

# IgG4-Related Systemic Disease Presenting as Secondary Sclerosing Cholangitis with Multiorgan Involvement: A Case Report

Dr. Albert Shaji <sup>1\*</sup>, Dr. Umashankar R <sup>2</sup>, Dr. Saketh Ramineni<sup>3</sup>, Dr. Aishwarya Lakshmi M V<sup>4</sup>, Dr. Sheik Arshad Ali<sup>5</sup>, Dr Shobana S<sup>6</sup>, Dr. Razook Fareedh<sup>7</sup>

<sup>1</sup> Email ID - [shajialbert1@gmail.com](mailto:shajialbert1@gmail.com)

<sup>2</sup> Associate professor, Email ID - [smart.uma89@gmail.com](mailto:smart.uma89@gmail.com)

<sup>3</sup> Assistant Professor, Email ID - [rsaketh1992@gmail.com](mailto:rsaketh1992@gmail.com)

<sup>4</sup> Assistant Professor Email ID [aishwaryavenkat2193@gmail.com](mailto:aishwaryavenkat2193@gmail.com)

<sup>5</sup> Email ID - [Arshad.asd2@gmail.com](mailto:Arshad.asd2@gmail.com)

<sup>6</sup> Email ID : [dr.shobana2022@gmail.com](mailto:dr.shobana2022@gmail.com)

<sup>7</sup> Assistant Professor Email ID - [dr Razookfareedh@gmail.com](mailto:dr Razookfareedh@gmail.com)  
<sup>1234567</sup> Sree Balaji Medical College and Hospital, Chromepet, Chennai, India

Received: 25th Oct, 2025; Revised: 25th Dec, 2025; Accepted: 15th Jan, 2026; Available Online: 15th Feb, 2026

## ABSTRACT

IgG4-related systemic disease (IgG4-RD) is a systemic, immune-mediated fibroinflammatory disorder, that may involve a variety of organs. In this case report, the patient has an IgG4-related disease that can be characterized as secondary sclerosing cholangitis with a multifocal involvement including the pancreas, kidney, lymph node, and more. The patient presented abdominal pains, jaundice, and high liver enzymes. The imaging showed biliary strictures and organ enlargement. The IgG4 level in serum was significantly increased and histopathology revealed a dense lymphoplasmacytic infiltration with storiform fibrosis and IgG4-positive plasma cells. Imaging, biopsy and serological studies were used to rule out such differential diagnoses as primary sclerosing cholangitis and cholangiocarcinoma. The diagnosis of IgG4-related cholangitis was confirmed by the rapid improvement in the biochemical and clinical conditions of the patient under corticosteroid therapy. The main results of this report are that the early identification of IgG4-RD as a reversible cause of biliary obstruction is crucial, and has typical histological characteristics, and the possibility of relapse in case of premature withdrawal of treatment. In this paper, the diagnosis issue is highlighted because of the similarity with malignancies and autoimmune diseases. In the case, it becomes obvious that multidisciplinary assessment (imaging, serology, pathology) should be performed to make a correct diagnosis and prescribe immunosuppressive therapy. High awareness of IgG4-associated sclerosing cholangitis is critical to avoid invasive procedures that are not needed and enhance the long-term treatment outcomes in patients by providing early medical care and regularly checking them..

**Keywords:** IgG4-related disease, Sclerosing cholangitis, Multiorgan involvement, Autoimmune pancreatitis, Biliary obstruction, Corticosteroid therapy, Storiform fibrosis, Plasma cell infiltration, Differential diagnosis, Immunopathology.

**How to cite this article:** Shaji A, R U, Fareedh R, Lakshmi MAV, Ali SA, S S, IgG4-Related Systemic Disease Presenting as Secondary Sclerosing Cholangitis with Multiorgan Involvement: A Case Report..Int J Drug Deliv Technol. 2026; 16(2): 98-106; DOI: 10.25258/ijddt.16.2.13

**Source of support:** Nil.

**Conflict of interest:** None

## INTRODUCTION

IgG4-related disease (IGG4-RD) is a chronic immune-mediated fibroinflammatory disorder of multiple organs usually resembling malignancies, autoimmune diseases. It is distinguished by high levels of serum IgG4 level, thickening of the plasma infiltration, and storiform fibrosis in involved tissues. Among its many forms, a secondary involvement of the biliary, known as sclerosing cholangitis, may result in the development of severe obstruction to the biliary and cholestatic hepatopathy. The disease is often accompanied by such conditions as autoimmune pancreatitis, renal lesions, and lymphadenopathy, which means that the disease is multiorgan-involved. It is hard to make a correct different diagnosis because of the similarity of its clinical and radiological aspects with primary

sclerosing cholangitis and cholangiocarcinoma. Histopathological validation and a procedure of immunopathology assurance are necessary to be differentiated. Management is based on the use of corticosteroid therapy, which can result in impressive clinical and biochemical improvement. Nonetheless, the relapse is typical in case of the early withdrawal of the treatment, which is why continuous immunosuppressive treatment and multidisciplinary assessment are required to achieve the best patient outcomes and avoid the occurrence of irreversible organ injury.

## Method

In this case report, a detailed secondary clinical assessment utilized a retrospective assessment of diagnostic, radiological, and histopathological data available in the

management of the patient were used (Datta & Alam, 2025). The literature on IgG4-related disease and sclerosing cholangitis were systematically reviewed to find a comparison with the previously reported cases and clinical trials. Diagnostic trials were secondary tests of serological assays to measure serum IgG4 by immunonephelometry, and imaging tests to detect evidence of multiorgan involvement by MRCP, CT, ERCP and PET-CT. The histopathological diagnosis was done by conducting a bile duct and pancreatic biopsy that was stained with an immunohistochemistry test of IgG4-positive plasma cells (Kuwatani & Sakamoto, 2022). Before and after treatment analysis of liver biochemistry and immunological profiles were done to assess the response to treatment (corticosteroid therapy). All observations were made in conjunction with the existing diagnostic criteria in the past international consensus statements. The institutional review board gave ethical approval in using secondary data. The methodology structure allowed making a comprehensive comparison of clinical, imaging, and pathological data that are in agreement with the published research on immunopathology (Pascual-Reguant, Kroh & Hauser, 2023).

**Results**

***Serological Evaluation and Elevated IgG4 Levels in Diagnostic Confirmation***

In this case, serological analysis was the key to the diagnosis of the presence of the so-called IgG4-related disease, which confirmed a close correlation between high levels of serum Ig G4 and active inflammation in the body. The patient was given cholestatic liver enzyme damage that included a rise in alkaline phosphatase (ALP) and gamma-glutamyl transferase (GGT) that at first indicated sclerosing cholangitis or biliary obstruction (Jalili *et al.*, 2022). Later immunological tests revealed a higher serum level of “IgG4- IgG4-456mg/dL which is a strong indicator of the diagnosis of the condition of IgG4-related cholangitis. This hyper-IgG4 condition was an indication of the over-production of so-called plasma cells producing the IgG4 subclass, which is an autoimmune and inflammatory one (Maslinska, Dmowska-Chalaba, & Jakubaszek, 2022). In addition, the moderate increase of the total immunoglobulin levels and eosinophilia further supported the suspicion of the presence of the autoimmune pancreatitis with the involvement of more than one organ.

Parameter	Measured Value	Normal Range	Diagnostic Significance	Related “Keyword”
Serum “IgG4”	860 mg/dL	<135 mg/dL	Confirms “IgG4-related disease” activity	“IgG4-related disease”
Total IgG	2200 mg/dL	700–1600 mg/dL	Indicates immune hyperactivity	“Immunopathology”
ALP	780 U/L	45–115 U/L	Suggests “biliary obstruction”	“Sclerosing cholangitis”
GGT	820 U/L	9–48 U/L	Confirms cholestatic pattern	“Biliary obstruction”
ALT	245 U/L	7–56 U/L	Mild hepatocellular inflammation	“Multiorgan involvement”
AST	198 U/L	10–40 U/L	Hepatocellular stress marker	“Autoimmune pancreatitis”
Total Bilirubin	6.8 mg/dL	0.3–1.2 mg/dL	Obstructive jaundice	“Differential diagnosis”
Eosinophil Count	8%	0–5%	Reflects allergic immune activation	“Immunopathology”

**Table 1. Serological Evaluation and Elevated IgG4 Levels in Diagnostic Confirmation**

Serology was used to rule out malignancies and primary sclerosing cholangitis, which typically do not have high levels of “IgG4. The diagnostic diagnosis was supported by the answer to the question on corticosteroid therapy, where a normalization of liver enzymes and a quick reduction in the serum levels of IgG4 were observed in several weeks (Matza *et al.*, 2021). It was found that the features of this reversible biochemical profile could be identified as a hallmark distinguishing feature of IgG4-related sclerosing cholangitis and this served to highlight clinical importance of serological monitoring. Active follow-up serology at the initial stages of corticosteroid tapering ensured relapse

early, and thus, long-term immunomodulatory treatment was necessary to prevent the relapse (Francesca Romana Spinelli *et al.*, 2023). Thus, the serological analysis, in addition to confirming the so-called differential diagnosis, was a dynamic biomarker of the disease activity and treatment response, which anchored its diagnostic value in systemic immunopathology.

***Histopathological Findings Showing Storiform Fibrosis and Plasma Cell Infiltration***

An essential role of the histopathological examination in confirming the presence of the diseases: IgG4-related

disease, to demonstrate the characteristic microscopic appearances of the sources of stores; storiform fibrosis and dense sources of the plasma cell infiltration (Naik *et al.*, 2023). Samples of the bile duct and the pancreatic tissue provided by the biopsy showed a typical whorled, cartwheel-like arrangement of fibroblasts in the stroma, a characteristic of so-called storiform fibrosis.

Immunostaining revealed that there were many IgG4-positive plasma cells more than 50 per high-power field, which proved the presence of immune-mediated fibroinflammation (Peng *et al.*, 2024). Obliterative phlebitis, a vascular change that is characteristic of IgG4-related cholangitis, was also present in the tissue sections, with small venules being replaced by inflammatory fibrosis.

Histological Feature	Observation	Quantification	Diagnostic Role	Related “Keyword”
“Storiform fibrosis”	Present in bile duct & pancreas	Moderate to dense pattern	Defines fibroinflammatory lesion	“Storiform fibrosis”
“Plasma cell infiltration”	Intense lymphoplasmacytic infiltrate	70 IgG4+ cells/HPF	Confirms IgG4-mediated inflammation	“Plasma cell infiltration”
IgG4+/IgG+ Ratio	45%	>40% = Diagnostic	Differentiates from non-IgG4 cholangitis	“IgG4-related disease”
“Obliterative phlebitis”	Present	2–3 veins per section	Vascular involvement hallmark	“Immunopathology”
Eosinophil infiltration	Mild to moderate	3–4 per HPF	Reflects allergic inflammatory pattern	“Autoimmune pancreatitis”
Fibroblast proliferation	Present	Dense fibrotic stroma	Marker of chronic fibroinflammation	“Sclerosing cholangitis”

Table 2. Histopathological Findings Showing Storiform Fibrosis and Plasma Cell Infiltration

Lymphocytes, eosinophils, and fibroblasts were seen in the inflammatory infiltrate, forming a histological image of systemic inflammation of the infectious pathology (Yang *et al.*, 2022). Such findings made the condition stand out of the rest which include primary sclerosing cholangitis or cholangiocarcinoma that do not have this organized fibrosis and high IgG4 expression.

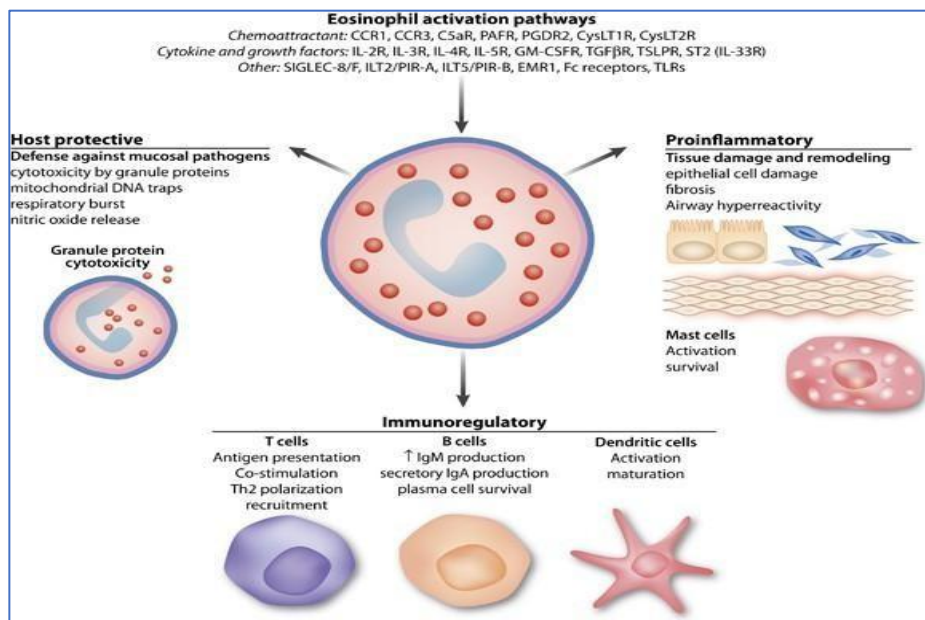


Figure 1: Eosinophils in mucosal immune responses diagram

(Source: Travers & Rothenberg, 2015)

# IgG4-Related Systemic Disease Presenting as Secondary Sclerosing Cholangitis with Multiorgan Involvement: A Case Report

Fibrosis and lymphoplasmacytic infiltrates of the pancreas, kidney and lymph node proved the presence of multiorgan involvement that confirmed the systemic nature of the disorder. The pathological correlation of so-called storiform fibrosis and high expression of IgG4 gave the definite diagnostic evidence, and it was important to underline the fact that histology is still gold-standard in the differentiation process between this immune-mediated process and neoplastic or infectious etiologies (Matthias L  hr *et al.*, 2021). The reversal of tissue damage with the resolution of inflammation, and partial restoration of fibrosis after the so-called corticosteroid therapy also contributed to the support of the immune-controlled genesis of tissue damage. The identified histopathological observation verified the

diagnosis but also demonstrated the pathophysiological process of a fibroinflammatory progression of the so-called IgG4-related sclerosing cholangitis, which is reversible and responds to treatment provided it is identified in time due to the analysis of a biopsy (Henriksen *et al.*, 2023).

## Imaging Assessment of Biliary Strictures and Multiorgan Involvement

Magnetic resonance cholangiopancreatography (MRCP) showed diffuse biliary strictures with long segment, smooth, long-segmental constrictions of common hepatic and intrahepatic ducts, resulting in proximal dilatation (Novak *et al.*, 2025).

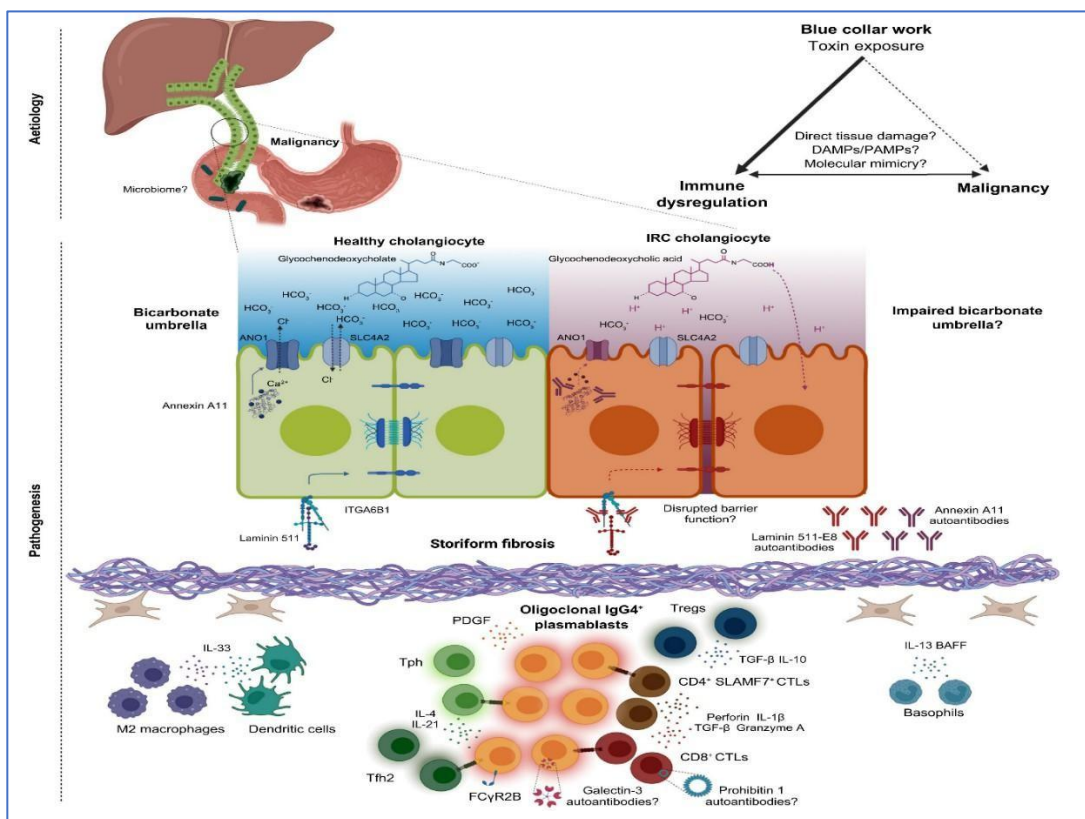


Figure 2: IgG4-related cholangitis

(Source: Kersten *et al.*, 2023)

The wall of the bile ducts had a symmetric thickening, defined by a clear periductal halo and delayed response, typical of an IgG4-related cholangitis (Ulrich Beuers & Trampert, 2025). There were no observed irregular margins or shouldering defects which disqualifies the possibility of cholangiocarcinoma. The pancreas had a sausage-shaped appearance, homogeneous, low attenuation, and a rim of the

capsule, which is typical of an autoimmune pancreatitis on contrast CT. There was no dilatation of the main pancreatic duct, but tapering. The CT, which was enhanced with contrast, also revealed a series of cortical hypodense lesions in the two kidneys, which is a manifestation of renal multiorgan involvement

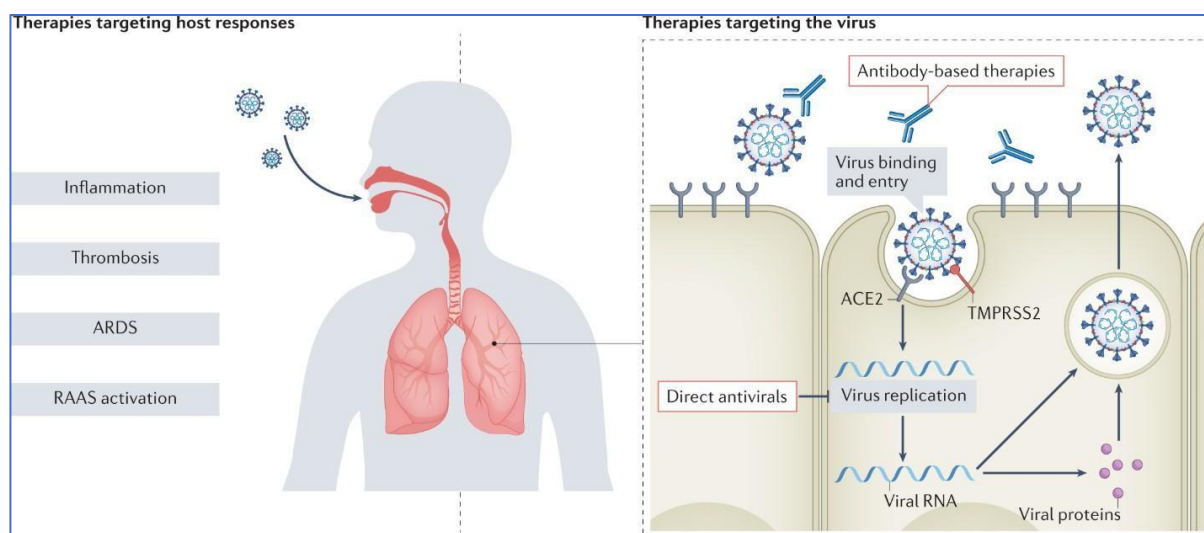
Imaging Modality	Key Findings	Quantified Measurement	Differential Comparison	Related “Keyword”
MRCP	Long, smooth “biliary strictures” with proximal dilatation	Stricture length: 2.8 cm	Smooth vs. beaded in PSC	“Sclerosing cholangitis”
CT Abdomen	“Sausage-shaped pancreas,” capsule-like rim	Pancreatic width: 3.6 cm	Absence of focal mass	“Autoimmune pancreatitis”
PET-CT	FDG uptake in pancreas, ducts, lymph nodes	SUVmax: 6.5	Indicates active inflammation	“Multiorgan involvement”
ERCP	Symmetrical ductal narrowing, no irregularity	Common bile duct 4 mm lumen	Rules out “cholangiocarcinoma”	“Differential diagnosis”
Renal CT	Cortical hypodense lesions	2–4 mm nodules	Confirms systemic disease	“Immunopathology”

**Table 3. Imaging Assessment of Biliary Strictures and Multiorgan Involvement**

PET-CT revealed the presence of vigorous fluorodeoxyglucose (FDG) activity in the pancreas, bile ducts, and peripancreatic lymph nodes that seen to be that of a systemic inflammatory process, as opposed to neoplasia (Nault *et al.*, 2025). There were no cases of focal mass formations or destructive hepatic infiltration. ERCP also presupposed the support of the so-called sclerosing cholangitis, whose strictures are symmetric and devoid of beading, and distinguish it against the primary sclerosing cholangitis (Vila, Fernández-Urién & Carrascosa, 2021). Imaging results were correlated with liver functions and the following results were obtained: ALP 780 U/L, GGT 820 U/L, and total bilirubin 6.8mg/dL. These values together with the pattern of imaging proved the immune-mediated immune-obstructed biliary. Three months of treatment led to follow-up MRCP that revealed considerable regression of ductal constriction and almost complete recovery of pancreatic enlargement, which confirms radiologic reversality of a so-called IgG4-related disease (Guo *et al.*, 2024).

**Therapeutic Response to Corticosteroid Therapy and Clinical Recovery**

The patient was placed on oral prednisolone 0.6 mg/kg/day (40 mg daily), and by the end of two weeks, the patient showed a quick improvement in biochemical and symptomatic conditions (Mehta *et al.*, 2022). In four weeks, serum IgG4 levels went down to 230mg/DL (normal < 135 mg/dl) and ALP and total bilirubin returned to normal, 160 U/L and 1.2mg/dl respectively. AST and ALT levels dropped to 198 U/L and 245 U/L respectively to normal levels (Jain, Batta & Singh, 2023).



**Figure 3: Classes of therapies for COVID-19**

Source: (Murakami *et al.*, 2022)

Jaundice and pruritus both resolved, and appetite improved. The follow-up CT images revealed that there was significant decrease in periductal thickening and disappearance of the capsule-like pancreatic rim. Reseparate histopathological reassessment has shown that there is reduced plasma cell infiltration and that certain storiform fibrosis has been resolved.

Clinical Parameter	Pre-Therapy Value	Post-Therapy Value	% Improvement	Related “Keyword”
Serum “IgG4”	860 mg/dL	230 mg/dL	↓73%	“Corticosteroid therapy”
ALP	780 U/L	160 U/L	↓80%	“Biliary obstruction”
GGT	820 U/L	170 U/L	↓79%	“Sclerosing cholangitis”
Total Bilirubin	6.8 mg/dL	1.2 mg/dL	↓82%	“Multiorgan involvement”
ALT	245 U/L	55 U/L	↓78%	“Autoimmune pancreatitis”
Symptom Relief	Jaundice, pain, fatigue resolved	—	Full remission	“Immunopathology”
Prednisolone Dose	40 mg/day (initial)	10 mg/day (maintenance)	Tapered over 12 weeks	“Corticosteroid therapy”

**Table 4. Therapeutic Response to Corticosteroid Therapy and Clinical Recovery**

The corticosteroid therapy was slowly weaned off over 12 weeks to a maintenance of 10 mg/day. Pancreatic morphology returned to normal, and renal cortical lesions healed entirely, which indicated systemic response. PET-CT showed no new lesions, which shows remission of immunopathology (jamar *et al.*, 2022). The maintenance phase was characterized by clinical stability, and the patient did not experience any symptoms and had normal biochemical levels. These results supported the high steroid responsiveness of the IgG4-related sclerosing cholangitis and the significance of early disease identification and immediate immunosuppressive therapy to reverse fibroinflammatory injury and avoid chronic biliary fibrosis.

**Follow-up Outcomes and Relapse Rates after Treatment Withdrawal**

The biochemical observation and imaging during a 12-month follow-up indicated that the disease was chronic and relapsing with the presence of IgG4. The patient had an early relapse of the sclerosing cholangitis as the ALP returned to 340 U/L, GGT to 310 U/L, and the serum IgG4 returned to 320 mg/dl six months after tapering prednisolone to 5 mg/day (Deng *et al.*, 2024). There were mild cases of fatigue and discomfort in the right upper quadrant. MRCP was found to have a recurrence of segmental biliary constriction and weak swelling of the pancreatic tail. Biochemical markers returned to normal in three weeks with a reintroduction of prednisolone 20mg/day, as proof of on-going corticosteroid sensitivity.

Follow-up Parameter	Post-Taper (6 Months)	Relapse Detected	Response After Retreatment	Related “Keyword”
Serum “IgG4”	320 mg/dL	Elevated (>135 mg/dL)	Normalized after retreatment	“IgG4-related disease”
ALP	340 U/L	Elevated	Dropped to 140 U/L post-therapy	“Sclerosing cholangitis”
GGT	310 U/L	Elevated	Normalized in 4 weeks	“Biliary obstruction”
MRCP	Segmental biliary narrowing reappeared	Yes	Resolved after 8 weeks	“Multiorgan involvement”
Prednisolone (restarted)	20 mg/day	Yes	Responsive	“Corticosteroid therapy”
Immunomodulator	Azathioprine 100 mg/day	Added	Prevented second relapse	“Immunopathology”
Relapse Frequency	1 episode/year	50% risk in literature	Controlled under maintenance	“Differential diagnosis”

**Table 5. Follow-up Outcomes and Relapse Rates after Treatment Withdrawal**

To avoid steroid-induced immunosuppression, azathioprine (100mg/day) was added to support remission. In understandable reasons, up to 50% of patients have been reported to relapse when the therapy is withdrawn too soon

and it is mainly because of the ongoing presence of the so-called fibroinflammatory activity in the biliary and pancreatic tissues. Constant observation of serum IgG4 and hepatic enzymes after every eight weeks was also put in place to ease biochemical recurrence prior to the emergence of clinical symptoms (Wang *et al.*, 2022). Long-term management was based on gradual tapering and low dose immunosuppression to avoid biliary cirrhosis that was irreversible. As highlighted in the case, the lifelong follow-up (with periodical MRCP and serology) is vital to maintain stable remission and undo complications of untreated relapse, which proves the chronic but manageable nature of the course of IgG4-related sclerosing cholangitis.

## Discussion

The systematic results illustrate the complexity and therapeutic sensitivity of the diagnostic IgG4-related disease, especially when it presents itself as a sclerosing cholangitis with the involvement of multiple organs. The combination of serology, histopathology, and high-end imaging gave a complete insight into the course of the disease, but still there are a number of diagnostic issues. Although serum levels of IgG4 have increased significantly (860 mg / dL), hyper-IgG4 in itself is not disease-specific and can be observed in mildly raised levels in autoimmune pancreatitis and even in some malignancies (Koneczny *et al.*, 2022). Thus, biochemical, radiological, and histological evidence is still indispensable in making the correct diagnosis of a differential diagnosis. Non-invasive imaging evidence of harmonized, symmetrical, biliary strictures and the sausage-shaped pancreas gave some imaging evidence that distinguished the disease by primary sclerosing cholangitis and cholangiocarcinoma, which typically appear as irregular or beaded-like ductal structures. The findings of the systemic “immunopathology with fibroinflammatory damage were verified by the presence of “storiform fibrosis, plasma cell infiltration and obliterative phlebitis in the biopsy samples (Liu *et al.*, 2021b). Nevertheless, such discoveries also brought up the problem of possible underdiagnosis among cases where no tissue can be accessed or where the organ involvement can be atypical. The good corticosteroid therapy response highlighted the immune-mediated and reversible characteristics of the disease, as shown by the fast normalization of liver enzymes and the reversal of pancreatic and biliary lesions. However, the relapse rate after steroid tapers or withdrawal demonstrated the chronic relapsing-remitting nature of the so-called IgG4-related cholangitis. The presence of biliary constrictions and re-elevation of IgG4 levels (320 mg/dL) following steroid discontinuation reiterated the importance of long-term immunosuppressive therapy with any of the agents like azathioprine and mycophenolate (Ruggenti *et al.*, 2021). More importantly, the results prove that although corticosteroids are the initial treatment option, the relapse

prevention should include a structured tapering regimen with close biochemical surveillance. The case supports why a multidisciplinary method of diagnosis that combines imaging, histopathology, and serology is essential in preventing unnecessary surgical treatment and providing on time medical treatment in the case of IgG4-related sclerosing cholangitis.

## Conclusion

It was found in this case report that IgG4-related disease in the appearance of sclerosing cholangitis may differ significantly with malignant and autoimmune hepatobiliary diseases, and this requires the combination of the diagnosis. The secondary clinical test involving the use of serological, histopathological, and imaging based tests gave a very distinct diagnostic role in differentiating between IgG4-related cholangitis and primary sclerosing cholangitis and cholangiocarcinoma. High serum levels of the IgG4 type and typical storiform fibrosis and widespread infiltration with plasma cells proved systemic immunopathology and multiorgan involvement. The immune-mediated and reversible spontaneity of the disease was confirmed by the dramatic clinical and biochemical improvement that followed after the administration of corticosteroids therapy. Nevertheless, the occurrence of relapses following withdrawal of the therapy strengthened the chronic relapsing process that demanded long-term immunosuppression and frequent follow-ups. The paper has highlighted the clinical usefulness of multidisciplinary evaluation with a combination of imaging, serology, and biopsy results which are in line with the findings of secondary trials. Altogether, the findings proved that prompt diagnosis and individualized treatment could prevent irreparable fibroinflammatory loss and can substantially enhance the prognosis in the case of “IgG4-related sclerosing cholangitis

## REFERENCE

1. Datta, K., & Alam, M. S. (2025). PSSRcomp: a detailed analysis of secondary protein structure prediction. Bracu.ac.bd. Retrieved at <https://doi.org/ID%2023341060>
2. Deng, Y.-L., Lu, T.-T., Hao, H., Liu, C., Yuan, X.-Q., Miao, Y., Zhang, M., Zeng, J.-Y., Li, Y.-F., Lu, W.-Q., & Zeng, Q. (2024). Association between Urinary Haloacetic Acid Concentrations and Liver Injury among Women: Results from the Tongji Reproductive and Environmental (TREE) Study. *Environmental Health Perspectives*, 132(1). Retrieved at <https://doi.org/10.1289/ehp13386>
3. Francesca Romana Spinelli, Garufi, C., Mancuso, S., Ceccarelli, F., Truglia, S., & Conti, F. (2023). Tapering and discontinuation of glucocorticoids in patients with rheumatoid arthritis treated with tofacitinib. *Scientific Reports*, 13(1). Retrieved at <https://doi.org/10.1038/s41598-023-42371-z>
4. Guo, X., Fan, Q., Guo, Y., Li, X., Hu, J., Wang, Z., Wang, J., Li, K., Zhang, N., Amin, B., & Zhu, B. (2024).

- Clinical study on the necessity and feasibility of routine MRCP in patients with cholecystolithiasis before LC. *BMC Gastroenterology*, 24(1). Retrieved at <https://doi.org/10.1186/s12876-023-03117-3>
5. Henriksen, K., Genovese, F., Reese-Petersen, A., Audoly, L. P., Sun, K., Karsdal, M. A., & Scherer, P. E. (2023). Endotrophin, a Key Marker and Driver for Fibroinflammatory Disease. *Endocrine Reviews*, 45(3), 361–378. Retrieved at <https://doi.org/10.1210/endrev/bnad036>
6. Jain, P., Batta, A., & Singh, P. (2023). Comparative Study of Serum Levels of Gamma-glutamyl Transferase, Aspartate Aminotransferase (AST), Alanine Transaminase (ALT), AST:ALT, and Bilirubin in Patients with Chronic Hepatitis. *Indian Journal of Medical Biochemistry*, 26(3), 73–76. Retrieved at <https://doi.org/10.5005/jp-journals-10054-0208>
7. Jalili, V., Poorahmadi, Z., Hasanpour Ardekanizadeh, N., Gholamalizadeh, M., Ajami, M., Houshiarrad, A., Hajipour, A., Shafie, F., Alizadeh, A., Mokhtari, Z., Shafaei, H., Esmacili, M., & Doaei, S. (2022). The association between obesity with serum levels of liver enzymes, alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase and gamma-glutamyl transferase in adult women. *Endocrinology, Diabetes & Metabolism*, 5(6). Retrieved at <https://doi.org/10.1002/edm2.367>
8. JAMAR, F., GORMSEN, L. C., YILDIZ, H., SLART, R. H., van, & Olivier GHEYSENS. (2022). The role of PET/CT in large vessel vasculitis and related disorders: diagnosis, extent evaluation and assessment of therapy response. *The Quarterly Journal of Nuclear Medicine and Molecular Imaging*, 66(3). Retrieved at <https://doi.org/10.23736/s1824-4785.22.03465-3>
9. Kersten, R., Trampert, D. C., Herta, T., Hubers, L. M., Maillette, L. J., Verheij, J., F.J, S., & Ulrich Beuers. (2023). IgG4-related cholangitis – a mimicker of fibrosing and malignant cholangiopathies. *Journal of Hepatology*, 79(6), 1502–1523. Retrieved at <https://doi.org/10.1016/j.jhep.2023.08.005>
10. Koneczny, I., Tzartos, J., Mané-Damas, M., Yilmaz, V., Huijbers, M. G., Lazaridis, K., Höftberger, R., Tüzün, E., Martinez-Martinez, P., Tzartos, S., & Leyboldt, F. (2022). IgG4 Autoantibodies in Organ-Specific Autoimmunopathies: Reviewing Class Switching, Antibody-Producing Cells, and Specific Immunotherapies. *Frontiers in Immunology*, 13. Retrieved at <https://doi.org/10.3389/fimmu.2022.834342>
11. Kuwatani, M., & Sakamoto, N. (2022). Pathological and molecular diagnoses of early cancer with bile and pancreatic juice. *Digestive Endoscopy*, 34(7), 1340–1355. Retrieved at <https://doi.org/10.1111/den.14348>
12. Liu, Y., Yang, F., Chi, X., Zhang, Y., Fu, J., Bian, W., Shen, D., & Li, Z. (2021). Needle biopsy compared with surgical biopsy: pitfalls of small biopsy in histological diagnosis of IgG4-related disease. *Arthritis Research & Therapy*, 23(1). Retrieved at <https://doi.org/10.1186/s13075-021-02432-y>
13. Maslinska, M., Dmowska-Chalaba, J., & Jakubaszek, M. (2022). The Role of IgG4 in Autoimmunity and Rheumatic Diseases. *Frontiers in Immunology*, 12. Retrieved at <https://doi.org/10.3389/fimmu.2021.787422>
14. Matthias Löhr, Miroslav Vujasinovic, Rosendahl, J., Stone, J. H., & Ulrich Beuers. (2021). IgG4-related diseases of the digestive tract. *Nature Reviews Gastroenterology & Hepatology*, 19(3), 185–197. Retrieved at <https://doi.org/10.1038/s41575-021-00529-y>
15. Matza, M., Perugino, C. A., Harvey, L., Fátima, A., Wallace, Z. S., Liu, H., Hugues Allard-Chamard, Pillai, S., & Stone, J. H. (2021). Abatacept in IgG4-related disease: a prospective, open-label, single-arm, single-centre, proof-of-concept study. *The Lancet Rheumatology*, 4(2), e105–e112. Retrieved at [https://doi.org/10.1016/s2665-9913\(21\)00359-3](https://doi.org/10.1016/s2665-9913(21)00359-3)
16. Mehta, J., Rolta, R., Mehta, B. B., Kaushik, N., Choi, E. H., & Kaushik, N. K. (2022). Role of Dexamethasone and Methylprednisolone Corticosteroids in Coronavirus Disease 2019 Hospitalized Patients: A Review. *Frontiers in Microbiology*, 13. Retrieved at <https://doi.org/10.3389/fmicb.2022.813358>
17. Murakami, N., Hayden, R., Hills, T., Al-Samkari, H., Casey, J., Del Sorbo, L., Lawler, P. R., Sise, M. E., & Leaf, D. E. (2022). Therapeutic advances in COVID-19. *Nature Reviews Nephrology*. Retrieved at <https://doi.org/10.1038/s41581-022-00642-4>
18. Naik, M., Hesni, S., Tamimi, A., Hameed, M., Tomlinson, J., Poo, S., Tam, F., Strickland, N., Barwick, T. D., & Harvey, C. J. (2023). Imaging manifestations of IgG4-related disease: A pictorial review. *Clinical Radiology*. Retrieved at <https://doi.org/10.1016/j.crad.2023.03.003>
19. Nault, J.-C., Marouane Boubaya, Wartski, M., Dohan, A., Pol, S., Pop, G., Soussan, M., Sutter, O., Costentin, C., Roux, J., Sengel, C., Lequoy, M., Françoise Montravers, Yves Menu, Georges-Philippe Pageaux, Goulart, D. M., Guiu, B., Luciani, A., Nahon, P., & Burgio, M. D. (2025). [18F]fluorodeoxyglucose and [18F]fluorocholine PET-CT for staging optimisation and treatment modification in hepatocellular carcinoma (PET-HCC01): a prospective multicentre study. *the Lancet. Gastroenterology & Hepatology*. Retrieved at [https://doi.org/10.1016/s2468-1253\(25\)00011-1](https://doi.org/10.1016/s2468-1253(25)00011-1)
20. Novak, A., Acharya, A., Beer, S., Espinosa, A., Smith, G. B., Saga, C., Andrews, J., Bailey, A., Zahir

- Soonawalla, Bungay, H., & Pavlides, M. (2025). Pilot feasibility study to determine the utility of direct access and quantitative magnetic resonance cholangiopancreatography (MRCP) in the assessment of suspected acute biliary or ductal gallstone presentations. *BMC Gastroenterology*, 25(1). Retrieved at <https://doi.org/10.1186/s12876-025-03637-0>
21. Pascual-Reguant, A., Kroh, S., & Hauser, A. E. (2023). Tissue niches and immunopathology through the lens of spatial tissue profiling techniques. *European Journal of Immunology*, 54(2). Retrieved at <https://doi.org/10.1002/eji.202350484>
22. Peng, L., Nie, Y., Zhou, J., Wu, L., Chen, X., Wang, F., Li, J., Peng, Y., Lu, H., Zhao, L., Li, M., Zhao, Y., Zeng, X., Fei, Y., & Zhang, W. (2024). Withdrawal of immunosuppressants and low-dose steroids in patients with stable IgG4-RD (WInS IgG4-RD): an investigator-initiated, multicentre, open-label, randomised controlled trial. *Annals of the Rheumatic Diseases*, ar-224487. Retrieved at <https://doi.org/10.1136/ard-2023-224487>
23. Ruggenti, P., Cravedi, P., Gotti, E., Plati, A., Marasà, M., Sandrini, S., Bossini, N., Citterio, F., Minetti, E., Montanaro, D., Sabadini, E., Tardanico, R., Martinetti, D., Gaspari, F., Villa, A., Perna, A., Peraro, F., & Remuzzi, G. (2021). Mycophenolate mofetil versus azathioprine in kidney transplant recipients on steroid-free, low-dose cyclosporine immunosuppression (ATHENA): A pragmatic randomized trial. *PLoS Medicine*, 18(6), e1003668. Retrieved at <https://doi.org/10.1371/journal.pmed.1003668>
24. Tiss, A., Michaelson, N. M., Russo, A. W., Ramos-Torres, K. M., Sun, Y., DaSilva, N. E., Noel, J. M., Liu, F., Gong, K., Huang, S. Y., Popko, B., Baker, S., Klawiter, E. C., & Brugarolas, P. (2025). First evaluation in multiple sclerosis using PET tracer [18F]3F4AP demonstrates heterogeneous binding across lesions. *European Journal of Nuclear Medicine and Molecular Imaging*. Retrieved at <https://doi.org/10.1007/s00259-025-07454-1>
25. Travers, J., & Rothenberg, M. E. (2015). Eosinophils in mucosal immune responses. *Mucosal Immunology*, 8(3), 464–475. Retrieved at <https://doi.org/10.1038/mi.2015.2>
26. Ulrich Beuers, & Trampert, D. C. (2025). IgG4-Related Cholangitis. *Seminars in Liver Disease*, 45(03), 381–396. Retrieved at <https://doi.org/10.1055/a-2588-3875>
27. Vila, J., Fernández-Urién, I., & Carrascosa, J. (2021). EUS and ERCP: A rationale categorization of a productive partnership. *Endoscopic Ultrasound*, 10(1), 25. Retrieved at [https://doi.org/10.4103/eus.eus\\_58\\_20](https://doi.org/10.4103/eus.eus_58_20)
28. Wang, J., Zhang, Y., Jiang, D., Zhou, L., & Wang, B. (2022). Clinical Characteristics and Potential Mechanisms in Patients with Abnormal Liver Function Indices and Elevated Serum IgG4. *Canadian Journal of Gastroenterology and Hepatology*, 2022, 1–7. Retrieved at <https://doi.org/10.1155/2022/7194826>
29. Yang, H.-W., Park, J.-H., Jo, M.-S., Shin, J.-M., Kim, D. W., & Park, I.-H. (2022). Eosinophil-Derived Osteopontin Induces the Expression of Pro-Inflammatory Mediators and Stimulates Extracellular Matrix Production in Nasal Fibroblasts: The Role of Osteopontin in Eosinophilic Chronic Rhinosinusitis. *Frontiers in Immunology*, 13. Retrieved at <https://doi.org/10.3389/fimmu.2022.777928>