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Review Article

Immunogenetic and Clinico-Epidemiology Classification of Immune-Mediated Inflammatory Diseases (IMIDs): What Internists and Rheumatologists Need to Know?

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Abstract

Immune-mediated inflammatory diseases (IMIDs) characterized by three nosological entities, autoimmune diseases, autoinflammatory diseases and inflammatory diseases of undetermined mechanism, share in common the inflammatory process but their clinical and biological expressions are extremely diverse. Epidemiological and clinical studies of IMIDs are mostly partial and non-exhaustive. Affections that constitute IMIDs are characterized by chronic inflammatory processes. All these affections are classified based on their immunogenetic, pathophysiological, and clinical profiles. It is well understood that similar therapeutic targets as well as prevention and treatment strategies can be developed for IMIDs with the same immunogenetic, pathophysiological, and clinical profiles. This work presents an immunogenetic, pathophysiological, and clinical classification, now especially integrating epidemiological data (rare <1/2000; common ≥1/2000). To achieve this, a literature review was also necessary to refine the classification by adding the epidemiological data (rare <1/2000; common ≥ 1/2000). This work highlights the comprehensive distribution of IMIDs through an immunogenetic, pathophysiological, and clinico-epidemiological classification.

Keywords: Immune-Mediated Inflammatory Diseases, Autoimmune Diseases, Autoinflammatory Diseases, Inflammatory Diseases of Undetermined Mechanism, Mali.

INTRODUCTION

IMIDs are characterized by three nosological entities and their nosological sub-entities: (i) autoimmune diseases (systemic autoimmune diseases, organ-specific autoimmune diseases), (ii) autoinflammatory diseases (monogenic autoinflammatory diseases, polygenic autoinflammatory diseases: "systemic" polygenic autoinflammatory diseases and "organ-specific" polygenic autoinflammatory diseases) and (iii) inflammatory diseases of undetermined mechanism (neoplasms, paraneoplastic syndromes and inflammatory diseases of iatrogenic origin) [1-5].

Prevention and treatment strategies must focus on priority actions, given the extent of the problem, especially in low-income countries where there is a lack of technical facilities and qualified human resources. Determining the overall and comprehensive distribution of IMIDs, taking into account immunogenetic, pathophysiological, and clinico-epidemiological classification, will help acheive this objective.

Admittedly, epidemiological and clinical studies of IMIDs are mostly partial and non-exhaustive, and have been conducted here and there in order to better understand the scope of this problem. However, there is no study that has examined IMIDs globally and exhaustsively, taking into account this immunogenetic, pathophysiological, and clinico-epidemiology classification.

Our study addressed this gap in the literature. Furthermore, to determine whether it is a rare or common affection based on prevalence studies, the present work has refined the known IMIDs classification by integrating the epidemiological profile (rare <1/2000; common ≥ 1/2000).

METHODS

To achieve this, a literature review was also necessary to refine the classification by adding the epidemiological data (rare <1/2000; common ≥ 1/2000)

An in-depth literature search was conducted over a two-month period to extract disease prevalence from relevant articles. Research articles in English and French dating were reviewed using databases such as PubMed, MEDLINE, Google Scholar, and press articles. A combination of keywords such as “prevalence and each autoimmune diseases”, “prevalence and each autoinflammatory diseases”, “prevalence and each inflammatory diseases of undetermined mechanism” was searched. The extracted articles were then reviewed to verify their relevance to the objectives of this work. A total of 146 articles were read for the final review after discarding 50 irrelevant articles. In addition, each IMIDs prevalence is recalculated in order to obtain the Ratio 1/2000. For each disease, it is just to multiply 2000 by number of cases (numerator) and then divided by the denometor.

IMMUNOGENETIC AND CLINICO-EPIDEMIOLOGICAL CLASSIFICATION OF IMMUNE EDIATED INFLAMMATORY DISEASES [1-7]

What Is The Immune Ediated Inflammatory Diseases?

IMIDs= three nosological entities and their nosological sub-entities:
(i) autoimmune diseases:
. systemic autoimmune diseases,
. organ-specific autoimmune diseases,
(ii) autoinflammatory diseases:
. monogenic autoinflammatory diseases,
. polygenic autoinflammatory diseases: "systemic" polygenic autoinflammatory diseases and "organ-specific» polygenic autoinflammatory diseases)
(iii) inflammatory diseases of undetermined mechanism:
. neoplasms,
. paraneoplastic syndromes,
. inflammatory diseases of iatrogenic origin.

1. What is the Autoimmune Diseases?

Autoimmune diseases = Pathological manifestations related to the involvement of the effectors of the immune system, B lymphocytes and T lymphocytes, which are specific to the antigens of the body to which this system belongs (self-antigens).
Autoimmune diseases = Usually classified into two groups: organ-specific autoimmune diseases and systemic autoimmune diseases

1.1. What are Systemic Autoimmune Diseases?

Systemic autoimmune diseases	Rare (Prevalence < 1/2000)	Common (Prevalence ≥ 1/2000	References
Connective tissue diseases			
Systemic lupus erythematosus		1.82/2000	[8]
Antiphospholipid syndrome	0.9/2000		[9]
Systemic scleroderma	0.48/2000		[10]
Idiopathic inflammatory myopathies of the dermatomyositis-polymyositis type	0.02/2000		[11]
Idiopathic inflammatory myopathies of the antisynthetase syndrome type	0.06/2000		[12]
Idiopathic inflammatory myopathies of the overlap myositis type	Not well established	Not well established	-
Rheumatoid arthritis		4.17/2000	[13]
Sjögren syndrome	0.4/2000		[14]
Mixed connectivite tissue diseases/Sharp syndrome	0.03/2000		[15]
Autoimmune systemic vasculitis			
Microscopic polyangiitis (MPA)	0.01		[16]
Ganulomatosis with polyangiitis (Wegener granulomatosis)	0.2/2000		[17]
Eosinophilic granulomatosis with polyangiitis (Churg and Strauss)	0.04/2000		[18]
Others			

1.2. What are the Organ-Specific Autoimmune Diseases?

Organ-specific autoimmune diseases	Rare (Prevalence < 1/2000)	Common (Prevalence ≥ 1/2000	References
Autoimmunes endocrinopathies			
De Quervain's thyroiditis	0.24/2000		[19]
Graves' disease		24/2000	[20]
Hashimoto's thyroiditis		100/2000	[21]
Ord's thyroiditis	Not well established	Not well established	-
Postpartum thyroiditis		100/2000	[22]
Diabetes mellitus type 1		10/2000	[23]
Addison's disease	0.23/2000		[24]
Autoimmune oophoritis		20/2000 of women under 40 years	[25]
Autoimmune polyendocrine syndrome type 1 (APS1)	0.01/2000		[26]
Autoimmune polyendocrine syndrome type 2 (APS2)	0.1/2000		[27]
Autoimmune polyendocrine syndrome type 3 (APS3)	Not well established	Not well established	-
Autoimmune hematological diseases			
Autoimmune hemolytic anemia	0.03/2000		[28]
Immune thrombocytopenia	0.07/2000 (adults)	1/2000 (children)	[29]
Thrombotic thrombocytopenic purpura	0.003/2000		[30]
Pernicious anemia		2/2000	[31]
Autoimmune dermatological diseases			
Discoid lupus erythematosus		1.7/2000	[32]
Psoriasis		50/2000	[33]
Alopecia areata		42/2000	[34]
Pemphigus vulgaris	0.31/2000		[35]
Bullous pemphigoid	0.36/2000		[36]
Cicatricial pemphigoid	Not well established	Not well established	-
Gestational pemphigoid	Not well established	Not well established	-
Epidermolysis bullosa acquisita	Not well established	Not well established	-
Vitiligo		20/2000	[37]
Linear IgA disease	Not well established	Not well established	-
Dermatitis herpetiformis	0.2		[38]
CREST syndrome	0.5/2000		[39]
Autoimmune hepatobiliary diseases			
Primary sclerosing cholangitis	0.1/2000		[40]
Primary biliary cholangitis	0.6/2000		[41]
Autoimmune hepatitis	0.06/2000		[42]
Autoimmune gastrointestinal diseases			
Celiac disease		20/2000	[43]
Autoimmune pancreatitis	0.02/2000		[44]
Autoimmune neuropathies			
Autoimmune central neuropathies			
Multiple sclerosis		1.8/2000	[45]
Myasthenia gravis	0.4/2000		[46]
Lambert–Eaton myasthenic syndrome	0.003/2000		[47]
Sydenham's chorea	Not well established	Not well established	-
Autoimmune encephalitis[a]	0.23/2000		[48]
Neuromyelitis optica (Devic's disease)	0.05/2000		[49]
Acute disseminated encephalomyelitis (ADEM)	0.02/2000		[50]
Stiff-person syndrome	Not well established	Not well established	-
Autoimmune peripheral neuropathies			
Polyradiculonévrites inflammatoires démyélinisantes chroniques (PICD)	0.03/2000		[51]
Acute sensory ataxic neuropathy (ASAN)	Not well established	Not well established	-

Organ-specific autoimmune diseases	Rare (Prevalence < 1/2000)	Common (Prevalence ≥ 1/2000	References
Chronic ataxic neuropathy ophtalmoplegia, immunoglobulin M paraprotein, cold agglutinins, and anti-disialosyl antibodies (CANOMAD)	Not well established	Not well established	-
Myelin-associated Glycoprotein (MAG)	0.006/2000		[52]
Miller Fischer Syndrome (MFS)	0.002/2000		[53]
Monoclonal gammopathy of undetermined significance /POEMS syndrome		92.4/2000	[54]
Multifocal motor Neuropathy (MMN)	0.02/2000		[55]
Acute inflammatory demyelinating polyneuropathy (AIDP)	0.1/2000		[56]
Acute motor axonal neuropathy (AMAN)	Not well established	Not well established	-
Acute motor sensory axonal neuropathy (AMSAN)	Not well established	Not well established	-
Autoimmune nodopathies[b]	Not well established	Not well established	-
Guillain-Barré syndrome	0.03/2000		[57]
Autoimmune myopathies			
Idiopathic inflammatory myopathies of the necrotizing autoimmune myositis type	0.07/2000		[58]
Autoimmune heart diseases			
Giant cell myocarditis	Not well established	Not well established	-
Rheumatic heart disease		10/2000	[59]
Autoimmune nephropathies			
Goodpasture syndrome	0.002/2000		[60]
IgA nephropathy	0.07/2000		[61]
Membranous nephropathy	0.2/2000		[62]
Lupus nephritis	Not well established	Not well established	-
Autoimmune respiratory diseases			
Pulmonary alveolar proteinosis	0.01/2000		[63]
Goodpasture syndrome	0.002/2000		[60]
Rheumatoid lung disease	Not well established	Not well established	-
Autoimmune eye diseases			
Autoimmune retinopathy	Not well established	Not well established	-
Autoimmune uveitis		7.52/2000	[64]
Optic neuritis		2.3/2000	[65]
Graves' ophthalmopathy	Not well established	Not well established	-
Vogt-Koyanagi-Harada disease	Not well established	Not well established	-
Others			
[a]**Autoimmune encephaitis :** Anti-dipeptidyl-peptidase-like protein-6 antibody Encephalitis, anti-N-methyl-D-aspartate receptor (anti-NMPR) antibody encephalitis, anti-A-Amino-3-hydroxy-5-methyl-4-isoxazolepropionic acid receptor (anti-AMPAR) antibody encephalitis, anti-gamma-aminobutyric acid receptor (anti-GABA-AR) antibody encephalitis, anti-gamma-aminobutyric acid receptor (anti-GABA-BR) antibody encephalitis, anti-voltage-gated potassium channel-complex (anti-VGKC) antibody encephalitis, anti-Glutamic acid decarboxylase (anti-GAD) antibody encephalitis, anti-Glycine receptor (anti-GLyR) antibody encephalitis, anti- Metabotropic glutamate receptor 1 (anti-mGluR1) antibody encephalitis, anti- Metabotropic glutamate receptor 5 (anti-mGluR5) antibody encephalitis and limbic encephalitis, and autoimmune cerebellar ataxia. [b]**Autoimmune nodopathies:** Autoimmune nodopathies : Anti-NF155 antibody nodopathy, Anti- CNTN1antibody nodopathy, Anti- Caspr1 antibody nodopathy, Anti- NF140/186 antibody nodopathy, Anti- Pan-NF (NF155, NF140, NF186) antibody nodopathy.			

2. What is the Autoinflammatory Diseases?

Auto-inflammatory diseases = Abnormality of innate immunity, no elevated or pathogenic autoantibodies, nor active T lymphocytes. Auto-inflammatory diseases = Subdivided into two groups: monogenic auto-inflammatory diseases and polygenic auto-inflammatory diseases.

2.1. What are Monogenic Autoinflammatory Diseases?

Monogenic autoinflammatory diseases	Rare (Prevalence < 1/2000)	Common (Prevalence ≥ 1/2000	References
Familial Mediterranean fever	0.6/2000		[66]
Muckle-Wells syndrome	0.02/2000		[67]
Periodic fever syndrome with hyperimmunoglobulinemia D	Not well established	Not well established	-
CINCA Syndrome	Not well established	Not well established	-
Tumour necrosis factor receptor-associated periodic syndrome (TRAPS)	Not well established	Not well established	-
Familial cold-induced urticaria	Not well established	Not well established	-
PAPA Syndrome	0.002/2000		[68]
Majeed Syndrome	0.002/2000		[69]
Blau syndrome	0.002/2000		[70]
Chronic recurrent multifocal osteomyelitis (CRMO)	0.002/2000		[71]
NLRP12-associated hereditary periodic fever syndrome	0.002/2000		[72]
Autoinflammation-PLCG2-associated antibody deficiency-immune dysregulation	0.002/2000		[73]
Proteasome-associated autoinflammatory syndrome	0.002/2000		[74]
Autoinflammatory syndrome with pyogenic bacterial infection and amylopectinosis	0.002/2000		[75]
Adenosine deaminase 2 deficiency	0.002/2000		[76]
Familial Chilblain lupus	0.002/2000		[77]
STING-associated vasculopathy with onset in infancy	0.002/2000		[78]
DITRA	0.002/2000		[79]
Vacuoles, E1 enzyme, X-linked, autoinflammatory, somatic (VEXAS) syndrome	Not well established	Not well established	-
Others			

2.2. What are Polygenic Autoinflammatory Diseases?

Polygenic autoinflammatory diseases = Clinical phenotype distant from that of hereditary fevers due to the absence of intermittent symptoms.
Polygenic autoinflammatory diseases = Multiple genes involved in the dysregulation of innate immunity, unlike the monogenic form.
Polygenic autoinflammatory diseases = Also subdivided into two groups based on the typical clinical form of single-organ or systemic involvement: systemic polygenic autoinflammatory diseases and organ-specific polygenic autoinflammatory diseases.

2.2.1 What are Systemic Polygenic Autoinflammatory Diseases?

Systemic polygenic autoinflammatory diseases	Rare (Prevalence < 1/2000)	Common (Prevalence ≥ 1/2000	References
Non-autoimmune systemic vasculitis			
Primary vasculitides with large vessel vasculitis			
Giant cell arteritis	0.6/2000		[80]
Takayasu arteritis	0.1/2000		[81]
Primary vasculitides with medium vessel vasculitis			
Polyarteritis nodosa	0.1/2000		[82]
Kawasaki disease	Not well established	Not well established	-
Primary vasculitides with small vessel vasculitis not antineutrophil cytoplasmic antibody (ANCA)-associated vasculitis and Anti-glomerular basement membrane but immune complex small vessel vasculitis			
Cryoglobulinaemic vasculitis	Not well established	Not well established	-
IgA vasculitis (Henoch-Schönlein purpura)	Not well established	Not well established	-
Hypocomplementaemic urticarial vasculitis (anti-C1q vasculitis)	Not well established	Not well established	-

Systemic polygenic autoinflammatory diseases	Rare (Prevalence < 1/2000)	Common (Prevalence ≥ 1/2000	References
Primary vasculitides with variable vessel vasculitis			
Cogan syndrome	0.01/2000		[83]
Behçet syndrome	0.1/2000		[84]
Primary vasculitides with single-organ vasculitis			
Cutaneous leukocytoclastic angiitis	Not well established	Not well established	-
Cutaneous arteritis	Not well established	Not well established	-
Primary central nervous system vasculitis	Not well established	Not well established	-
Isolated aortitis	Not well established	Not well established	-
Idiopathic pauci-immune pulmonary capillaritis	Not well established	Not well established	-
Secondary vasculitides particularly vasculitis associated with systemic disease			
Lupus vasculitis	Not well established	Not well established	-
Rheumatoid vasculitis	Not well established	Not well established	-
Sarcoid vasculitis	Not well established	Not well established	-
Sneddon syndrome	Not well established	Not well established	-
Secondary vasculitides particularly vasculitis associated with probable etiology			
Hepatitis C virus-associated cryoglobulinaemic vasculitis	Not well established	Not well established	-
Hepatitis B virus-associated vasculitis	Not well established	Not well established	-
Syphilis-associated aortitis	Not well established	Not well established	-
Drug-associated immune complex vasculitis	Not well established	Not well established	-
Drug-associated ANCA-associated vasculitis	Not well established	Not well established	-
Cancer-associated vasculitis	Not well established	Not well established	-
Varicella zoster virus-associated vasculitis	Not well established	Not well established	-
Other systemic polygenic autoinflammatory diseases with non-vascular predilection			
Amylose	Not well established	Not well established	-
Systemic sarcoidosis	0.6/2000		[85]
Still's disease	0.1/2000		[86]
Atrophic polychondritis	Not well established	Not well established	-
Others			

2.2.2. What are the Organ-Specific Polygenic Autoinflammatory Diseases?

Organ-specific polygenic autoinflammatory diseases	Rare (Prevalence < 1/2000)	Common (Prevalence ≥ 1/2000	References
Chronic inflammatory rheumatism			
Microcrystalline arthropathies			
Gout		78/2000	[87]
Chondrocalcinosis		110/2000	[88]
Hydroxyapatite	Not well established	Not well established	-
Spondylarthropathies			
Ankylosing spondylitis	0.15/2000		[89]
Enteropathic arthritis.	Not well established	Not well established	-
Psoriatic arthritis		11/2000	[90]
Reactive arthritis.	0.1/2000		[91]
Juvenile spondyloarthritis	0.25/2000		[92]
Undifferentiated spondyloarthritis	Not well established	Not well established	-
Other chronic inflammatory rheumatisms			
Polymyalgia rheumatica		9.9/2000	[93]
Remitting seronegative symmetrical synovitis with pitting edema (RS3PE)	Not well established	Not well established	-
SAPHO (synovitis – acne – palmoplantar pustulosis – hyperostosis – osteitis)	Not well established	Not well established	-
Chronic inflammatory bowel diseases			
Crohn's disease		6.2/2000	[94]
Ulcerative colitis		5.05/2000	[95]

Organ-specific polygenic autoinflammatory diseases	Rare (Prevalence < 1/2000)	Common (Prevalence ≥ 1/2000	References
Non-autoimmune inflammatory myopathies			
Idiopathic inflammatory myopathies of the inclusion body myositis type	0.01		[96]
Chronic inflammatory eye diseases			
Sympathetic ophthalmia	Not well established	Not well established	-
Others			

2.3. What is the Inflammatory Diseases of Undetermined Mechanism?

Inflammatory diseases of undetermined mechanism=
neoplasms,
paraneoplastic syndromes,
inflammatory diseases of iatrogenic origin.

2.3.1. What Are Neoplasms?

Neoplasms:
Solid tumors,
Hematological malignancies.
Note: There so many data on neoplasm but most these evidences report only incidence and mortality rate.

2.3.1.1. What Are Solid Tumors?

Solid tumors	Rare (Prevalence < 1/2000)	Common (Prevalence ≥ 1/2000	References
Hepatocellular carcinoma	Not well established	Not well established	-
Breast cancer	Not well established	Not well established	-
Stomach cancer	Not well established	Not well established	-
Prostate cancer	Not well established	Not well established	-
Kaposi sarcoma	Not well established	Not well established	-
Uterine cervix cancer	Not well established	Not well established	-
Colorectal cancer	Not well established	Not well established	-
Bladder cancer	Not well established	Not well established	-
Prostate benign tumor	Not well established	Not well established	-
Esophageal cancer	Not well established	Not well established	-
Benign and malignant kidney tumor	Not well established	Not well established	-
Bronchopulmonary cancer	Not well established	Not well established	-
Oto-rhino-laryngological cancer	Not well established	Not well established	-
Benign and malignant brain tumor	Not well established	Not well established	-
Other neoplasms			

2.3.1.2. What are Hematological Malignancies?

Hematological malignancies	Rare (Prevalence < 1/2000)	Common (Prevalence ≥ 1/2000	References
Non-Hodgkin lymphoma	Not well established	Not well established	-
Chronic myeloid leukemia	Not well established	Not well established	-
Hodgkin lymphoma	Not well established	Not well established	-
Dysmyelopoiesis	Not well established	Not well established	-
Acute lymphoid leukemia	Not well established	Not well established	-
Chronic lymphoid leukemia	Not well established	Not well established	-
Multiple myeloma	Not well established	Not well established	-
Other ematological malignancies			

2.3.2. What is the Paraneoplastic Syndromes? And what are Paraneoplastic Syndromes?

Paraneoplastic syndromes= one of inflammatory diseases of undetermined mechanism. Here this is to say the inflammatory process in neoplasm is different to that observed in paraneoplasme syndrome.

Paraneoplastic syndromes	Rare (Prevalence < 1/2000)	Common (Prevalence ≥ 1/2000	References
Paraneoplastic arthritis	Not well established	Not well established	-
Paraneoplastic lower limb thrombophlebitis	Not well established	Not well established	-
Others			

2.3.3. What are Inflammatory Diseases of Iatrogenic Origin?

Inflammatory diseases of iatrogenic origin	Rare (Prevalence < 1/2000)	Common (Prevalence ≥ 1/2000	References
Drug-induced inflammatory rheumatisms			
Pyrazinamide-induced gout	Not well established	Not well established	-
Barbiturates-Induced Arthropathies	Not well established	Not well established	-
Amphotericin B-Induced Arthropathies	Not well established	Not well established	-
DPP-4 inhibitors-Induced Arthropathies	Not well established	Not well established	-
Immune checkpoint inhibitors-Induced Arthropathies	Not well established	Not well established	-
Metoprolol-Induced Arthropathies	Not well established	Not well established	-
Others			
Drug-induced inflammatory osteopathies			
Dexamethasone-induced fragility osteopathy	Not well established	Not well established	-
Thiazolidinediones-induced fragility osteopathy	Not well established	Not well established	-
Antiretroviral drug-induced fragility osteopathy	Not well established	Not well established	-
Others			
Drug-induced inflammatory myopathies			
hypolipemic drugs-induced inflammatory myopathies	Not well established	Not well established	-
beta-blockers-induced inflammatory myopathies	Not well established	Not well established	-
amiodarone-induced inflammatory myopathies	Not well established	Not well established	-
colchicine-induced inflammatory myopathies	Not well established	Not well established	-
zidovudine-induced inflammatory myopathies	Not well established	Not well established	-
cyclosporine-induced inflammatory myopathies	Not well established	Not well established	-
checkpoint inhibitors-induced inflammatory myopathies	Not well established	Not well established	-
Others inflammatory diseases of iatrogenic origin			

CONCLUSION

This work highlights the comprehensive distribution of IMIDs through an immunogenetic, pathophysiological, and clinico-epidemiological classification.

Decision-makers will be able to discover the global distribution of IMIDs, eventually to estimate the burden associated with these conditions, but also to adapt prevention and treatment strategies. This work may interest clinicians, particularly by integrating this data into their diagnostic approach, which will improve their clinical suspicion index. These results have opened the door to many other research questions for researchers. This book provides very instructive results for medical students and residents.

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