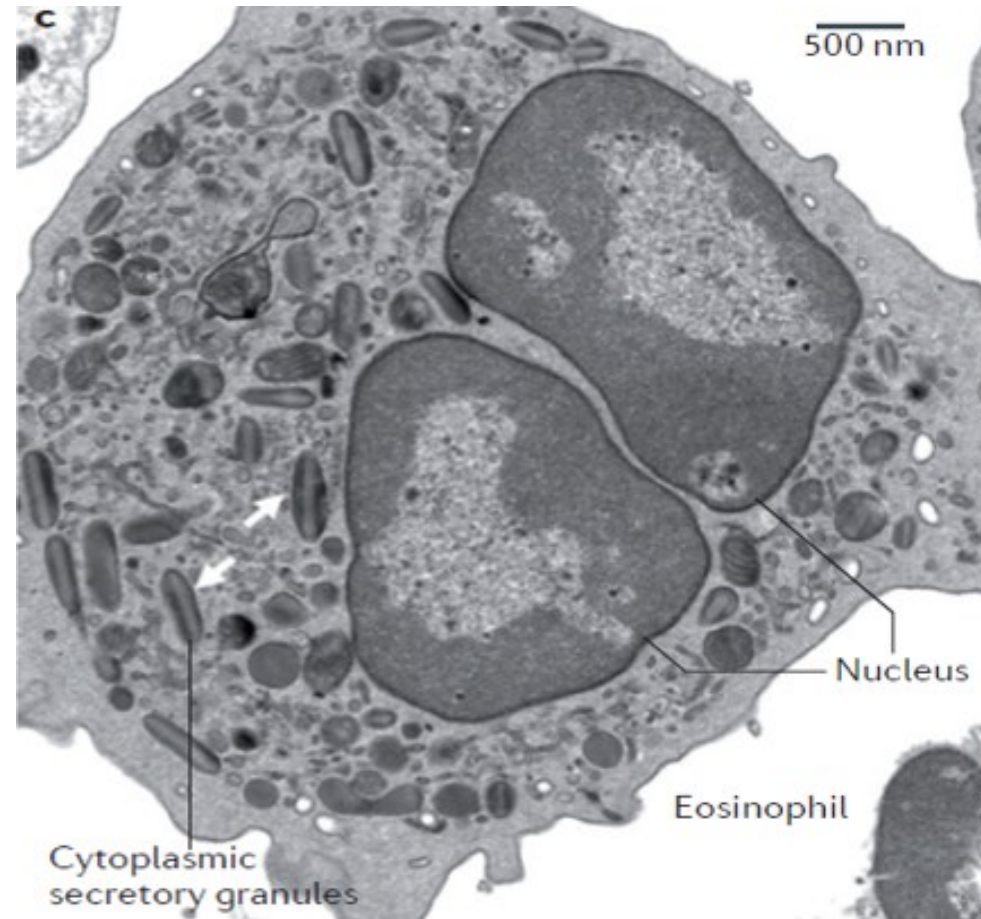
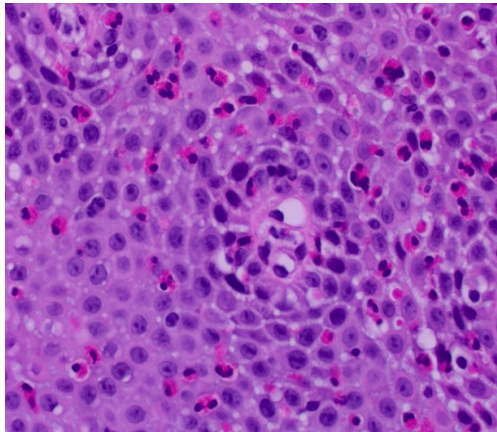
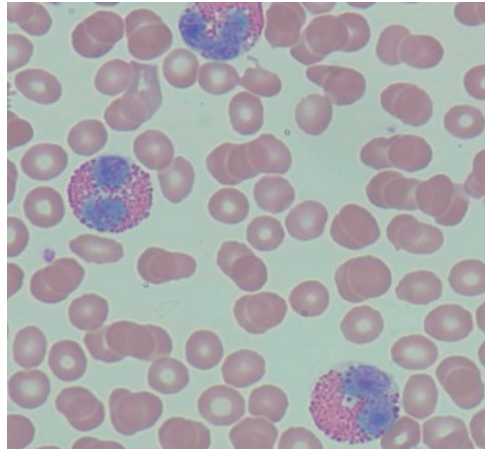


호산구 증가, 무엇을 해야 할까?

2024. 9. 22

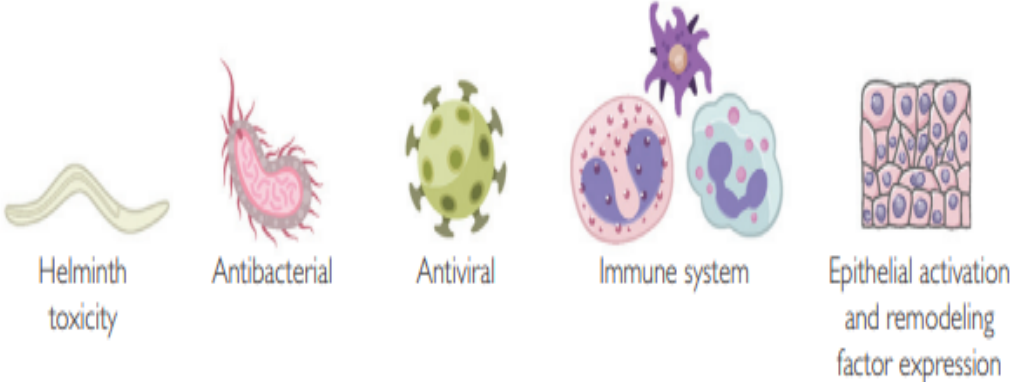
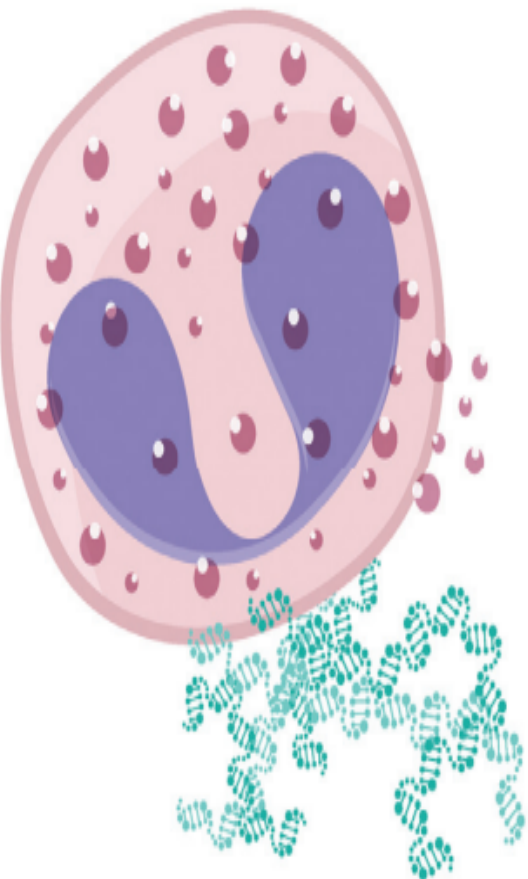
동아의대 내과
남영희

Eosinophil



1-3% of total WBC in healthy individuals

Eosinophil degranulation & Granule proteins



	EPX		—	—	—	
	MBP			—	Neutrophil, mast cell and basophil activation	
	ECP				—	—
	EDN	—	—		Dendritic cell recruitment and activation	—
	CLC/gal-10	—	—	—	Th2 activation	—
	EET	—		—	—	—

eosinophil peroxidase

major basic protein

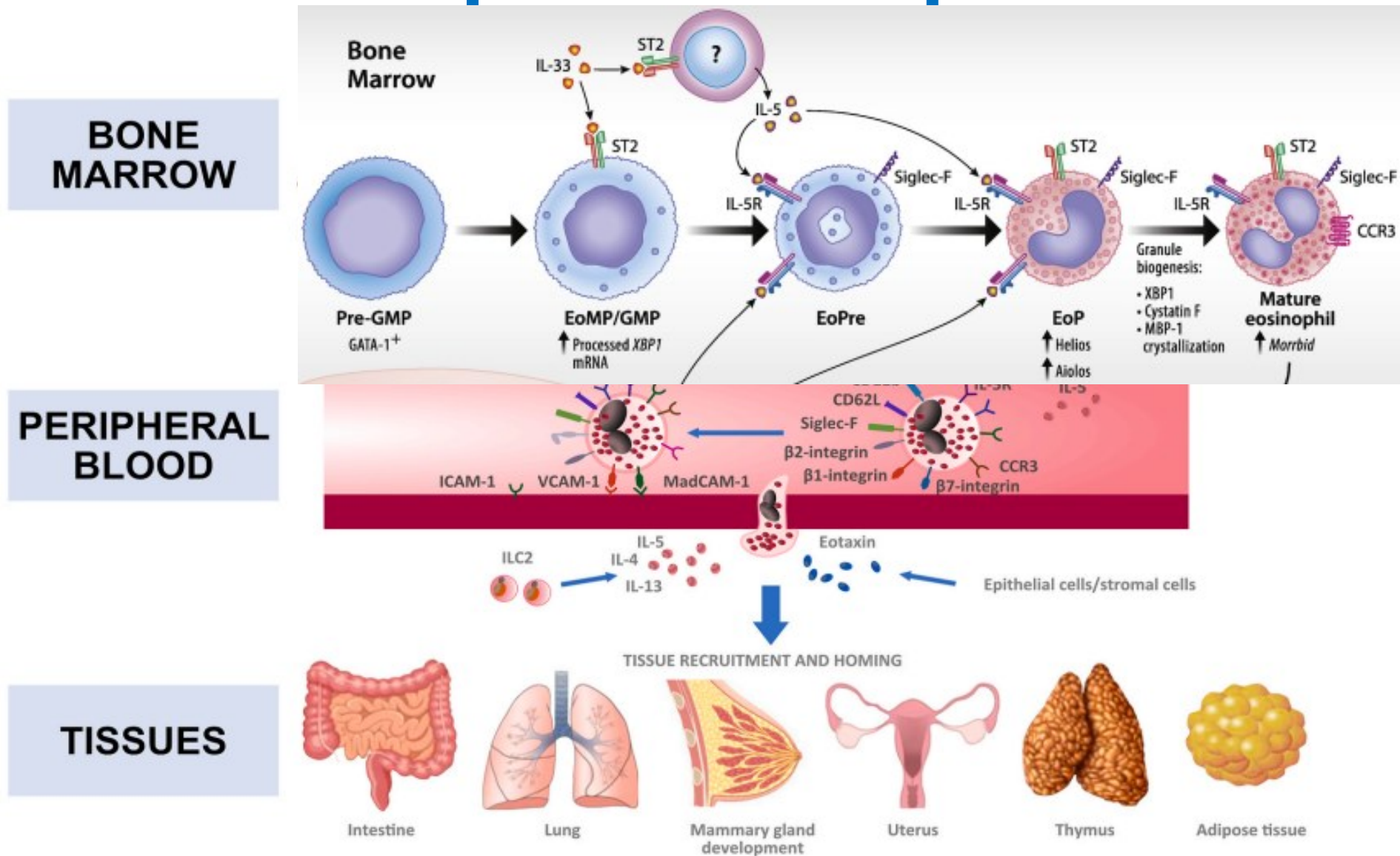
eosinophil cationic protein

eosinophil-derived neurotoxin

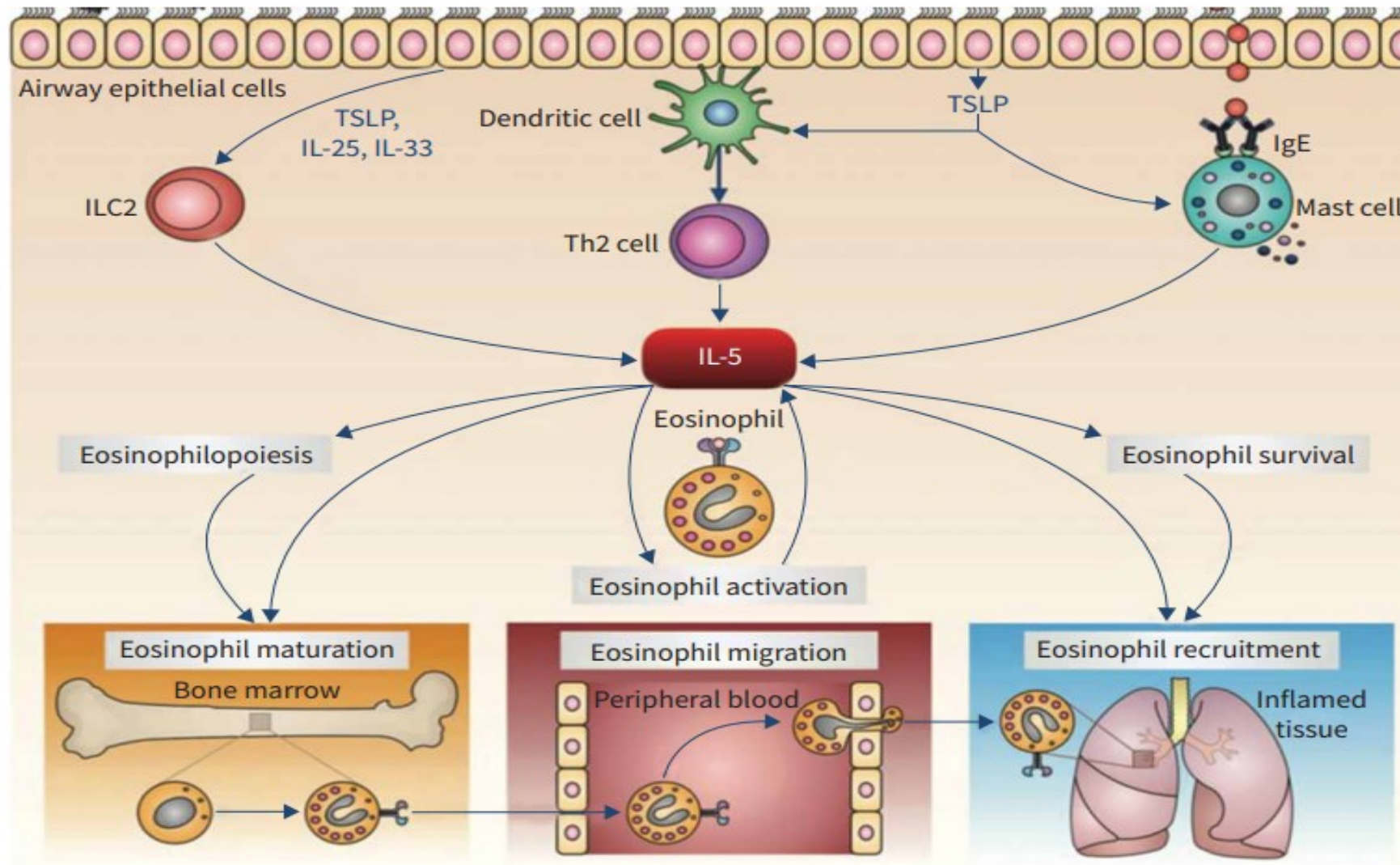
Charcot-Leyden crystal protein/galectin-10

eosinophil extracellular trap

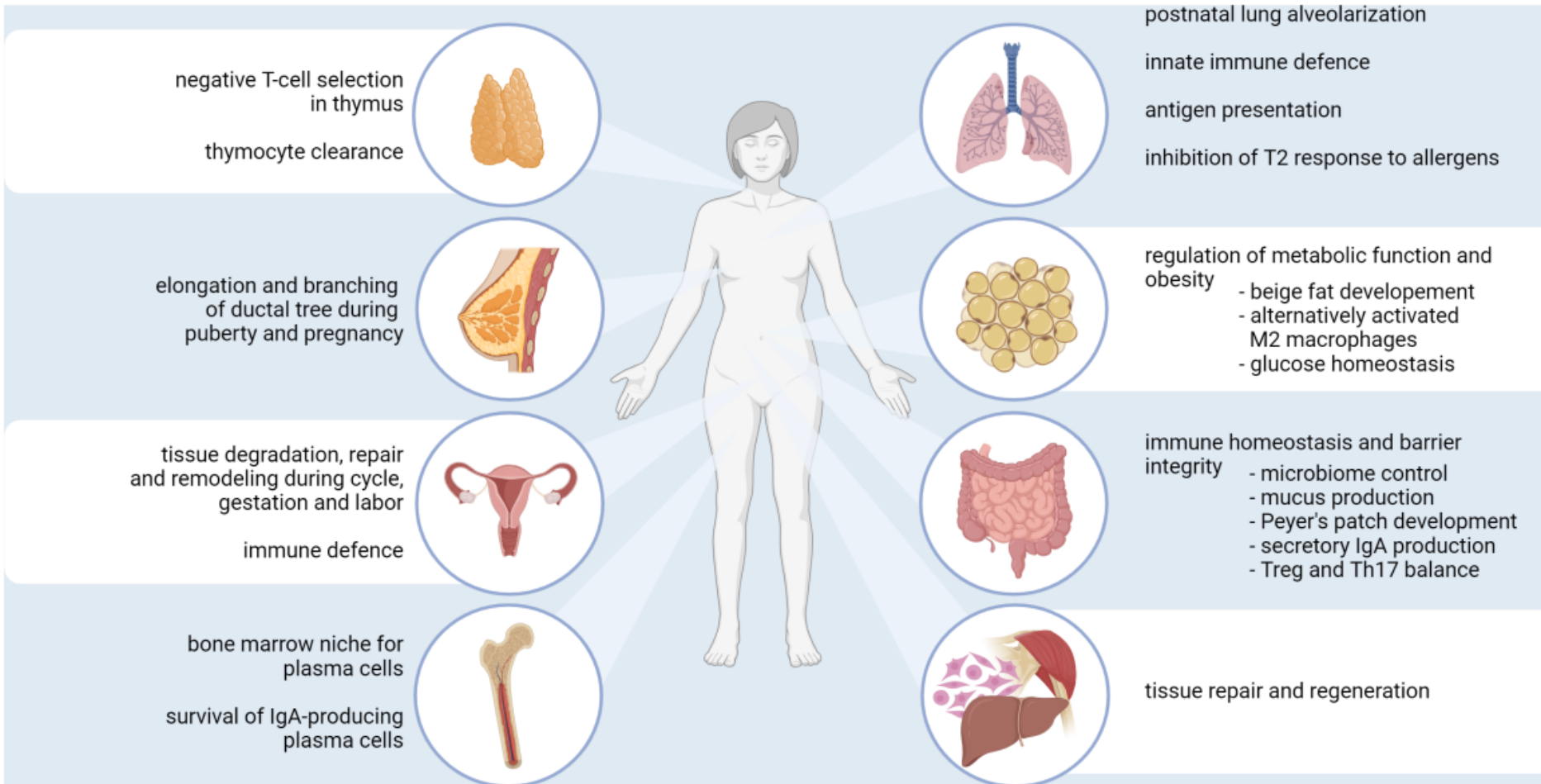
Eosinophil development



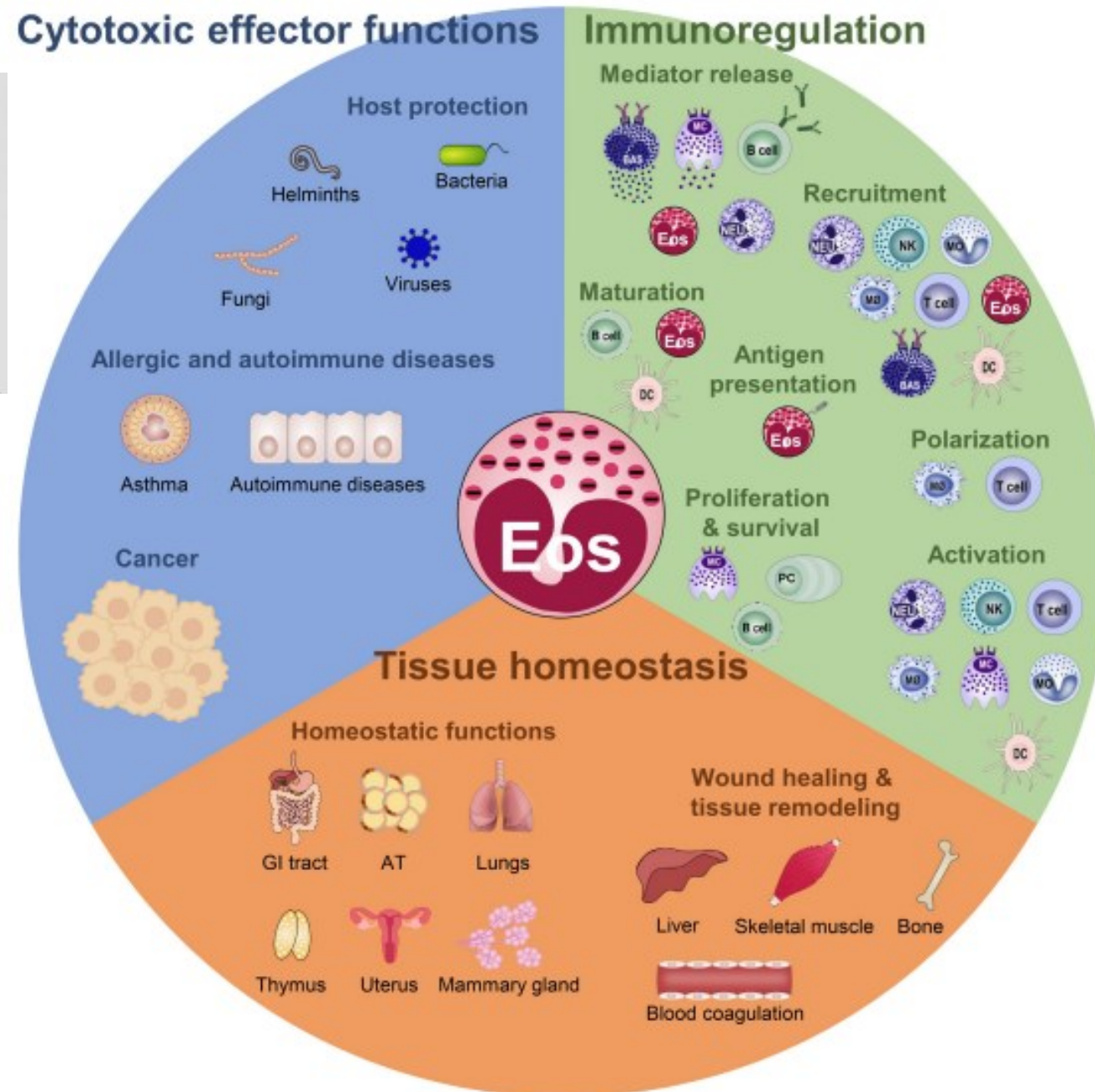
Interleukin (IL)-5 in eosinophil biology



Eosinophils in health



Homeostasis & protective response



Eosinophilia

- **Absolute eosinophil count (AEC) ≥ 500 cells/ μ L**
 - mild: 500 - 1500 cells/ μ L
 - moderate: 1500 – 5000 cells/ μ L
 - severe: ≥ 5000 cells/ μ L
- ✓ Pseudoeosinophilia
- Hypereosinophilia: AEC ≥ 1500 cells/ μ L
- Hypereosinophilic syndrome
 - HE + end organ manifestations a/w eosinophilia

	검사명	H V	검사결과	판독지	단위	참고치
1	Routine CBC (LM0131~38)					목록처방
2	WBC	▼	2.52		10 ³ /uL	3.5-10
3	RBC	▼	3.03		10 ⁶ /uL	3.9-5.5
4	Hemoglobin	▼	9.6		g/dL	13-17
5	Hematocrit	▼	28.5		%	38-50
6	MCV		94.1		fL	80-98
7	MCH		31.7		pg	27-34
8	MCHC		33.7		g/dL	32-36
9	Platelet		177		10 ³ /uL	140-360
10	Diff. Count (LM0141~54)			%		목록처방
11	Band Neutrophil			%		0-2
12	Seg. Neutrophil		40.4	%		40-70
13	Lymphocyte		30.2	%		20-47
14	Monocyte	▲	15.9	%		3-10
15	Eosinophil	▲	13.1	%		0-7
16	Basophil		0.4	%		0-2
17	At.Lymphocyte			%		0-0
18	Metamyelocyte			%		0-0
19	Myelocyte			%		0-0
20	Promyelocyte			%		0-0
21	Blast			%		0-0
22	Plasma cell			%		0-0
23	N.RBC		0.0		/100WBC	0 /100WBC
24	ANC	▼	1.02		10 ³ /uL	2.5

AEC: 330

	검사명	H V	검사결과	판독지	단위
1	Routine CBC (LM0131~38)				
2	WBC	▼	2.84		10 ³ /uL
3	RBC	▼	2.95		10 ⁶ /uL
4	Hemoglobin	▼	9.8		g/dL
5	Hematocrit	▼	29.0		%
6	MCV	▲	98.3		fL
7	MCH		33.2		pg
8	MCHC		33.8		g/dL
9	Platelet		178		10 ³ /uL
10	Diff. Count (LM0141~54)			%	
11	Band Neutrophil			%	
12	Seg. Neutrophil	▼	20.0	%	
13	Lymphocyte		35.0	%	
14	Monocyte	▲	12.0	%	
15	Eosinophil	▲	33.0	%	
16	Basophil			%	
17	At.Lymphocyte			%	
18	Metamyelocyte			%	
19	Myelocyte			%	
20	Promyelocyte			%	
21	Blast			%	
22	Plasma cell			%	
23	N.RBC				/100WBC
24	ANC	▼	0.57		10 ³ /uL

AEC: 937

접수일자	시간	결과일자	시간	RV	검시
2024-08-20	12:13	2024-08-21	16:07	▲	22.0
2024-08-20	12:13	2024-08-20	13:15	▲	31.0

- 검사종류 : 일반혈액검사(2024-08-20)
- 검체종류 : WB
- 검사실소견 :
- (?)는 검사결과가 확정이 되지 않은 상태입니다.

	검사명	H V	검사결과
1	Routine CBC (LM0131~38)		
2	WBC		7.20
3	RBC	▼	3.60
4	Hemoglobin	▼	12.1
5	Hematocrit	▼	33.7
6	MCV		93.6
7	MCH		33.6
8	MCHC		35.9
9	Platelet		178
10	Diff. Count (LM0141~54)		
11	Band Neutrophil		
12	Seg. Neutrophil		45.0
13	Lymphocyte	▼	12.0
14	Monocyte	▲	11.0
15	Eosinophil	▲	31.0
16	Basophil		1.0
17	At.Lymphocyte		AEC: 2232
18	Metamyelocyte		
19	Myelocyte		
20	Promyelocyte		
21	Blast		
22	Plasmocyte		
23	N.RBC		
24	ANC		3.24

Clinical Remarks : 호산구증가

Red Blood Cells (Hb: 11.9 g/dl)

Size & Stainability: Normocytosis (+) Normochromia (+)
Microcytosis () Hypochromia ()
Macrocytosis () Hyperchromia ()
Dimorphism () Anisocytosis ()
Polychromasia ()

Shape : Poikilocytosis ()
Elliptocytes () Schistocytes () Tear drop cells ()
Target cells () Spherocytes () Burr cells ()
Rouleaux formation () Autoagglutination ()
Basophilic stippling () Howell-Jolly Bodies ()

White Blood Cells (WBC: 6,930 /uL)

Number :
Distribution : seg (56) lymph (13) mono (9) eo (22) baso () band ()
atypical lymph () metamyelo () myelo () promyelo ()
blast () nRBC()/100 WBCs

Blast () Immature cells () Left shift () Toxic granulation ()
Vacuolations () Leukoerythroblastosis () Hypersegmentation ()
Hypogranulation ()

Platelets (PLT: 173 K/uL)

Number :
Platelet clumps () Giant Platelets () Hypogranular platelets ()

Others

Imp) Mild normocytic normochromic anemia
Moderate eosinophilia

R/I) Anemia of chronic disorders
R/I) Reactive eosinophilia (drug/allergy/skin disorder/infection)

Rec) 1. Reticulocyte count, serum Fe/TIBC/ferritin, IRF
2. Blood, urine, and sputum cultures, ESR, CRP, procalcitonin
3. Stool examination, LFT, IgE
4. FISH for PDGFRB, PDGFRB, FGFR1, PCM1-JAK2
5. Further clinical evaluation for causes of eosinophilia

Definitions

(interval $\geq$ 1 month)



Name/term	Abbreviation	Definition and criteria
Hypereosinophilia	HE	≥ 1.5 eosinophils $\times 10^9$ /L peripheral blood on two examinations (interval ≥ 2 weeks). ^a Tissue HE may or may not be detected.
Tissue hypereosinophilia	Tissue HE	One or more of the following applies: a) the percentage of eosinophils in bone marrow section exceeds 20% of all nucleated cells, and/or b) a pathologist is of the opinion that tissue infiltration by eosinophils is extensive and/or or c) marked deposition of eosinophil granule proteins is found (in the absence or presence of tissue infiltration by eosinophils)
Hypereosinophilic syndrome	HES	a) criteria for blood HE fulfilled and: b) organ damage and/or dysfunction attributable to tissue HE ^b and: c) exclusion of other disorders or condition as major reason for organ damage
Tissue-restricted HES ^c (organ-restricted HES)		a) tissue HE but criteria for blood HE not fulfilled and: b) organ damage and/or dysfunction attributable to tissue HE ^b and: c) exclusion of other disorders or conditions as major reason for organ damage

Eosinophil-associated diseases and disorders

- Allergic and Immunologic disorders

- atopic and related disease
- primary immunodeficiency
- other immunodysregulatory syndromes

- Rheumatologic disorders IgG4-related disease

- Dermatologic disorders Angioedema with eosinophilia

- Pulmonary disorders Acute/chronic eosinophilic pneumonia

- Gastrointestinal disorders Eosinophilic gastrointestinal disorder

- Medications and toxin-related eosinophilia

- Infectious disease

- helminth / protozoal infections
- ectoparasite infestation
- fungal infections
- HIV infection

- Hematologic and neoplastic disorders

- myeloid neoplasm, myeloproliferative disorders
- lymphoma, leukemia
- solid tumors
- idiopathic hypereosinophilic syndrome
- hypereosinophilia of undetermined significance

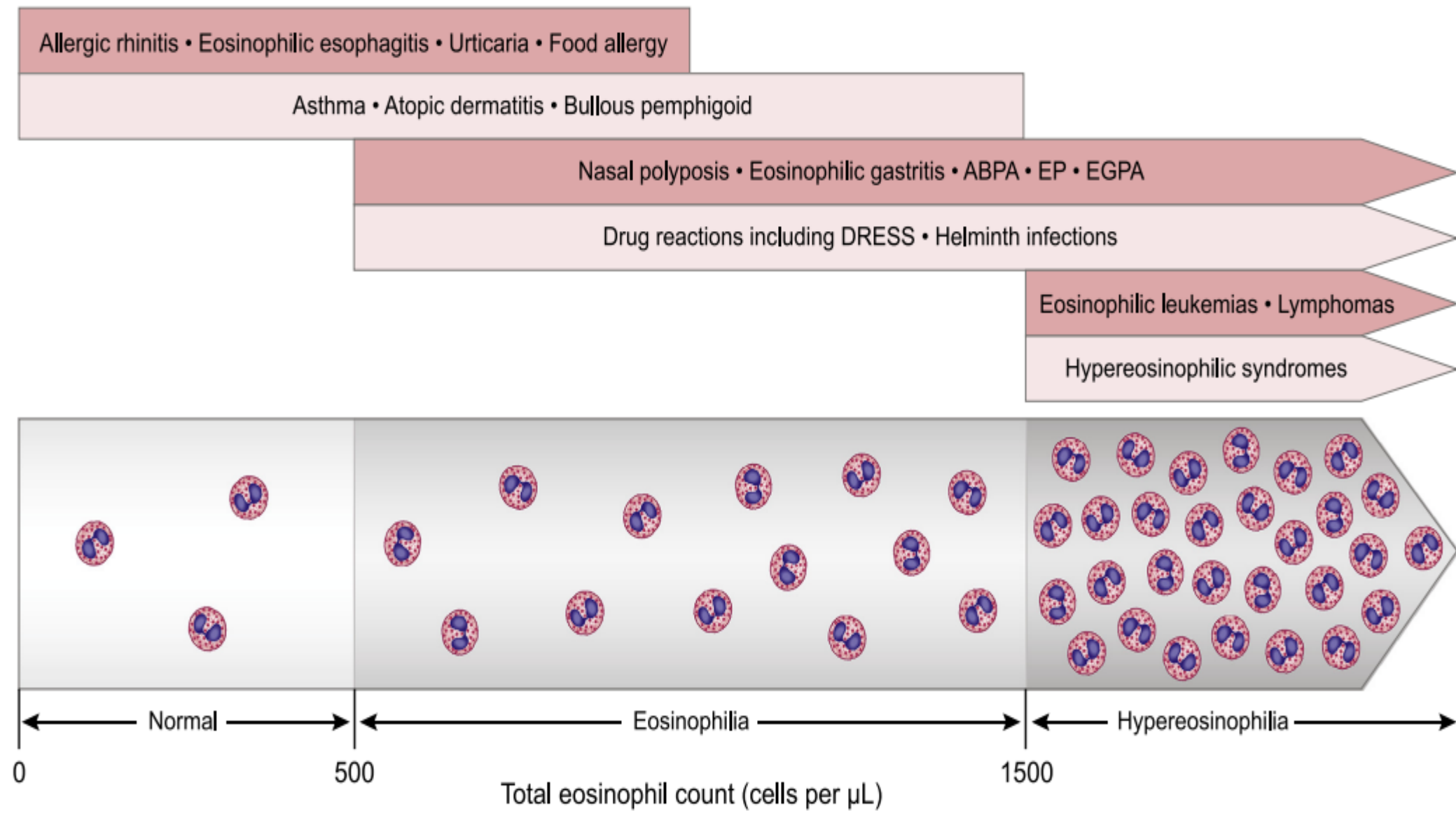
- Other

- cholesterol embolism
- hypoadrenalism
- radiation
- serositis

Eosinophil-associated diseases and disorders

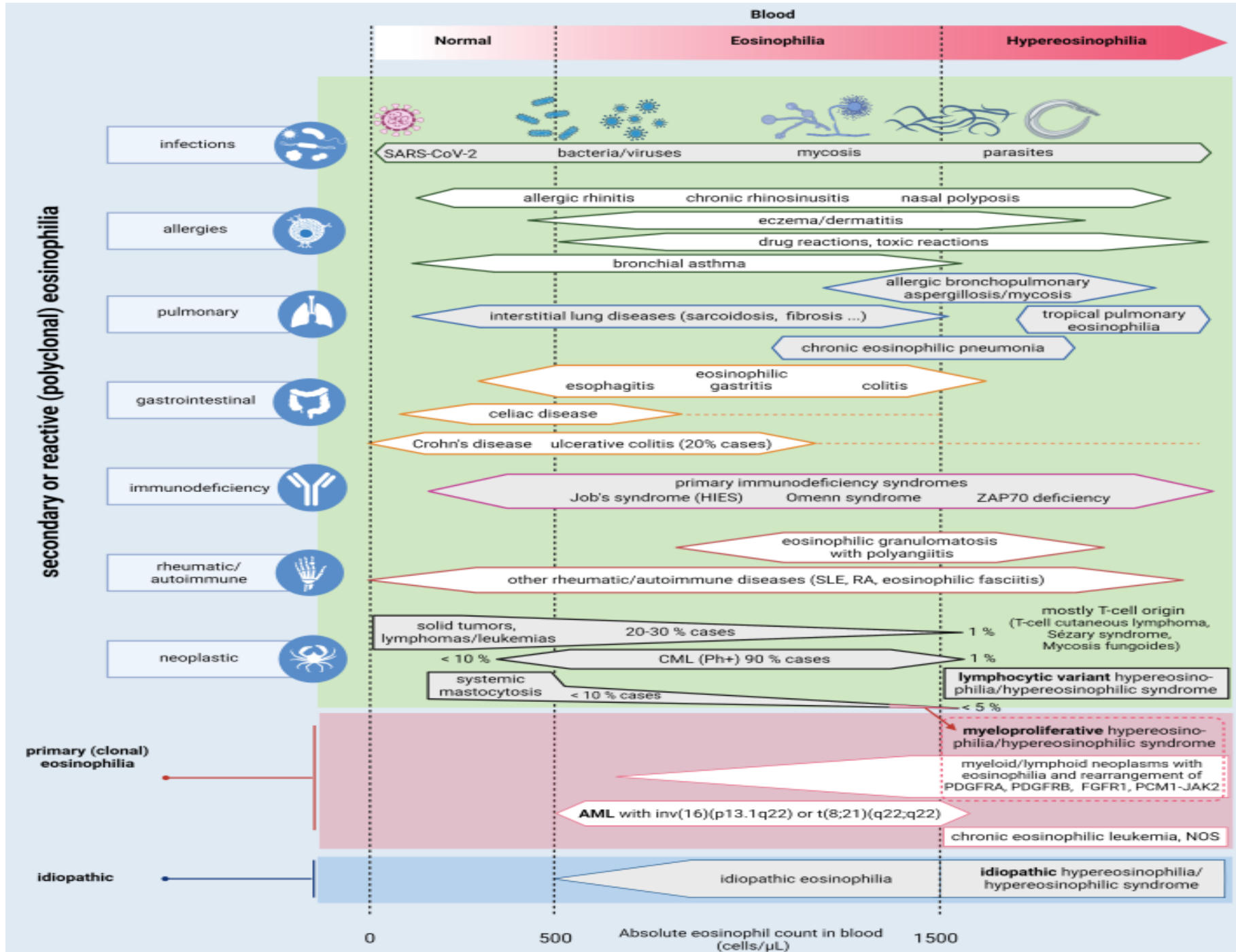
Body System	Disease Manifestations
Integumentary System	Atopic Dermatitis
	Contact Dermatitis
	Cutaneous T-Cell Lymphoma
	Eosinophilic Cellulitis/Dermatitis (Wells' Syndrome)
	Episodic Angioedema with Eosinophilia (Gleich's Syndrome)
	Bullous Pemphigoid
	Pemphigus
	Eosinophilic Pustular Folliculitis
	Systemic Sclerosis
Upper Respiratory System	Allergic Rhinitis
	Chronic Sinusitis
	Chronic Rhinosinusitis with Nasal Polyps
Lower Respiratory System	Aspirin/NSAID Exacerbated Respiratory Disease
	Asthma
	Allergic Bronchopulmonary Aspergillosis
	Eosinophilic Pneumonia
	Drug-Induced Eosinophilic Lung Disease
	Chronic Obstructive Pulmonary Disease
Cardiovascular System	Lung Transplantation
	Eosinophilic Myocarditis
	Cholesterol Crystal Embolism
Gastrointestinal System	Eosinophilic Esophagitis
	Eosinophilic Gastroenteritis
	Eosinophilic Gastritis
	Eosinophilic Colitis
	Eosinophilic Pancreatitis
Endocrine	Adrenal Insufficiency (Addison's Disease)
	Withdrawal of Glucocorticoids
	Hypopituitarism

Body System	Disease Manifestations
Rheumatologic	Eosinophilic Granulomatosis with Polyangiitis (Churg-Strauss)
	Immunoglobulin G4 Related Disease
	Diffuse Fasciitis with eosinophilia
	Eosinophilic Fasciitis (Shulman Syndrome)
	Eosinophilia Myalgia Syndrome
	Eosinophilic Myositis
Infectious Processes	Parasitic Infection (roundworm, hookworm, tapeworm, etc.)
	Mycobacterial Infection
	Protozoa Infection
	Fungal Infection
	Viral Infection (HIV, Human T cell Lymphotropic Virus type 1)
Neoplastic Processes	Myeloid Tumors
	- Acute Eosinophilic Leukemia
	- Chronic Myeloid Leukemia
	Lymphoid Tumors
	- Hodgkin's Lymphoma
	Solid Tumors
Allergic/Immunologic	Mastocytosis
	Idiopathic Hypereosinophilia
	Hyper IgE Syndrome (Job Syndrome)
	Omenn Syndrome
	Drug Induced Eosinophilia
Other	Drug Induced Hypersensitivity Syndrome (formerly Drug Reaction with Eosinophilia and Systemic Symptoms)
	Radiation Exposure



Hypereosinophilia classification

Variant of HE	Abbreviation	Features
Hereditary (familial) HE	HE _{FA}	<u>Familial clustering</u> , often evidence of a <u>hereditary immunodeficiency</u> (inborn errors of immunity with eosinophilia), no evidence of a reactive or neoplastic underlying disease, and no signs or symptoms indicative of HES
HE of unknown significance	HE _{US}	No known underlying etiology of HE, no positive family history, no evidence of a reactive or neoplastic condition or disorder underlying HE, and <u>no signs or symptoms</u> indicative of HES
Secondary (reactive) HE	HE _R	Underlying <u>reactive condition or disease</u> that explains HE, no evidence for a clonal bone marrow disease that explains HE ^a ; and no signs or symptoms indicative of HES
Clonal (neoplastic) HE	HE _N	Underlying <u>stem cell, myeloid, or eosinophil neoplasm inducing HE^a</u> ; no signs/symptoms indicative of HES

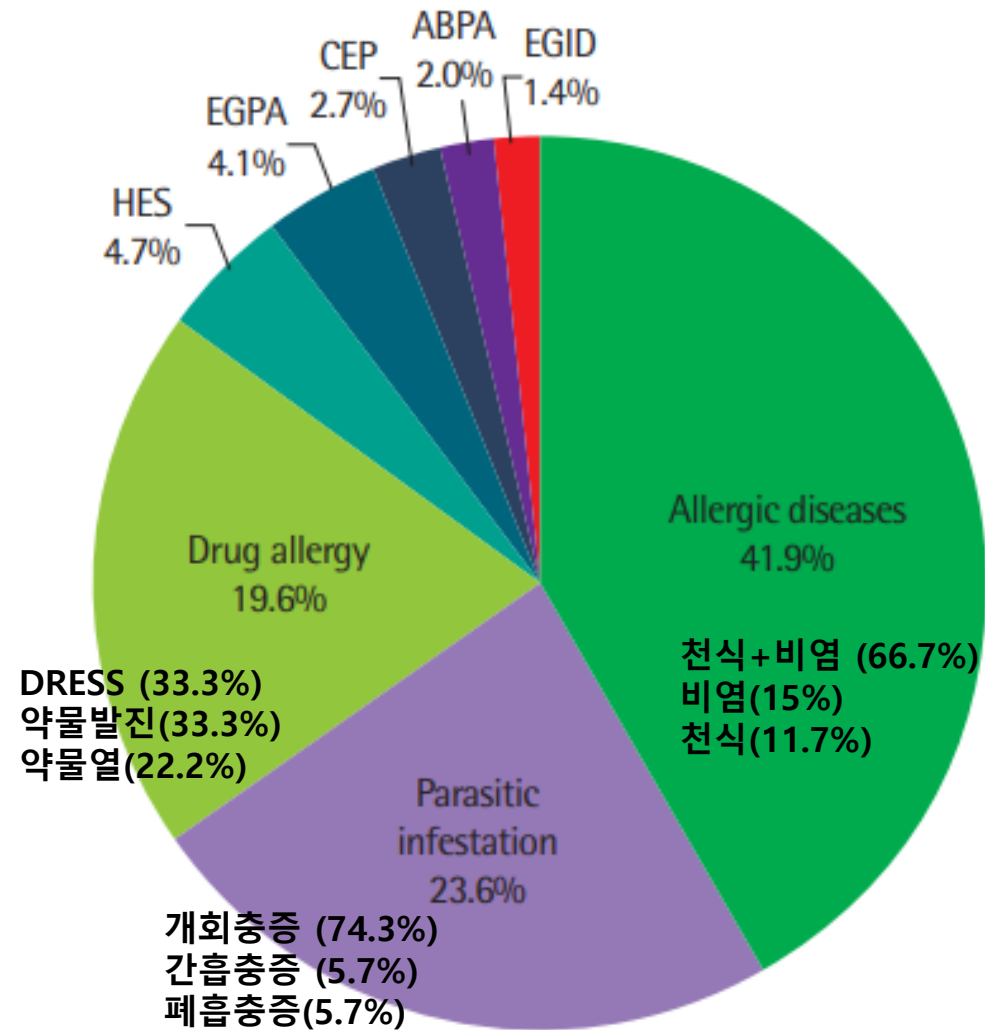


Etiology

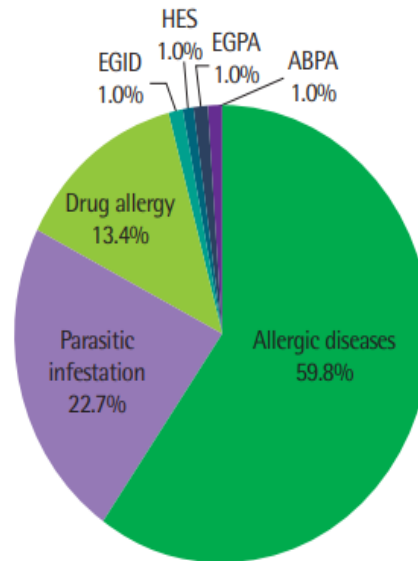
- 단일 대학병원 알레르기내과 (2016년 1월~12월)

AEC $\geq$ 500 cells/ μ L (n=148)

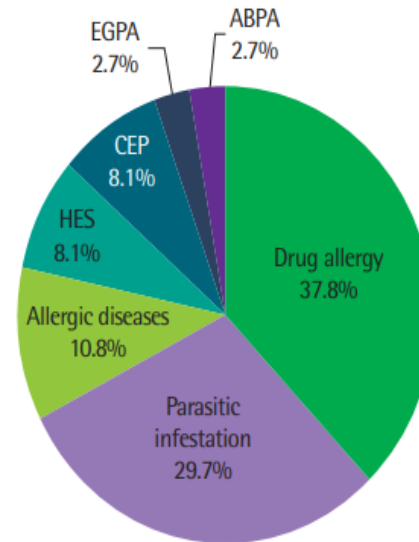
- mean eo (%): $18.2\% \pm 14.1\%$
- mean AEC: $2306 \pm 4952/\mu$ L



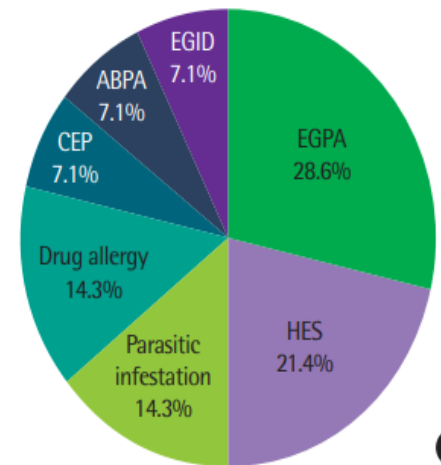
Mild (<1500/ μ L)
(n=97, 65.5%)



Moderate (1500-5000/ μ L)
(n=37, 25%)



Severe (>5000/ μ L)
(n=14, 9.5%)



Allergic disease

- Allergic rhinitis/conjunctivitis
- Asthma
- Atopic dermatitis
- Chronic rhinosinusitis (with/without nasal polyps)

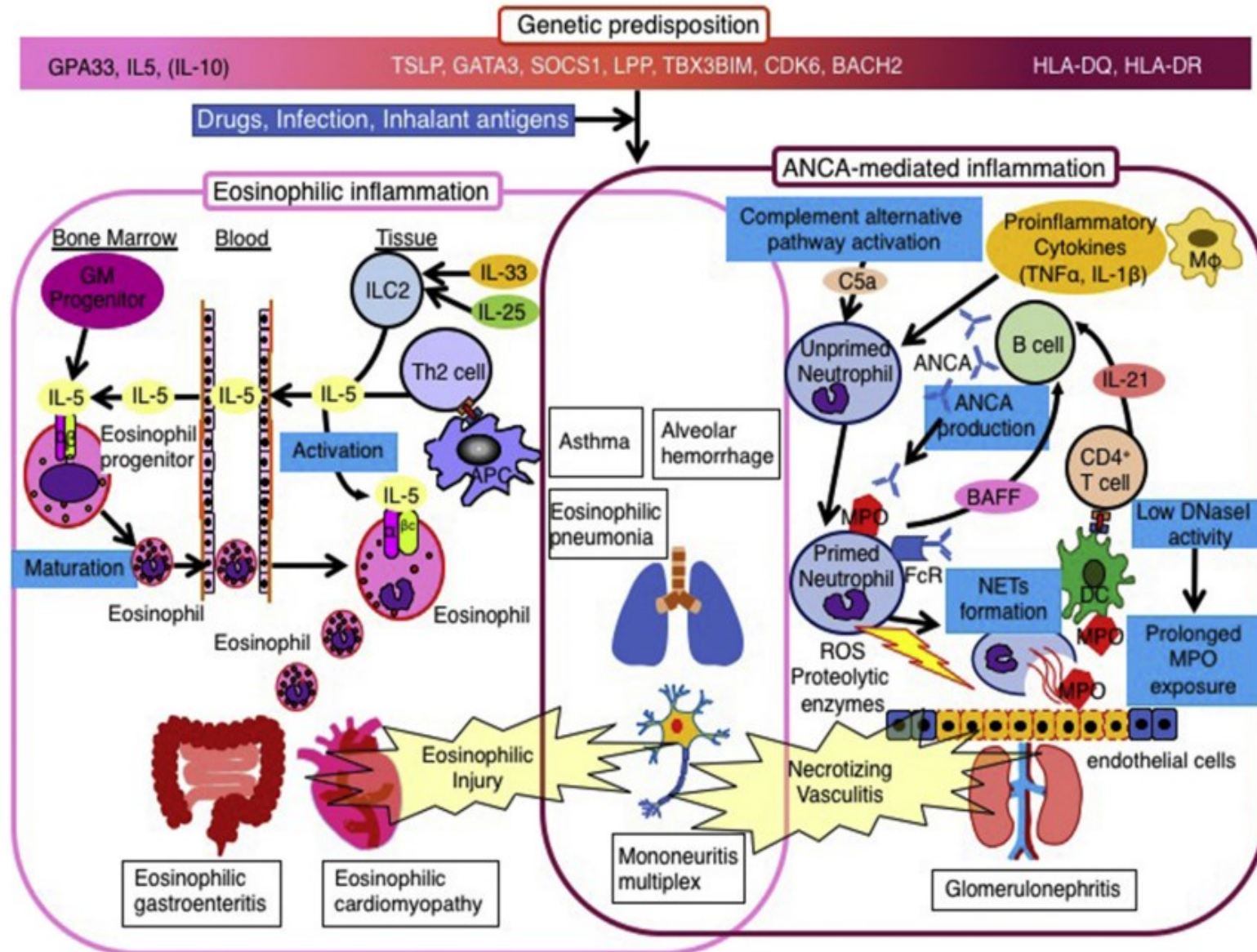


Eosinophilic granulomatosis with polyangiitis
Allergic bronchopulmonary aspergillosis
Chronic eosinophilic pneumonia

- 알레르기 병력, 가족력
- 특정 물질, 계절 등에 의해 악화 (specific IgE)
- 대부분 **mild eosinophilia**

Eosinophilic granulomatosis with polyangiitis

- Allergic angiitis granulomatosis
- Churg-Strauss Syndrome
- Systemic necrotizing vasculitis (small to medium-sized vessel)
- ANCA-associated vasculitis



Eosinophilic granulomatosis with polyangiitis

Small- or medium-vessel vasculitis &

- Asthma
 - > 10% blood eosinophilia
 - Neuropathy, mono or poly
 - Non-fixed pulmonary infiltrates
 - Paranasal sinus abnormalities
 - Extravascular eosinophils (biopsy)
- (≥4 positive)

American College of Rheumatology, 1990

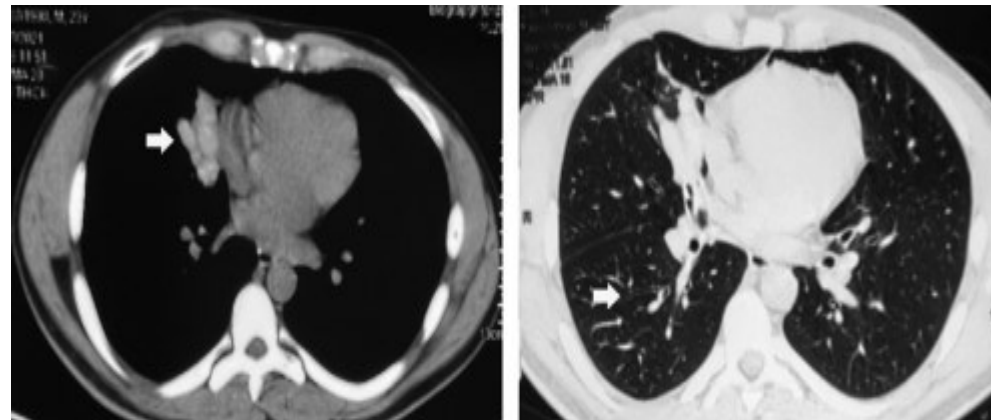
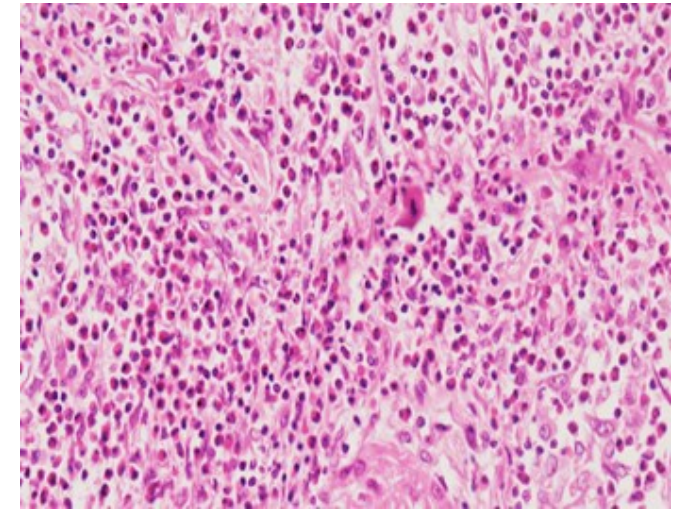
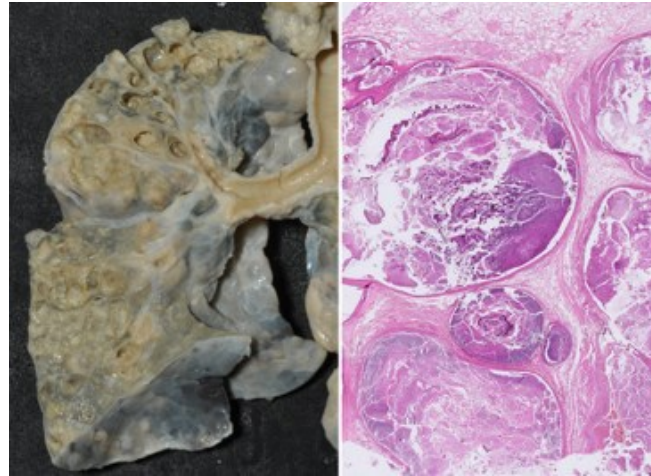
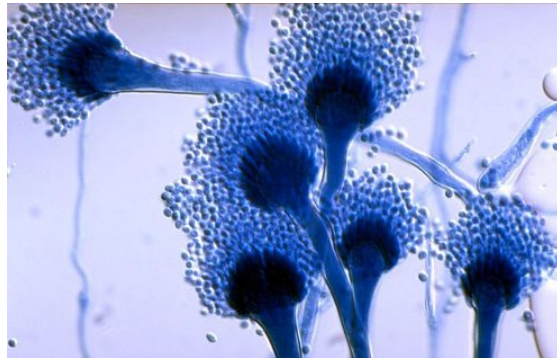
Clinical criteria	Obstructive airway disease	+3
	Nasal polyps	+3
	Mononeuritis multiplex	+1
Laboratory & biopsy criteria	Blood eosinophil count $\geq 1 \times 10^9/\text{liter}$	+5
	Extravascular eosinophilic predominant inflammation on biopsy	+2
	Positive test for cytoplasmic ANCA or anti-proteinase 3 antibodies	-3
	Hematuria	-1

(≥6 scores)

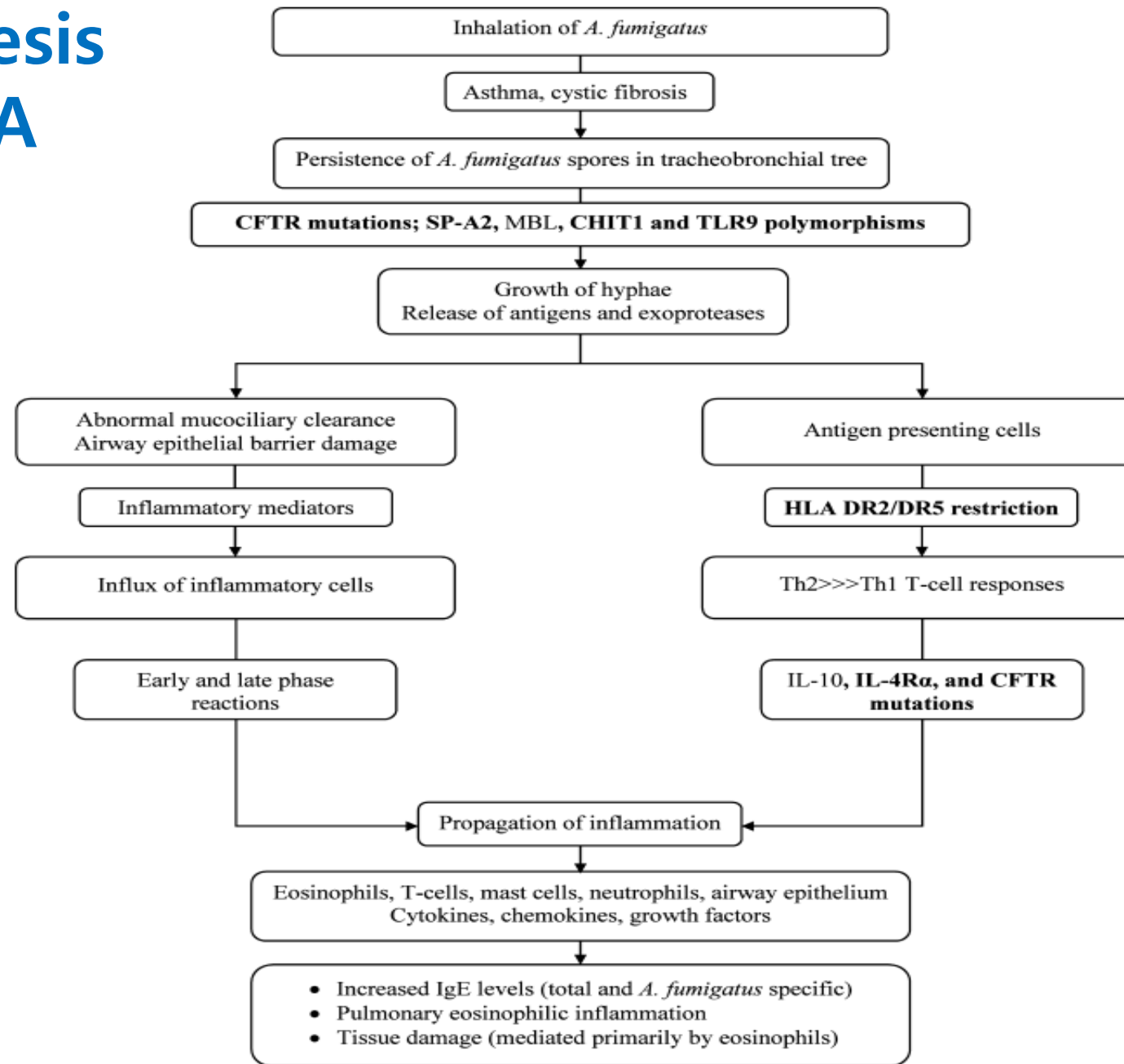
American College of Rheumatology/ European alliance of associations for rheumatology 2022

Allergic bronchopulmonary aspergillosis

- Allergic pulmonary disorder caused by **hypersensitivity to *Aspergillus fumigatus***



Pathogenesis of ABPA

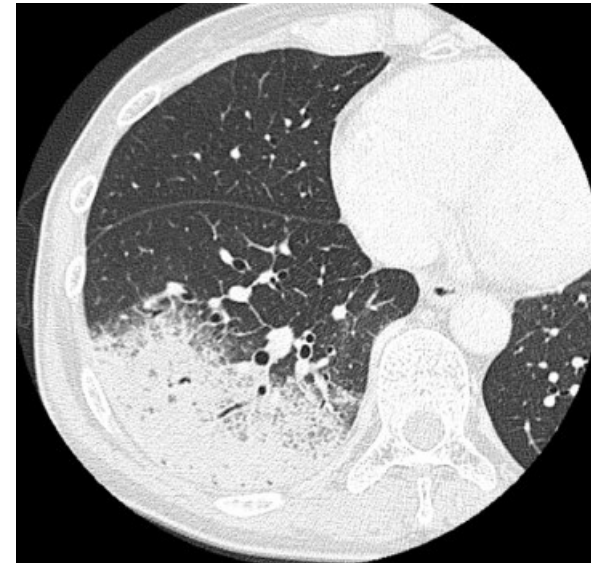


Diagnostic criteria of ABPA

Rosenberg-Patterson Criteria (1977) ⁷⁷	ISHAM ABPA Working Group Criteria (2013) ⁷	Modified ISHAM ABPA Working Group criteria (2021) ⁷¹	Asano et al. Criteria (≥5-6) (2021) ¹³⁸
Primary: 1. Episodic bronchial obstruction (asthma). 2. Peripheral blood eosinophilia. 3. Immediate skin reactivity to <i>Aspergillus</i> antigen. 4. Precipitating antibodies against <i>Aspergillus</i> antigens. 5. Elevated serum immunoglobulin E concentrations. 6. History of pulmonary infiltrates (transient or fixed). 7. Central bronchiectasis. Secondary: 1. <i>Aspergillus fumigatus</i> in sputum (repeated culture or microscopy). 2. History of expectoration of brown plugs or flecks. 3. Late skin reactivity (Arthus reaction) to <i>Aspergillus</i> antigen.	Predisposing conditions: 1. Asthma or CF. Obligatory: 1. Positive type 1 <i>Aspergillus</i> skin test or elevated IgE antibody against <i>A. fumigatus</i>. 2. Total IgE > 1000 IU/mL (If all other criteria are satisfied, a total IgE < 1000 IU/mL is acceptable). And ≥2 of the following: 1. Precipitating antibodies or IgG against <i>A. fumigatus</i>. 2. Radiographic opacities consistent with ABPA. 3. Peripheral blood eosinophilia > 500 cells/μL in treatment-naïve patients (maybe historical).	Presence of all the following: 1. Asthma. 2. <i>Aspergillus</i>-specific IgE > 0.35 kUA/L. 3. Serum total IgE > 500 IU/mL. And at least 2 of the following: 1. <i>A. fumigatus</i> specific IgG > 27 mgA/L. 2. Bronchiectasis on CT chest. 3. Peripheral blood eosinophilia > 500 cells/μL.	1. Current or previous history of asthma or asthmatic symptoms. 2. Peripheral blood eosinophilia (≥500 cells/μL). 3. Elevated total serum IgE levels (≥417 IU/mL). 4. Immediate cutaneous hypersensitivity or specific IgE for filamentous fungi. 5. Presence of precipitins or specific IgG for filamentous fungi. 6. Filamentous fungal growth in sputum cultures or bronchial lavage fluid. 7. Presence of fungal hyphae in bronchial mucus plugs. 8. Central bronchiectasis on CT. 9. Presence of mucus plugs in central bronchi, based on CT/bronchoscopy or mucus plug expectoration history. 10. High attenuation mucus on CT chest.

Chronic eosinophilic pneumonia

- Cough, progressive dyspnea, low-grade fever, weight loss, wheezing, malaise...
- Rarely develop respiratory failure
- Blood eosinophilia (mean: 30%) + elevated IgE (>500 IU)
- Diagnosis
 - clinical symptoms (lasting > 2 weeks)
 - abnormal chest radiographic findings
 - eosinophilia in BAL (usually >25%), blood eosinophilia
 - exclusion of other known eosinophilic pneumonias



Parasite infection

Parasite	Ingestion of food
간흡충(<i>Clonorchis sinensis</i>)	민물생선회
폐흡충(<i>Pargaeonimus westermani</i>)	민물 게, 민물가재
개회충(<i>Toxocara canis</i>)	동물의 간 (소, 타조), 천엽, 동물 내장
스파르가눔(<i>sparganum</i>)	뱀, 개구리
유구낭미충(<i>cysticercus cellulosae</i>)	돼지고기
고래회충(<i>Anisakis simplex</i>)	바다물고기



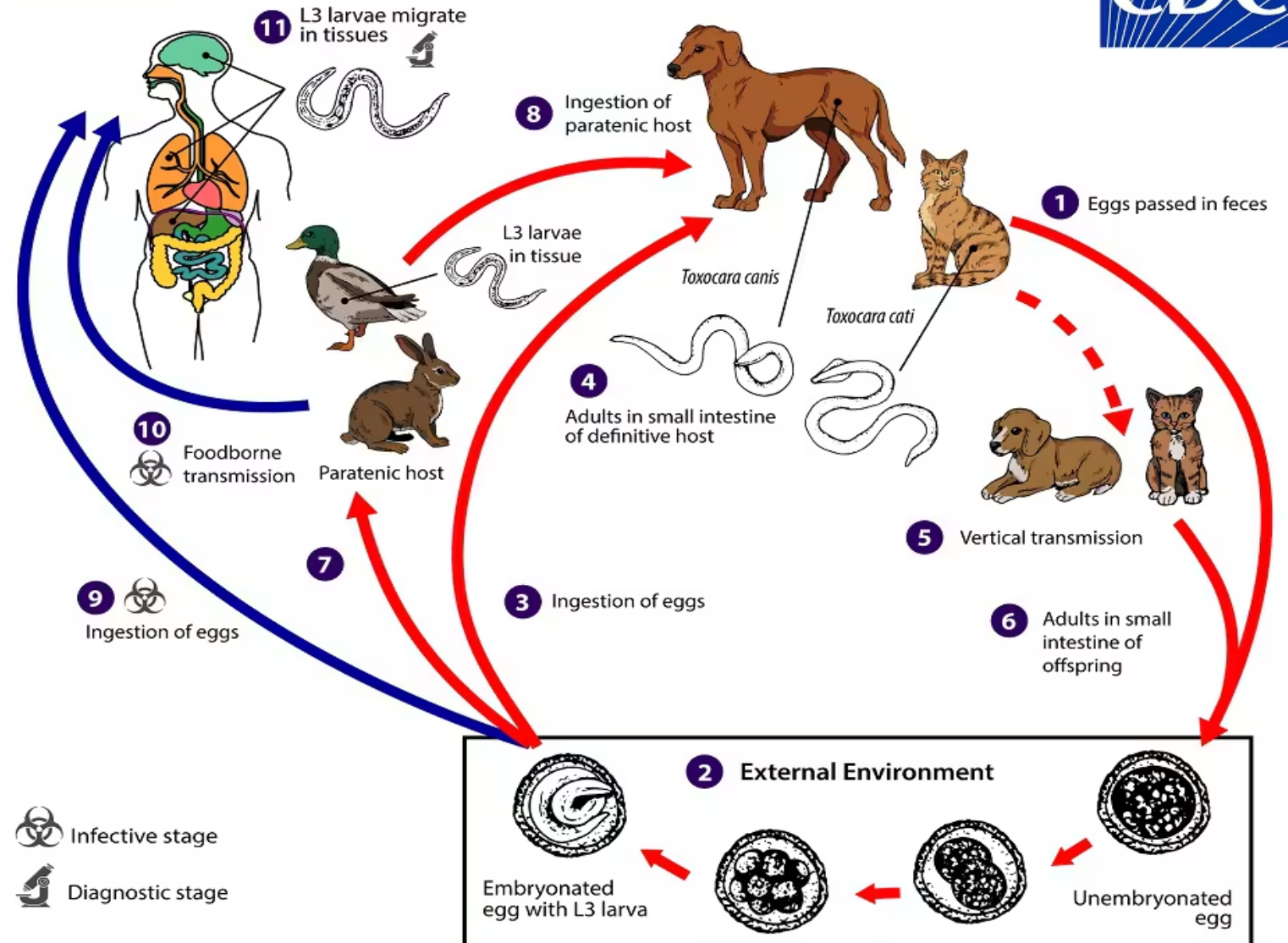
Toxocariasis

DPDx

Toxocara spp.



Most infections: asymptomatic
Visceral larva migrans (VLM)
Ocular larva migrans (OLM)



Toxocariasis

AEC ≥ 500 cells/μL (2017.1 ~ 2018.2)

Table 1. Positive rates of toxocariasis and other parasitic infections in eosinophilia patients by ELISA (n=81)

Infection	Positive rate (%)
No parasite	65.4
Parasites	34.6
<i>T. canis</i> only	22.2%
<i>T. canis</i> + <i>C. sinensis</i>	2.5
<i>T. canis</i> + <i>C. sinensis</i> +metacestodes of <i>T. solium</i>	1.2
<i>T. canis</i> + <i>C. sinensis</i> +metacestodes of <i>T. solium</i> +sparganum	1.2
<i>C. sinensis</i>	1.2
Metacestodes of <i>T. solium</i>	7.4
<i>C. sinensis</i> +metacestodes of <i>T. solium</i>	3.7

Table 3. Comparison of characteristics among the diverse parasitic infestations

Variable	Toxocariasis (n=26)	Clonorchiasis (n=2)	Paragonimiasis (n=2)
Risk factors		OR (95% CI)	
Male		21.876 (1.667-287.144)	
Preference for raw meat/liver		5.899 (1.004-34.669)	
A heavy alcohol-drinking habit		8.767 (1.018-75.497)	
Total IgE (IU/mL)	887 (0-11,800) (n=26)	251 (120-382) (n=2)	1,113 (715-1,510) (n=2)

Allergy Asthma Respir Dis 2019;7:142-149

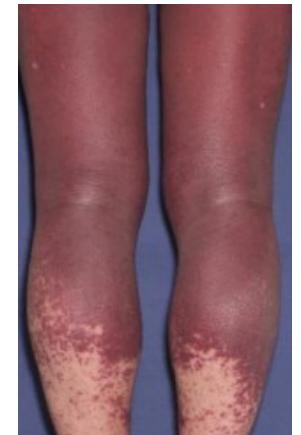
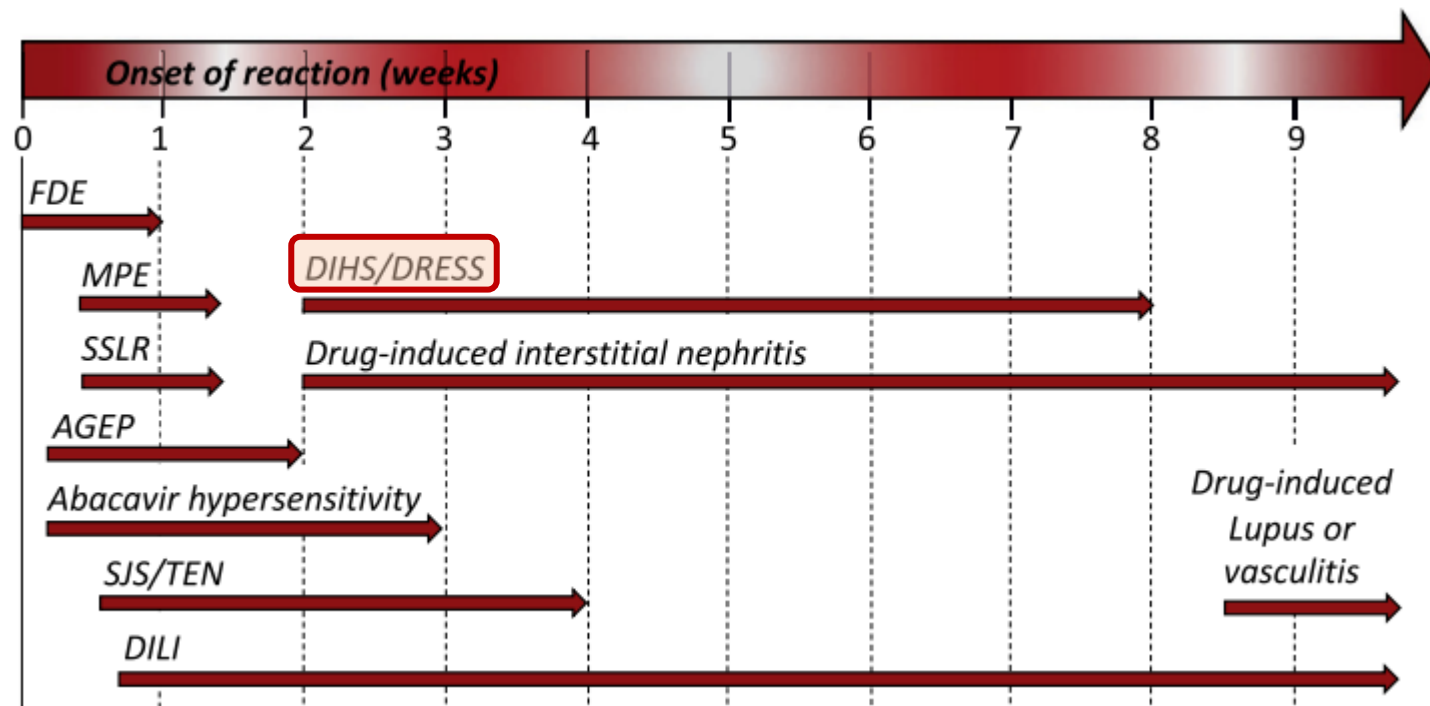
Toxocara canis (dog), Toxocara cati (cat)

Parasite infection

- Diagnosis
 - Ova, biopsy, serology (ELISA), image study
- Treatment
 - Paragonomiasis, Clonorchiasis: praziquantel (25mg/kg tid, 2 days)
 - Toxocariasis: albendazole (400mg bid, 5-7 days)
 - Strongyloides: ivermectin (200µg/kg, 1-2 days)
(disseminated strongyloidiasis if receiving high-dose corticosteroids)

Delayed drug hypersensitivity

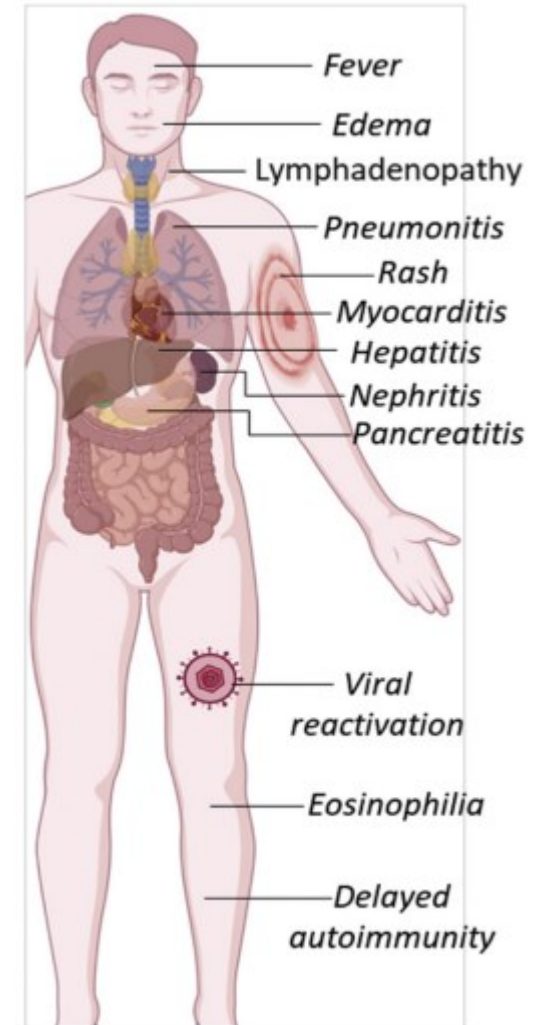
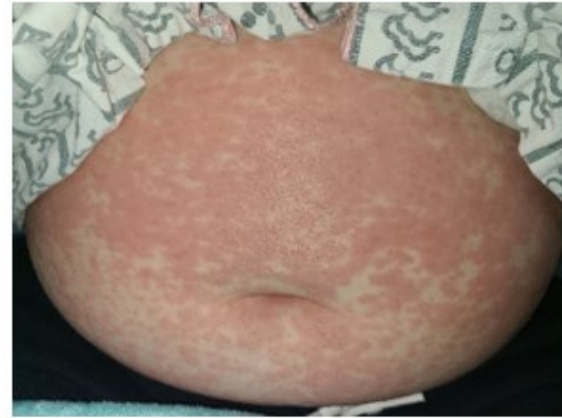
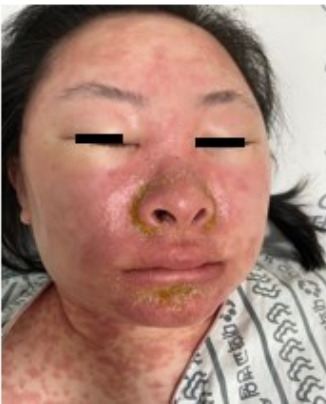
- T-cell mediated
- Clinically diverse reactions: skin rash, eosinophilia....



Drug Reaction With Eosinophilia and Systemic Symptoms (DRESS)

DIHS (Japanese Consensus Group)³

1. Maculopapular rash developing >3 wk after starting with a limited number of drugs
2. Prolonged clinical symptoms after discontinuation of the causative drug
3. Fever ($>38^{\circ}\text{C}$)
4. Liver abnormalities (ALT >100 U/L)*
5. Leukocyte abnormalities (at least 1 present)
 - a. Leukocytosis ($>11 \times 10^9/\text{L}$)
 - b. Atypical lymphocytosis ($>5\%$)
 - c. Eosinophilia ($>1.5 \times 10^9/\text{L}$)
6. Lymphadenopathy
7. HHV-6 reactivation
 - The diagnosis is confirmed by the presence of the 7 criteria above (typical DIHS) or of 5 of the 7 (atypical DIHS)



Severe cutaneous adverse reactions

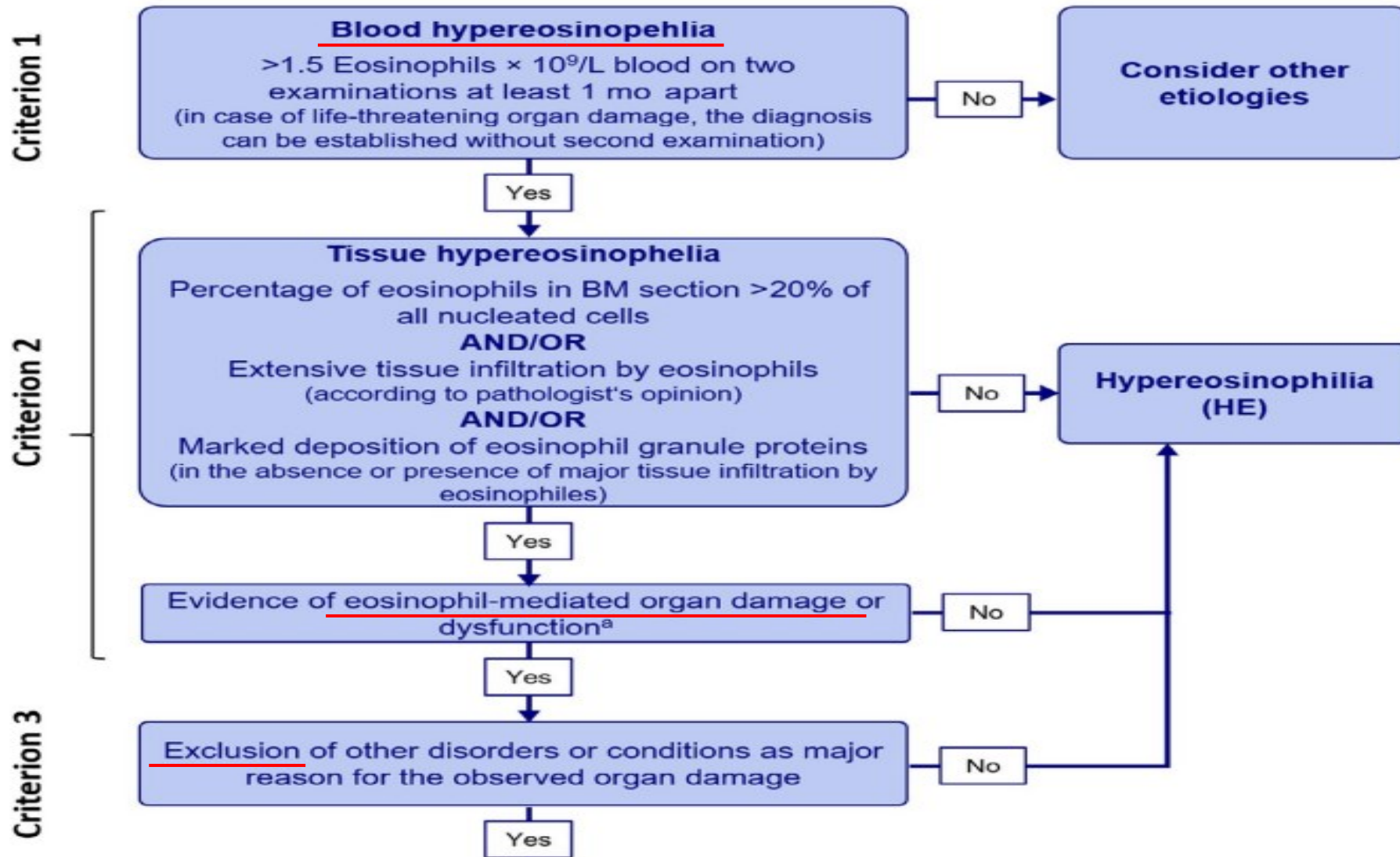
Korean SCAR registry (2010 ~2015)

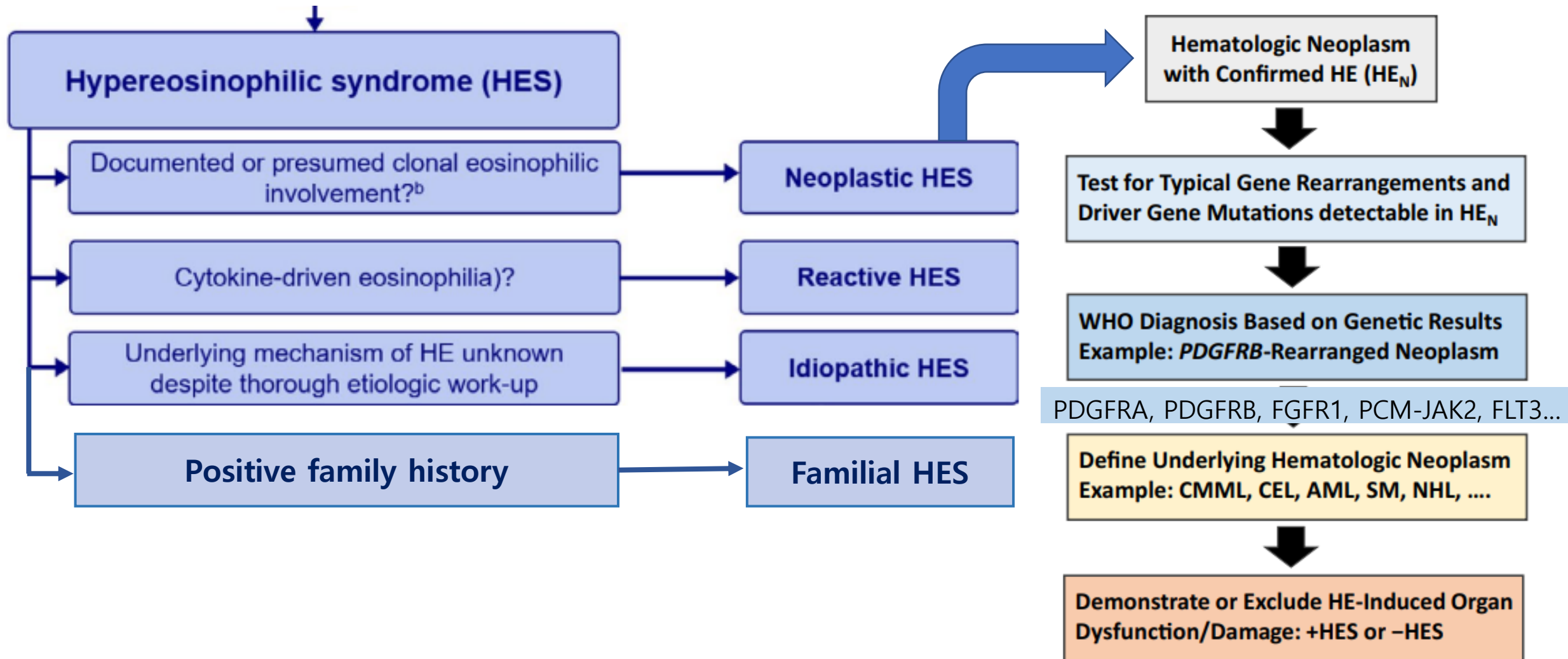
Characteristic	Total	DRESS	SJS/TEN	SJS	Overlap	TEN
No. of cases (%)	745	361 (48.5)	384 (51.5)	267 (35.8)	35 (4.7)	82 (11.0)
Male (%)	49.0	50.1	47.9	46.8	45.7	52.4
Age (y), median (IQR)	56 (35-70)	55 (42-68)	56 (35-70)	54 (33-70)	61 (42-72)	56 (39-70)
Time interval from first drug intake to symptoms (d), median (IQR)*	18 (11-32)	24 (14-35)	13 (8-24)	12 (8-24)	13 (8-25)	12 (8-23)
Duration of disease from initial symptoms (d), median (IQR) [†]	20 (14-30)	21 (15-31)	20 (14-30)	18 (13-24)	24 (16-41)	34 (21-48)
Route of admission						
Emergency room (%)	51.2	48.6	53.6	52.7	57.1	53.7
Outpatient clinic (%)	33.2	28.1	38.1	39.4	34.3	36.5
Inpatients at the onset (%)*	15.6	23.3	8.3	7.9	8.6	9.8
Courses after admission						
ICU care (%)* [†]	6.8	4.7	8.9	4.1	14.3	22.0
Recovered (%)* [†]	85.2	92.8	78.1	86.1	71.4	54.9
Sequelae (%)* [†]	8.2	3.0	13.0	9.4	11.4	25.6
Death (%)* [†]	6.6	4.2	8.9	4.5	17.1	19.5

	Total	SJS/TEN	DRESS	Sequelae (%)	Mortality (%)
<u>Allopurinol</u>	104	51	53	7	11
Cephalosporins	81	39	42	4	6
Carboxamide antiepileptics	73	29	44	8	1
NSAIDs	64	54	10	13	3
Antituberculous agents	48	9	39	4	8
Penicillins	48	28	20	10	4
Other antiepileptics	41	21	20	10	2
Glycopeptide antibacterials	36	8	28	6	11
Quinolones	30	16	14	13	17
Acetaminophen	24	20	4	21	0
Antineoplastic agents	15	9	6	0	13
Dapsone	15	0	15	13	0
Valproic acid	15	5	10	7	20
Hydantoin antiepileptics	14	8	6	7	0
Carbonic anhydrase inhibitors	11	11	0	27	9
Sulfonamide antibacterial	10	7	3	10	10



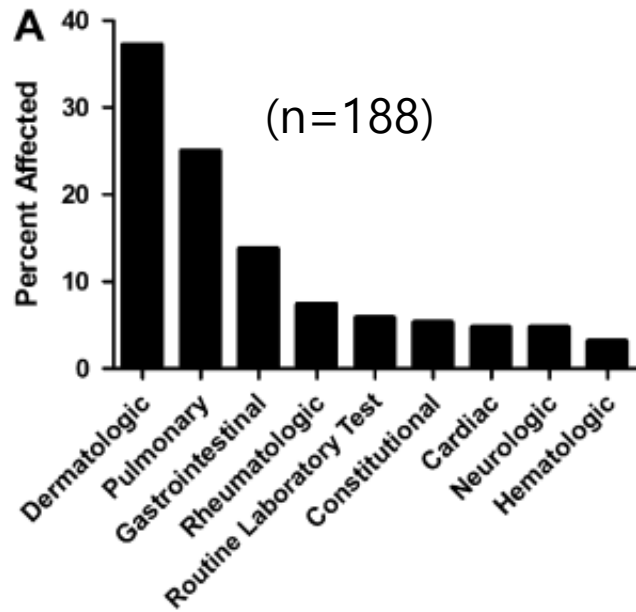
Hypereosinophilic syndrome



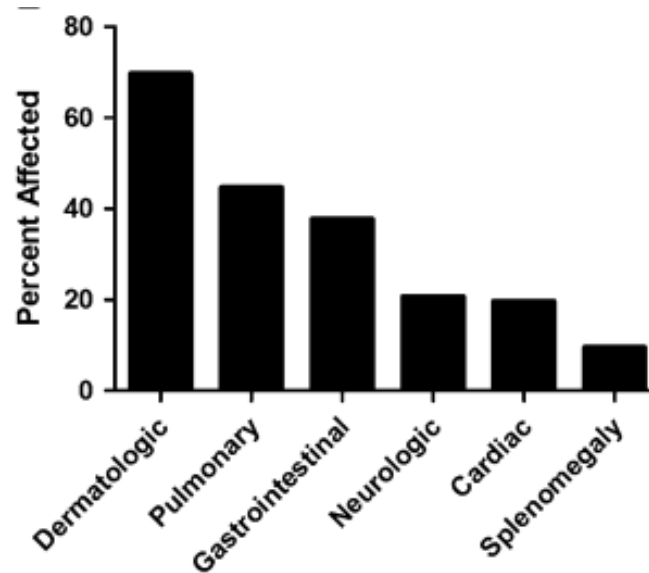
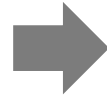


Hypereosinophilic syndrome

Clinical manifestations

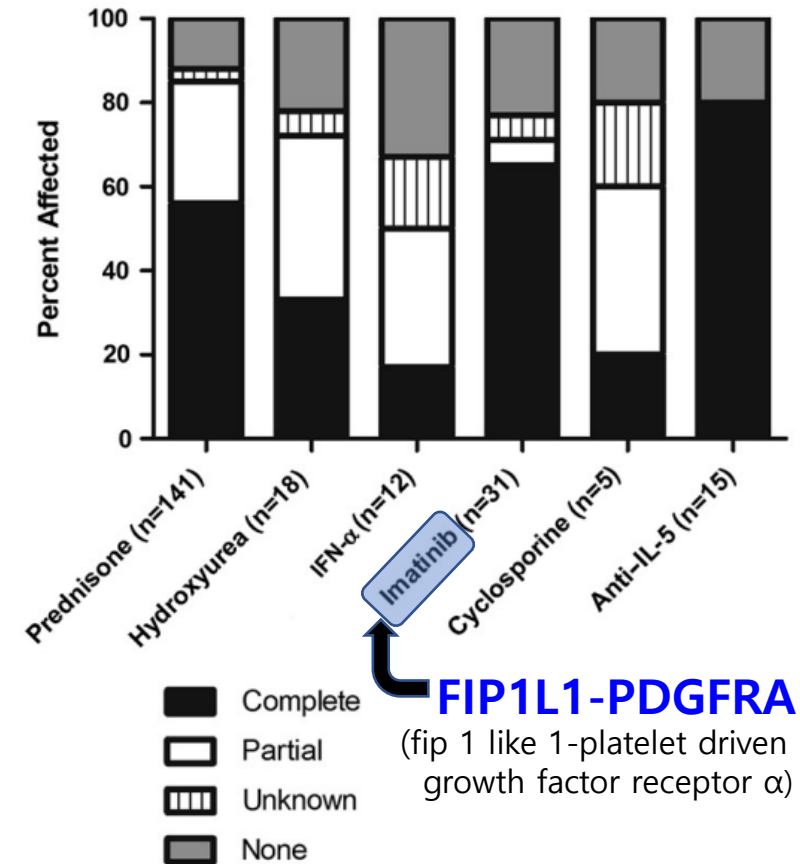


Initial



Subsequent

Treatment response

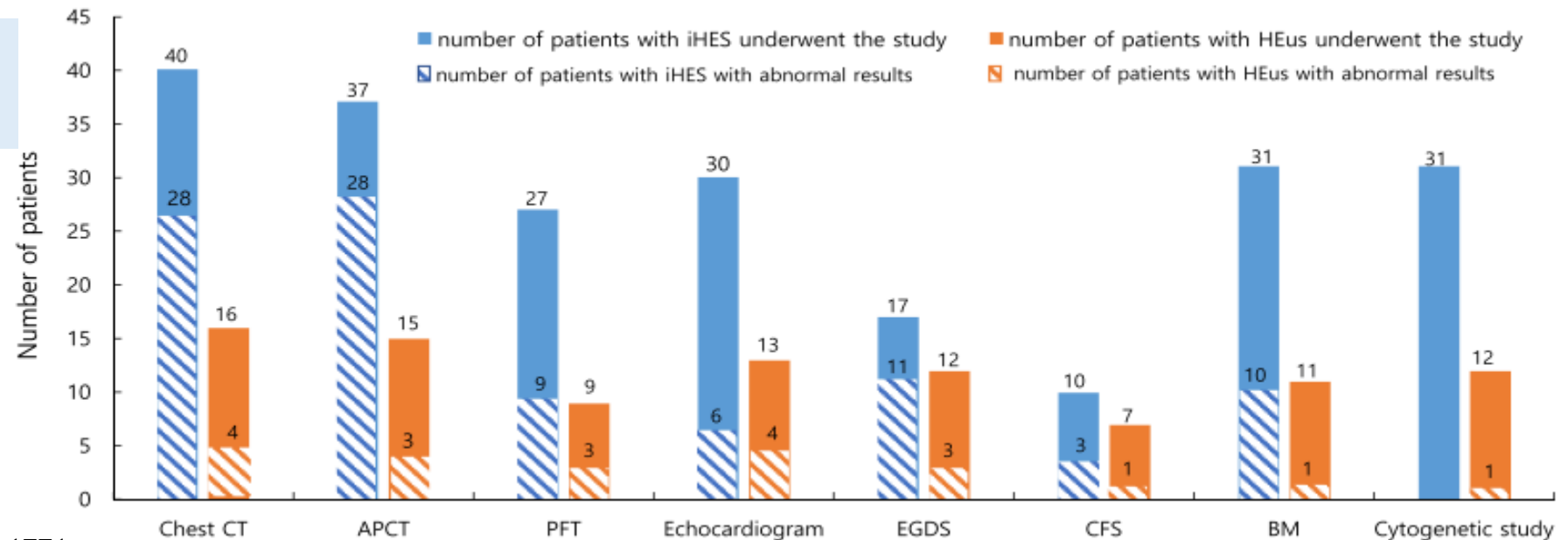


Idiopathic hypereosinophilia - a multicenter retrospective analysis

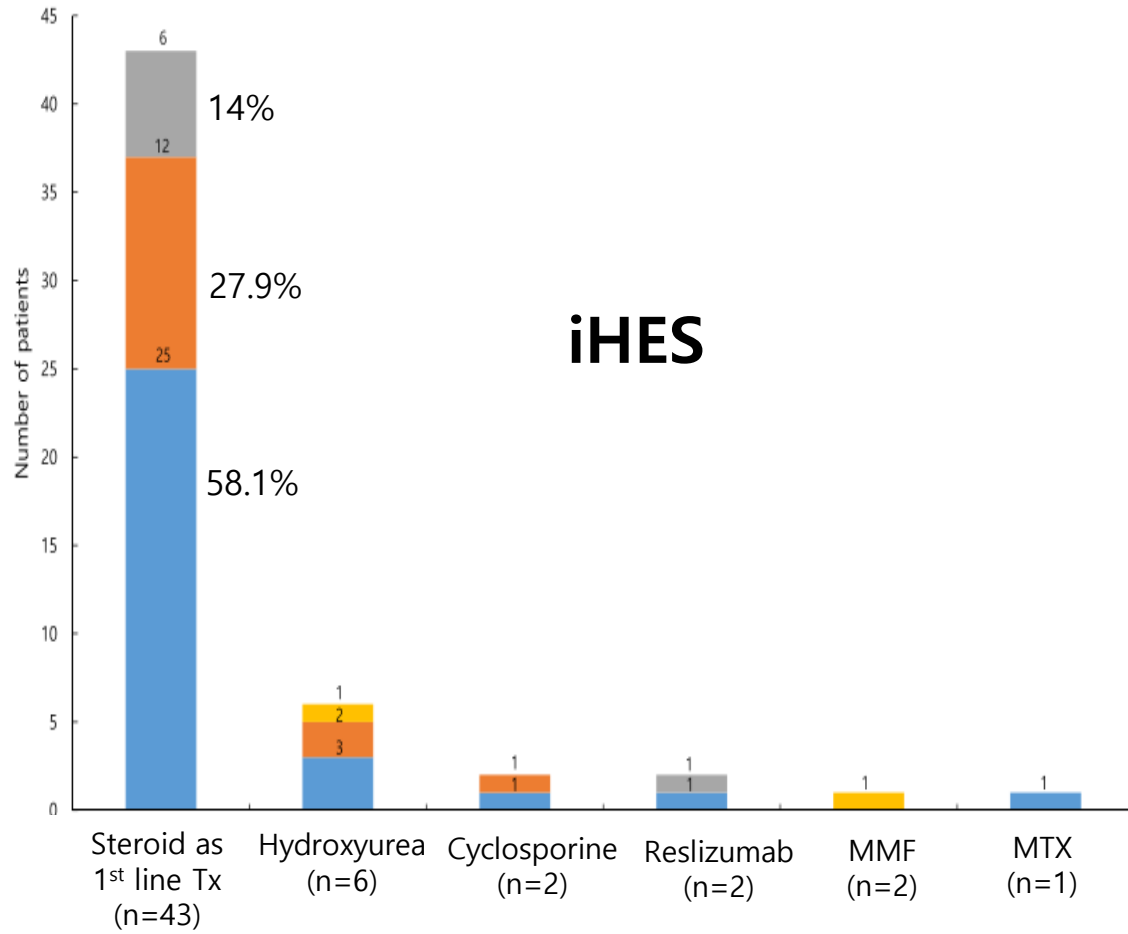
Total n=73
(2010.1~2021.6)

Clinical Manifestations	iHES N=45, (%)	HEus N=28, (%)	Description of Clinical Symptoms and/or Organ Dysfunction
Cutaneous	22 (48.9)	5 (17.9)	Urticaria, angioedema, pruritus, rash, vesicle or bullae, nodular and/or mass like lesion
Pulmonary	27 (60)	4 (14.3)	Cough, dyspnea, pleural effusion, sputum, pulmonary infiltration
Gastrointestinal	27 (60)	4 (14.3)	Abdominal pain, nausea, vomiting, dyspepsia, diarrhea, colitis, ascites, liver infiltration
Cardiac	6 (13.3)	0 (0.0)	Chest pain, heart failure, cardiomyopathy, myocarditis, pericardial effusion, endocarditis
Neurologic	6 (13.3)	1 (3.6)	Vertigo, dizziness, neuropathy
Rheumatologic	1 (2.2)	1 (3.6)	Arthritis, arthralgia, myalgia
Hematologic	20 (44.4)	4 (14.3)	Anemia, thrombocytopenia, thromboembolism, bone marrow abnormality
Constitutional	10 (22.2)	0 (0.0)	Fever, weight loss, malaise, fatigue

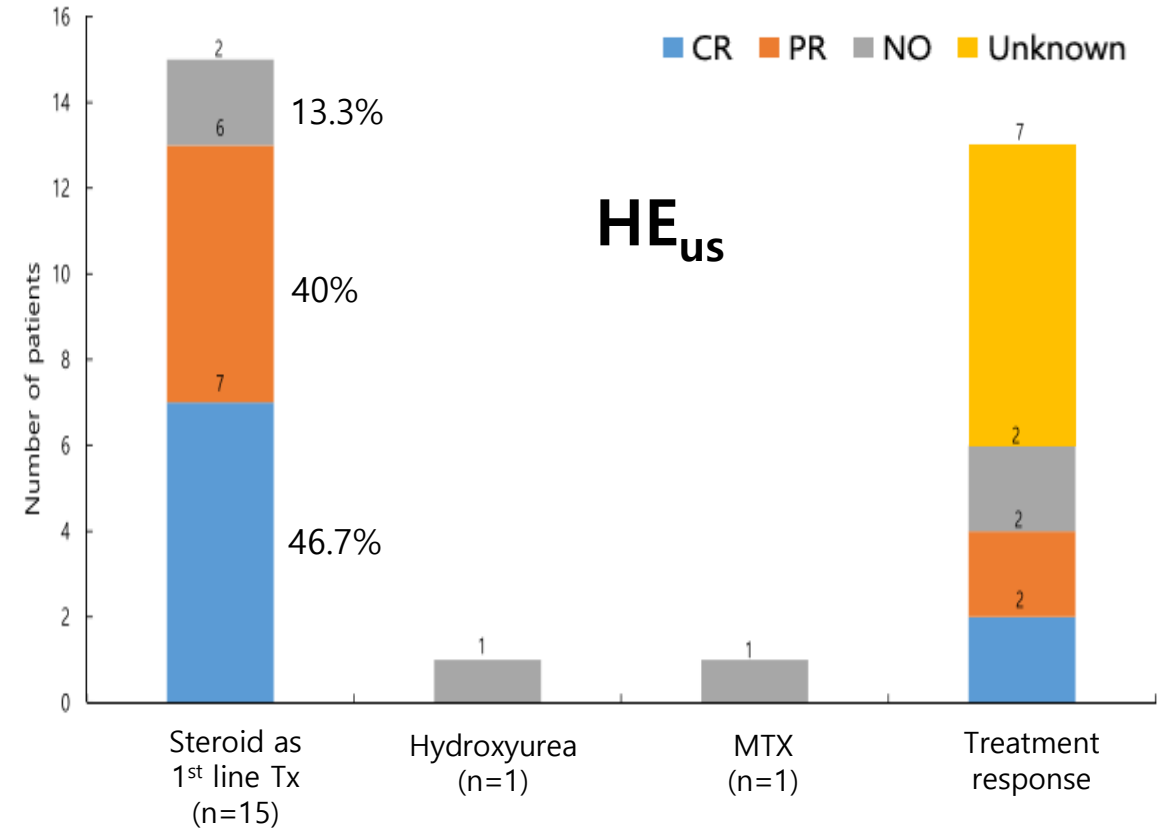
Evaluation of organ involvement



Treatment response



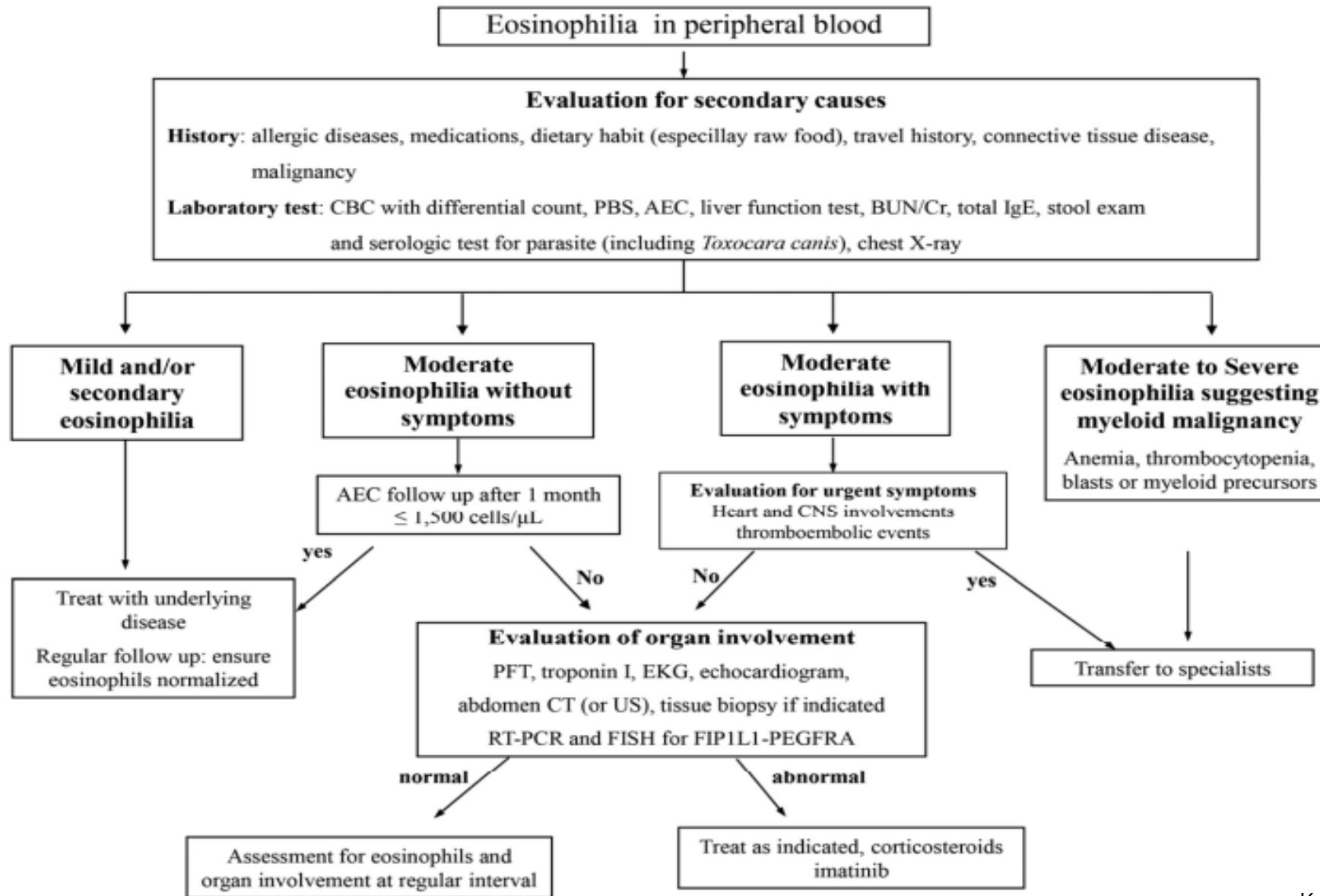
95.6%

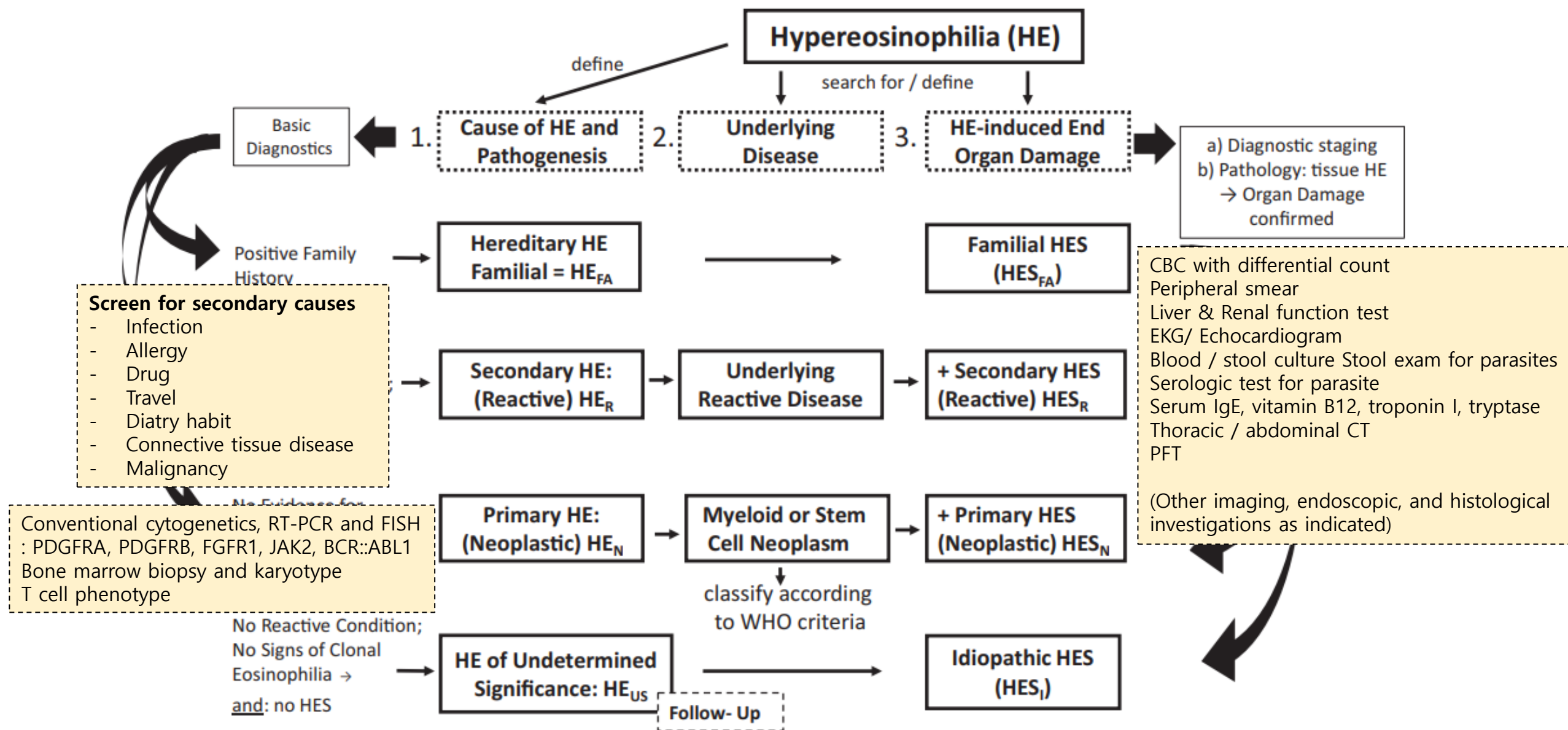


53.6%

46.4%

Diagnostic approach of eosinophilia





Anti-eosinophil biologics

HES
↑

PDGFRA (-) HES (phase 2)
↑

Molecule	Mepolizumab	Reslizumab	Benralizumab	Dupilumab	Omalizumab	Tezepelumab
Target	IL-5	IL-5	IL5R	IL4/13R α	IgE	TSLP
Inhibition of eosinophils	Direct	Direct	Direct	Indirect	Indirect	Direct
<i>Eosinophils in</i>						
Peripheral blood	↓↓	↓↓	↓↓↓	↓ (↑ ^a)	↓	↓↓
Airway/lung tissue	±	↓	↓↓↓	↓	±	↓↓
Sputum	↓	↓	↓↓	↓	↓	↓
BALF	↓	↓	↓↓	?	↓	↓↓
Oesophagus	↓	↓	↓ ^b	↓↓	∅	?
Duodenum	∅	?	↓↓	?	↓	?
Bone marrow	↓	↓	↓↓	∅	?	?
Residential lung eosinophils	∅	∅	Possible ↓	∅	∅	?

Summary

- **Eosinophilia**

- Absolute eosinophil count

- **다양한 원인**

- primary, secondary (m/c), idiopathic....
allergic disease, drug, parasite...

- **장기 침범 여부**

- 무증상
- 피부, 폐, 심장, 위장관, 신경...