	13
Prodromal disturbances	Cough, abdominal pain	Otitis, mastoiditis, abdominal pain, purpuric rash	Sinusitis, arthralgia, weight loss
Organ involvement			
Skin	None	Palpable purpuric rash (lower extremities)	Palpable purpuric rash (lower extremities)
Upper respiratory tract	None	Otitis media, mastoiditis, sinusitis	Rhinitis, sinusitis
Lower respiratory tract	Bleeding	Bleeding	Bleeding
Intestine	Intussusception, bowel perforation, peritonitis	Abdominal pain	Occult bleeding
Kidney	Glomerulonephritis, transient renal failure	Mild proteinuria and hematuria	Mild proteinuria and hematuria
Renal biopsy	Pauciimmune glomerulonephritis	Mild glomerular hyalinosis	Mild glomerular hyalinosis
Antineutrophil cytoplasmic autoantibodies			
Pattern	Perinuclear myeloperoxidase	Cytoplasmic proteinase 3	Cytoplasmic proteinase 3
Antigen			
Final diagnosis	Microscopic polyangiitis	Wegener granulomatosis	Wegener granulomatosis
Course	Remission (untreated for 18 months)	Chronic kidney disease	Chronic kidney disease

Bern, Switzerland between 1991 and 1998. Furthermore, we review the pediatric literature dealing with pulmonary renal syndromes.

CASE REPORTS

Specific Pulmonary Renal Syndrome

Three children had a systemic vasculitis associated with circulating antineutrophil cytoplasmic autoantibodies (Table 1). The diagnosis of glomerulonephritis complicating peritonitis and Henoch-Schönlein purpura had been initially suspected in 2 patients. Based on typical histopathological findings, the final diagnosis was Wegener granulomatosis in 2 and microscopic polyangiitis in 1 patient. The patients were put on treatment with prednisone and cyclophosphamide. In addition, cotrimoxazol was given to the 2 patients with Wegener granulomatosis.

Two children presenting with a pulmonary renal syndrome were found to have systemic lupus erythematosus (Table 2). Both patients were treated with prednisone and azathioprin and are currently in remission.

Nonspecific Pulmonary Renal Syndrome

A *nonspecific pulmonary renal syndrome* was noted in 16 children. In 12 patients, pulmonary edema due to fluid overload (N = 9), pulmonary thromboembolism (N = 2), or pulmonary infections (N = 1) complicated the course of a glomerular disease, as shown in Table 3. In 4 children, a preexisting pulmonary disease was followed by a glomerular one, as listed in Table 4.

REVIEW OF THE LITERATURE ON PULMONARY RENAL SYNDROME IN CHILDHOOD

At least 28 pediatric patients with renal and pulmonary involvement and with a diagnosis of Wegener granulomatosis have been reported,[11–31] as shown in Table 5. Apart from renal and pulmonary involvement, the great majority of these patients presented with either rhinosinusitis or otitis. In the reports no distinction was made between Wegener granulomatosis and microscopic polyangiitis.

The diagnosis of Goodpasture disease was seen in only 13 pediatric patients with a *specific pulmonary renal syndrome*,[32–40] as shown in Table 6. In 2 of the 13 patients, no information on testing for circulating antibodies against glomerular basement membrane or renal biopsy findings was available.

The most common cause of *specific pulmonary renal syndrome* reported in the pediatric literature is systemic lupus erythematosus.[41,42] The major extrarenal and extrapulmonary features in pediatric patients with renal and

TABLE 2—Clinical and Laboratory Findings in 2 Pediatric Patients With Specific Pulmonary Renal Syndrome and Systemic Lupus Erythematosus

Patient	1, female	2, male
Current age, years	17	14
Age at diagnosis, years	12	13
Prodromal disturbances	Weight loss, fever, arthralgia, butterfly rash, chest pain	Weight loss, fatigue, fever, cough
Pulmonary involvement	Pleural effusion	Infiltrate (right upper lobe)
Renal biopsy	Extramembranous glomerulonephritis	Diffuse proliferative glomerulonephritis
ARA[1] criteria for the classification of lupus erythematosus	Discoid rash, photosensitivity, arthritis, renal disorder, serositis	Hemolytic anemia, leukopenia, thrombocytopenia, renal disorder
Course	Remission	Remission

[1]ARA, American Rheumatism Association, other than antinuclear autoantibodies to native deoxyribonucleic acid.

TABLE 3—Clinical and Laboratory Findings in 12 Pediatric Patients With a Nonspecific Pulmonary Renal Syndrome[1]

Male:female	7:5
Age, years[2]	3.5 (0.5–14)
Underlying glomerular disease	
Postinfectious glomerulonephritis	4
Postdiarrheal hemolytic-uremic syndrome	3
Finnish-type nephrotic syndrome	2
Idiopathic childhood nephrotic syndrome (refractory to steoids)	2
Extramembranous glomerulonephritis in SLE	1
Pulmonary complications	
Pulmonary edema	9
Pulmonary thromboembolism	2
Pneumocystis carinii pneumonia	1

[1]Pulmonary complication of an underlying glomerular disease.
[2]Median and ranges.

pulmonary involvement in connection with systemic lupus erythematosus were recently reviewed by Nadorra and Landing.[41] They include female predominance, cardiovascular involvement, hematological involvement, skin and joint involvement, and central nervous system involvement, as summarized in Table 7.

A recent review indicates that only 11 pediatric patients with Henoch-Schönlein purpura were reported with associated pulmonary and renal features, as shown in Table 8. The typical biopsy features of Henoch-Schönlein purpura, including either mesangial IgA deposition or a leukocytoclastic vasculitis accompanied by vascular IgA deposition, were not demonstrated in 5 patients.[43]

Hemolytic uremic syndrome is a rare but recognized complication of systemic diseases caused by pneumococcal infection.[44] The features of 32 pediatric patients with postpneumococcal hemolytic uremic syndrome are given in Table 9.[44] The direct Coombs test was very often positive in this condition.

Churg-Strauss disease is rare in childhood.[45–48] To our knowledge, no more than 4 pediatric cases of Churg-Strauss syndrome have been reported. No renal involvement was noted in the mentioned patients.

DISCUSSION

The term *pulmonary renal syndrome* is used to describe adult patients with serious and potentially threatening multisystem diseases dominated by a pulmonary and a renal component. Several reviews of this topic have appeared.[1–10] Our study was performed to assess the features of pulmonary renal syndrome in pediatric patients. We observed that in childhood a diversity of specific and nonspecific conditions, which differ at least in part from those in adults, produce pulmonary renal syndrome, as summarized in Table 10.

Both in childhood and in adulthood, *nonspecific pulmonary renal syndrome* is more frequent than the *specific* one. This term[3] refers either to pulmonary edema, pulmonary thromboembolism, or pulmonary infection (mostly caused by opportunistic organisms[49]) complicating the course of glomerular disease, or to glomerular diseases following a pulmonary disease, mostly an infection caused by common organisms such as *Mycoplasma pneumoniae* or *Legionella pneumophila.*[49–51] The tendency toward developing a *nonspecific pulmonary renal syndrome* is likely the same in children and adults with the exception of pneumococcal pneumonia, a well recognized cause of hemolytic uremic syndrome in childhood. The direct Coombs test is positive in this form of hemolytic uremic syndrome.[44] The designation "secondary amyloidosis" refers to tissue deposition of fibrils composed of fragments of serum amyloid A protein.[52] Secondary renal amyloidosis has been reported in cystic fibrosis with severe pulmonary involvement.[53–55]

It has been assumed that the clinical presentation of acute glomerulonephritis with pulmonary hemorrhage (as manifested by hemoptysis or pulmonary infiltrates) is indicative of antiglomerular basement membrane antibodies, as seen in Goodpasture disease. These findings, however, are not diagnostic of antiglomerular basement

TABLE 4—Clinical and Laboratory Findings in Four Pediatric Patients With a Nonspecific Pulmonary Renal Syndrome[1]

Case	Age (years)	Gender	Pulmonary disease	Glomerular disease	Comment
1	11	Male	Streptococcal pleuropneumonia (A-Streptococci recovered from pleural fluid)	Severe poststreptococcal glomerulonephritis with transient anuria and severe arterial hypertension	Blood C_3-complement strongly reduced (transiently)
2	4	Male	Lobar pneumonia of unknown origin (pneumococcal?)	Mild glomerulonephritis	Blood C_3- and C_4-complement within normal range
3	3	Female	Lobar pneumonia of unknown origin (pneumococcal?)	Severe glomerulonephritis and renal failure not requiring dialysis (creatinine up 365 μmol/L, urea up to 31.9 mmol/L)	Blood C_3- and C_4-complement within normal range
4	6	Female	Chronic lung edema and severe idiopathic dilated cardiomyopathy	Severe glomerulonephritis and systemic microscopic polyangiitis[2]	No clear-cut link between cardiomyopathy and microscopic polyangiitis

[1]Glomerular complication of an underlying pulmonary disease.
[2]Antineutrophil cytoplasmic autoantibodies (titer 1:160) against proteinase 3.

TABLE 5—Features in 28 Pediatric Patients With Both Renal and Pulmonary (Lung Hemorrhage) Involvement Considered to Have Wegener Granulomatosis[11–31]

N	28
Female:male	20:8
Age, years[1]	12 (2–16)
Renal involvement, N	28/28
Pulmonary involvement, N	28/28
Rhinosinusitis, N	20/28
Otitis, N	5/28
Laryngotracheal involvement, N	3/28

[1]Median and range.

TABLE 6—Features in 13 Pediatric Patients With Pulmorenal Syndromes Considered to Have Goodpasture Disease[32–40]

N	13
Female:male	10:3
Age, years[1]	14 (4.5–17)
Pulmonary involvement, N	13/13
Renal involvement, N	13/13
Circulating antibodies against GBM, N[2]	8/9
IgG deposits along GBM, N[2]	7/7

[1]Median and range.
[2]In 2 patients, no information on testing for circulating antibodies against glomerular basement membrane or renal biopsy findings was reported. GBM, glomerular basement membrane.

membrane antibody disease, since they can be seen in systemic vasculitis and systemic lupus erythematosus. Vasculitides such as Wegener granulomatosis (more rarely microscopic polyangiitis or Churg-Strauss syndrome), Goodpasture disease, or systemic lupus erythematosus are the most common causes of *specific pulmonary renal syndrome* in adult patients.[1–10,56–58] The present review of the pediatric literature suggests that, apart from the mentioned disorders, Henoch-Schönlein

TABLE 7—Major Extrarenal and Extrapulmonary Involvement[1] in Pediatric Patients With Renal and Pulmonary Involvement in Systemic Lupus Erythematosus, as Reviewed by Nadorra and Landing[41]

Female predominance	+++
Cardiovascular involvement	+++
Hematologic involvement	+++
Skin and joint involvement	++
Central nervous system involvement	++

[1]++, more than 50% of cases; +++, more than 80% of cases.

TABLE 8—Features in 11 Pediatric Patients With Pulmorenal Syndromes Considered to Have Henoch-Schönlein Purpura[43]

N	11
Female:male	5:6
Age, years[1]	14 (4.5–17)
Renal involvement, N	11/11
Pulmonary involvement, N	11/11
Skin involvement, N	11/11
Joint involvement, N	11/11
Abdominal involvement, N	10/11
Cardiac involvement, N	3/11

[1]Median and range.

TABLE 9—Features in 32 Pediatric Patients With Hemolytic Uremic Syndrome Complicating Pneumococcal Pneumonia[44]

N	32
Female:male[1]	12:11
Age, months[2]	13 (5–31)
Direct Coombs test positive[3]	11/12
Positive blood cultures	26/32

[1]Information not available in 9 cases.
[2]Median and range.
[3]No information available in 20 cases.

TABLE 10—Specific and Nonspecific Conditions That Produce Pulmonary Renal Syndrome in Children

	Nonspecific pulmonary renal syndromes	
Specific pulmonary renal syndromes	Pulmonary disease complicating preexisting glomerular disease	Glomerular disease complicating pulmonary disease
Systemic lupus erythematosus	Pulmonary edema	Postinfectious glomerulonephritis (A-Streptococcus, Pneumococcus, Mycoplasma, Leginonella)
Vasculitides	Pulmonary thromboembolism	
Wegener granulomatosis (and microscopic polyangiitis)	Pulmonary infection[1]	Postpneumococcal hemolytic uremic syndrome
Henoch-Schönlein purpura		
Goodpasture disease		Amyloidosis complicating cystic fibrosis

[1]Mostly caused by opportunistic organisms.

purpura also causes a *specific pulmonary renal syndrome* in this age group.[43] This fact is not surprising, considering that this disease is the most common systemic vasculitis that occurs in childhood.[59] Interestingly, recent data suggest a subclinical pulmonary involvement in most children with Henoch-Schönlein purpura.[60]

Churg-Strauss syndrome (or allergic angiitis and granulomatosis) is among the proposed etiologies of systemic diseases which share pulmonary and renal abnormalities.[1–10] This multisystemic vasculitis is characterized by allergic rhinitis, asthma, and peripheral blood eosinophilia. The most common organs involved are the lung and the skin, followed by the cardiovascular, gastrointestinal, central nervous, and, more rarely, renal systems. Unlike other vasculitides, however, renal involvement has never been noted in children with this syndrome.[45–48]

A large set of diagnostic markers can be used in patients with *specific pulmonary renal syndromes.* The presence of circulating antineutrophil cytoplasmic autoantibodies in pulmonary renal syndrome makes Wegener granulomatosis (or, more rarely, either microscopic polyangiitis or Churg-Strauss syndrome) the leading clinical possibility.[7–10,61] Recognition of antiglomerular basement membrane antibodies is virtually diagnostic for Goodpasture disease.[7–10,56–58] However, in some patients both positive antineutrophil cytoplasmic autoantibodies and antiglomerular basement membrane antibodies are present.[56–58] Antinuclear autoantibodies, mostly antibodies directed against native deoxyribonucleic acid, are an essential component in systemic lupus erythematosus.[1–10,62] Finally, decreased circulating levels of complement C_3 occur both in systemic lupus erythematosus and poststreptococcal glomerulonephritis.[62–63]

CONCLUSIONS

This article is the first to focus on pulmonary renal syndromes in pediatric practice. In childhood, pulmonary renal syndromes present as a rare but serious medical emergency. Since many causes may produce this syndrome and early diagnosis is crucial, the evaluation of a child presenting with pulmonary and renal symptoms includes, apart from a thorough history and physical examination, laboratory tests directed toward the possible causes of specific pulmonary renal syndrome. They include: 1) anti-glomerular basement membrane antibodies, which are essentially diagnostic of Goodpasture disease; 2) anti-neutrophil cytoplasmic antibodies, which are suggestive of Wegener granulomatosis or related diseases; 3) anti-nuclear antibodies in patients suspected of having lupus; 4) complement C_3-levels, that are usually reduced in poststreptococcal glomerulonephritis and systemic lupus erythematosus; and 5) complete blood cell count and the direct Coombs test, that help to diagnose postpneumococcal hemolytic uremic syndrome. A skin biopsy is often indicated in adults with a pulmonary renal syndrome. However, since in Henoch-Schönlein purpura the rash is usually very distinctive, a skin biopsy is rarely indicated in young patients with the typical purpuric lesions.

REFERENCES

1. Matthay RA, Bromberg SI, Putman CE. Pulmonary renal syndromes—a review. Yale J Biol Med 1980;53:497–523.
2. Rankin JA, Matthay RA. Pulmonary renal syndromes. II. Etiology and pathogenesis. Yale J Biol Med 1982;55:11–26.
3. Salant DJ. Immunopathogenesis of crescentic glomerulonephritis and lung purpura. Kidney Int 1987;32:408–425.
4. Bonsib SM, Walker WP. Pulmonary-renal syndrome: clinical similarity amidst etiologic diversity. Mod Pathol 1989;2:129–137.
5. Young KR. Pulmonary-renal syndrome. Clin Chest Med 1989;10: 665–675.
6. Urizar RE, McGoldrick MD, Cedra J. Pulmonary-renal syndrome. Its clinicopathological approach in 1991. NY State J Med 1991; 91:212–221.
7. Saxena R, Bygren P, Arvarstson B, Wieslander J. Circulating autoantibodies as serological marker in the differential diagnosis of pulmonary renal syndrome. J Intern Med 1995;238:143–152.
8. Niles JL, Böttinger EP, Saurina GR, Kelly KJ, Pan G, Collins AB, McCluskey RT. The syndrome of lung hemorrhage and nephritis is usually an ANCA-associated condition. Arch Intern Med 1996; 156:440–445.

9. Green RJ, Ruoss SJ, Kraft SA, Duncan SR, Berry GJ, Raffin TA. Pulmonary capillaritis and alveolar hemorrhage. Update on diagnosis and management. Chest 1996;110:1305–1316 [published erratum appears in Chest 1997;112:300].
10. Kalluri R. Goodpasture syndrome. Kidney Int 1999;55:1120–1122.
11. Feldman F, Fink H, Gruezo Z. Wegener's granulomatosis. Am J Dis Child 1966;112:587–592.
12. Roback SA, Herdman RC, Hoyer J, Good RA. Wegener's granulomatosis in a child. Am J Dis Child 1969;118:608–614.
13. Moorthy AV, Chesney RW, Segar WE, Groshong T. Wegener granulomatosis in childhood: prolonged survival following cytotoxic therapy. J Pediatr 1977;91:616–618.
14. Cohen SR, Landing BH, King KK, Isaacs H. Wegener's granulomatosis causing laryngeal and tracheobronchial obstruction in an adolescent girl. Ann Otol Rhinol Laryngol [Suppl] 1978;87:15–19.
15. Baliga R, Chang CH, Bidani AK, Perrin EVD, Fleischmann LE. A case of generalized Wegener's granulomatosis in childhood: successful therapy with cyclophosphamide. Pediatrics 1978;61:286–290.
16. Backman A, Grahne B, Holopainen E, Leisti J, Paavolainen M. Wegener's granulomatosis in childhood. A clinical report based on 3 cases. Int J Pediatr Otorhinolaryngol 1979;1:145–149.
17. Nespoli L, Duse M, Vitiello MA, Perinotto G, Fiocca R, Giannetti A, Colombo A. A rapid unfavorable outcome of Wegener's granulomatosis in early childhood. Eur J Pediatr 1979;131:277–282.
18. Hansen LP, Jacobsen J, Skytte H. Wegener's granulomatosis in a child. Eur J Respir Dis 1983;64:620–624.
19. Chyu JYH, Hagstrom WJ, Soltani K, Faibisoff B, Whitney DH. Wegener's granulomatosis in childhood: cutaneus manifestations as the presenting signs. J Am Acad Dermatol 1984;10:341–346.
20. Hall SL, Miller LC, Duggan E, Mauer SM, Beatty EC, Hellerstein S. Wegener granulomatosis in pediatric patients. J Pediatr 1985;106:739–744.
21. Parelhoff ES, Chavis RM, Friendly DS. Wegener's granulomatosis presenting as orbital pseudotumor in children. J Pediatr Ophthalmol Strabismus 1985;22:100–104.
22. Katsanis E, Mc Laine PN. Wegener granulomatosis. J Pediatr 1986;108:792–793.
23. Singer J, Suchet I, Horwitz T. Paediatric Wegener's granulomatosis: two case histories and a review of literature. Clin Radiol 1990;40:50–51.
24. McHugh K, Manson D, Eberhard BA, Shore A, Laxer RM. Wegener's granulomatosis in childhood. Pediatr Radiol 1991;21:552–555.
25. McHugh K, Manson D, Eberhard BA, Laxer RM, Shore A. Splenic necrosis in Wegener's granulomatosis. Pediatr Radiol 1991;21:588–589.
26. Pintos-Morell G, Roca-Comas A, Naranjo MA, Tural C, Abad E, Javier G, Prats J. Anti-neutrophil cytoplasmic auto-antibodies-associated vasculitis with pulmonary and renal involvement. Eur J Pediatr 1993;152:473–475.
27. Freed GL. Wegener's granulomatosis presenting as fever of unknown origin. Clin Pediatr (Phila) 1994;33:162–165.
28. Shuhart DT, Torretti DJ, Maksimak JF, George S. Acute myositis as an unusual presentation of Wegener's granulomatosis. Arch Pediatr Adolesc Med 1994;148:875–876.
29. Ellis EN, Wood EG, Berry P. Spectrum of disease associated with antineutrophil cytoplasmic autoantibodies in pediatric patients. J Pediatr 1995;126:40–43.
30. Reznik VM, Griswold WR, Lemire JM, Mendoza SA. Pulmonary hemorrhage in children with glomerulonephritis. Pediatr Nephrol 1995;9:83–86.
31. Gottlieb BS, Miller LC, Ilowite NT. Methotrexate treatment of Wegener granulomatosis in children. J Pediatr 1996;129:604–607.
32. Chambers SR, Chambers CL, Baskin TW. Pulmonary alveolar hemorrhage with glomerulonephritis and SA sicklemia, Goodpasture's syndrome in a Negro child. Clin Pediatr (Phila) 1971;10:351–354.
33. Dippell J, Koch KM, Fassbinder W, Kühner R, Schneider A, Wönne R. Syndrom Glomerulonephritis und Lungenblutung in der Pädiatrie. Monatsschr Kinderheilkd 1976;124:450–452.
34. Ozsoylu S, Hicsonmez G, Berkel I, Say B, Tinaztepe B. Goodpasture's syndrome (pulmonary hemosiderosis with nephritis). Clin Pediatr (Phila) 1976;15:358–360.
35. Martini A, Binda S, Mariani G, Scotta MS, Ruberto G. Goodpasture's syndrom in a child: natural history and effect of treatment. Acta Paediatr Scand 1981;70:435–439.
36. Simonsen H, Brun C, Thomsen OF, Larsen S, Ladefoged J. Goodpasture's syndrome in twins. Acta Med Scand 1982;212:425–428.
37. Levin M, Rigden SPA, Pincott JR, Lockwood CM, Barratt TM, Dillon MJ. Goodpasture's syndrome: treatment with plasmapheresis, immunosuppression, and anticoagulation. Arch Dis Child 1983;58:697–702.
38. Fanburg BL, Niles JL, Mark EJ. A 17 year-old girl with massive hemoptysis and acute oliguric renal failure. N Engl J Med 1993;329:2019–2026.
39. Rosenblum ND, Colvin RB. A 13 year-old girl with gross hematuria four years after a diagnosis of idiopathic pulmonary hemosiderosis. N Engl J Med 1993;328:1183–1190.
40. McCarthy LJ, Cotton J, Danielson C, Graves Y, Bergstein J. Goodpasture's syndrome in childhood: treatment with plasmapheresis and immunosuppression. J Clin Apheresis 1994;9:116–119.
41. Nadorra RL, Landing BH. Pulmonary lesions in childhood onset systemic lupus erythematosus: analysis of 26 cases, and summary of literature. Pediatr Pathol 1987;7:1–18.
42. Delgado EA, Malleson PN, Pirie GE, Petty RE. The pulmonary manifestations of childhood onset systemic lupus erythematosus. Semin Arthritis Rheum 1990;19:285–293.
43. Vats KR, Vats A, Kim Y, Dassenko D, Simaiko AR. Henoch-Schönlein purpura and pulmonary hemorrhage: a report and literature review. Pediatr Nephrol 1999;13:530–534.
44. von Vigier RO, Seibel K, Bianchetti MG. Positive Coombs test in pneumococcus-associated hemolytic uremic syndrome—a review of the literature. Nephron 1999;82:183–184.
45. O'Sullivan BP, Nimlin K, Gang DL. A fifteen-year-old boy with eosinophilia and pulmonary infiltrates. J Pediatr 1993;123:660–666.
46. Heine A, Beck R, Stropahl G, Unger K, Guthoff R. Entzündlicher Pseudotumor der anterioren Orbita—ein Symptom bei einer allergisch-granulomatösen Angiitis (Churg-Strauss-Syndrom). Ophtalmologie 1995;92:870–873.
47. Mpofu C, Bakalinova D, Kazi MA, Dawson KP. Churg Strauss syndrome in childhood. Ann Trop Pediatr 1995;15:341–344.
48. Rabusin M, Lepore L, Costantinides F, Bussani R. A child with severe asthma. Lancet 1998;351:32.
49. Hellmann DB, Petri M, Whiting-O'Keefe Q. Fatal infections in systemic lupus erythematosus: the role of opportunistic organisms. Medicine (Baltimore) 1987;66:341–348.
50. Shah A, Check F, Baskin S, Reyman T, Menard R. Legionnaire's disease and acute renal failure: case report and review. Clin Infect Dis 1992;14:204–207.
51. Said MH, Layani MP, Colon S, Faraj G, Glastre C, Cochat P. Mycoplasma pneumoniae-associated nephritis in children. Pediatr Nephrol 1999;13:39–44.

52. Falk RH, Comenzo RL, Skinner M. The systemic amyloidosis. N Engl J Med 1997;337:898–909.
53. Castile R, Shwachman H, Travis W, Hadley CA, Warwick W, Missmahl HP. Amyloidosis as a complication of cystic fibrosis. Am J Dis Child 1985;139:728–732.
54. Melzi ML, Costantini D, Giani M, Claris Appiani A, Giunta AM. Severe nephropathy in three adolescents with cystic fibrosis. Arch Dis Child 1991;66:1444–1447.
55. Patier JL, Maiz L, Frutos B, Suarez L, Escobar H. Intermittent macroscopic haematuria—an unusual manifestation of amyloidosis complicating cystic fibrosis. Nephron 1998;79:383–384.
56. Bolton WK. Goodpasture's syndrome. Kidney Int 1996;50:1753–1766.
57. Hellmark T, Segelmark M, Wieslander J. Anti-GBM antibodies in Goodpasture syndrome: anatomy of an epitope. Nephrol Dial Transplant 1997;12:646–648.
58. Balmelli C, Laux-End R, Di Rocco D, Carvajal-Busslinger MI, Bianchetti MG. Purpura Schönlein-Henoch: Verlauf bei 139 Kindern. Schweiz Med Wochenschr 1996;126:293–298.
59. Chaussain M, de Boissieu D, Kalifa G, Epelbaum S, Niaudet P, Badoual J, Gendrel D. Impairment of lung diffusion capacity in Schönlein-Henoch purpura. J Pediatr 1992;121:12–16.
60. Laux-End R, Gerber HA, Sauvain MJ, Bianchetti MG. Antineutrophil autoantibodies and systemic vasculitis: a report of five cases. Acta Paediatr 1997;86:438–439.
61. Tan EM. Antinuclear antibodies: diagnostic markers and clues to the basis of systemic autoimmunity. Pediatr Infect Dis J 1988;7:3–9.
62. Rimediotti MJ, Bianchetti MG, Penzien JM, Matter L, Lüthi C, Zimmermann A, Oetliker OH. Glomerulonephritis mit transitorischer C_3-Hypokomplementämie und endotheliomesangiale Glomerulonephritis im Kindesalter: eine Langzeiterfahrung. Schweiz Med Wochenschr 1992;122:1803–1809.