Viral infections in children

Regina Fölster-Holst, Kiel

Munkebjerg 14-16 januar 2026

Conflicts of interest

Abbott
AbbVie
Allergika
Celltrion
Chiesi
Insight Immunology
La Roche Posay
Leo Pharma
Novartis
Pierre Fabre
Pfizer
Regeneron
Sanofi
UCB

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No influence on the following talk

Focal points

- Direct inoculation of viruses
- Viral exanthems
- Viruses in relation to other diseases

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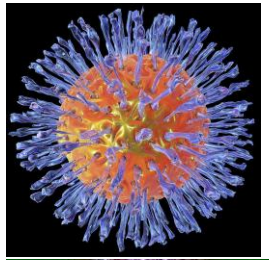
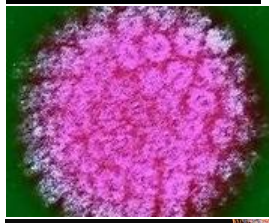
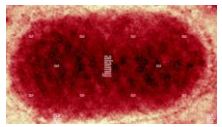
- Direct inoculation of viruses
- Viral exanthems
- Viruses in relation to other diseases

Direct inoculation

- Herpes viruses (HSV)
- Human papillomavirus (HPV)
- Molluscum contagiosum (MC)
- Parapoxvirus ovis (Orf virus)







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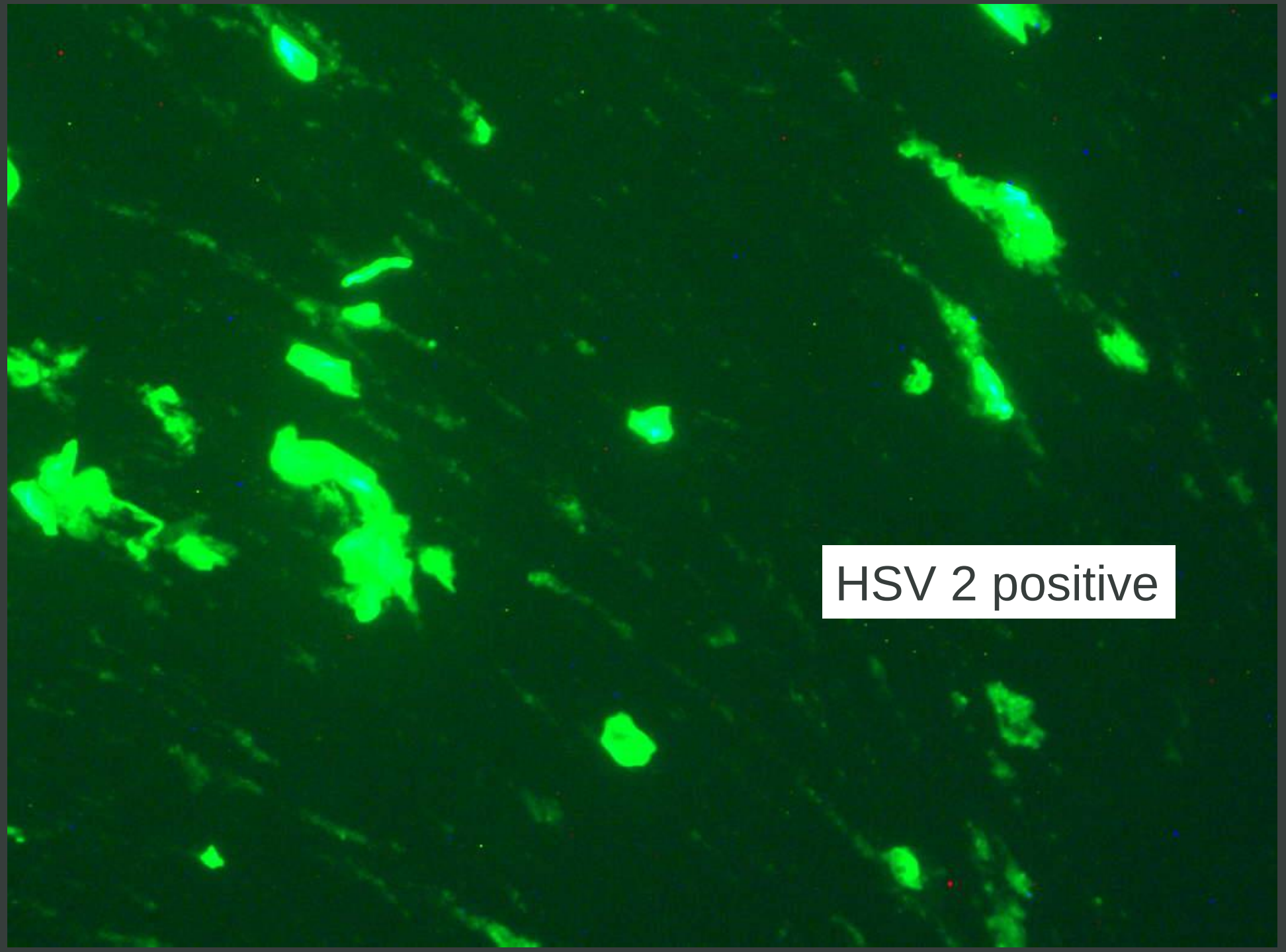
Gingivostomatitis herpetica

- Most primary HSV infections are asymptomatic
- Mainly infants and preschool children are affected
- Oral and perioral involvement,
- Problems: fever, eating and drinking difficulties, secondary bacteremia, dehydration
- Supportive therapy (analgesics, fluids), in severe cases Acyclovir (capsules or suspension), in immunocompromised patients intravenously

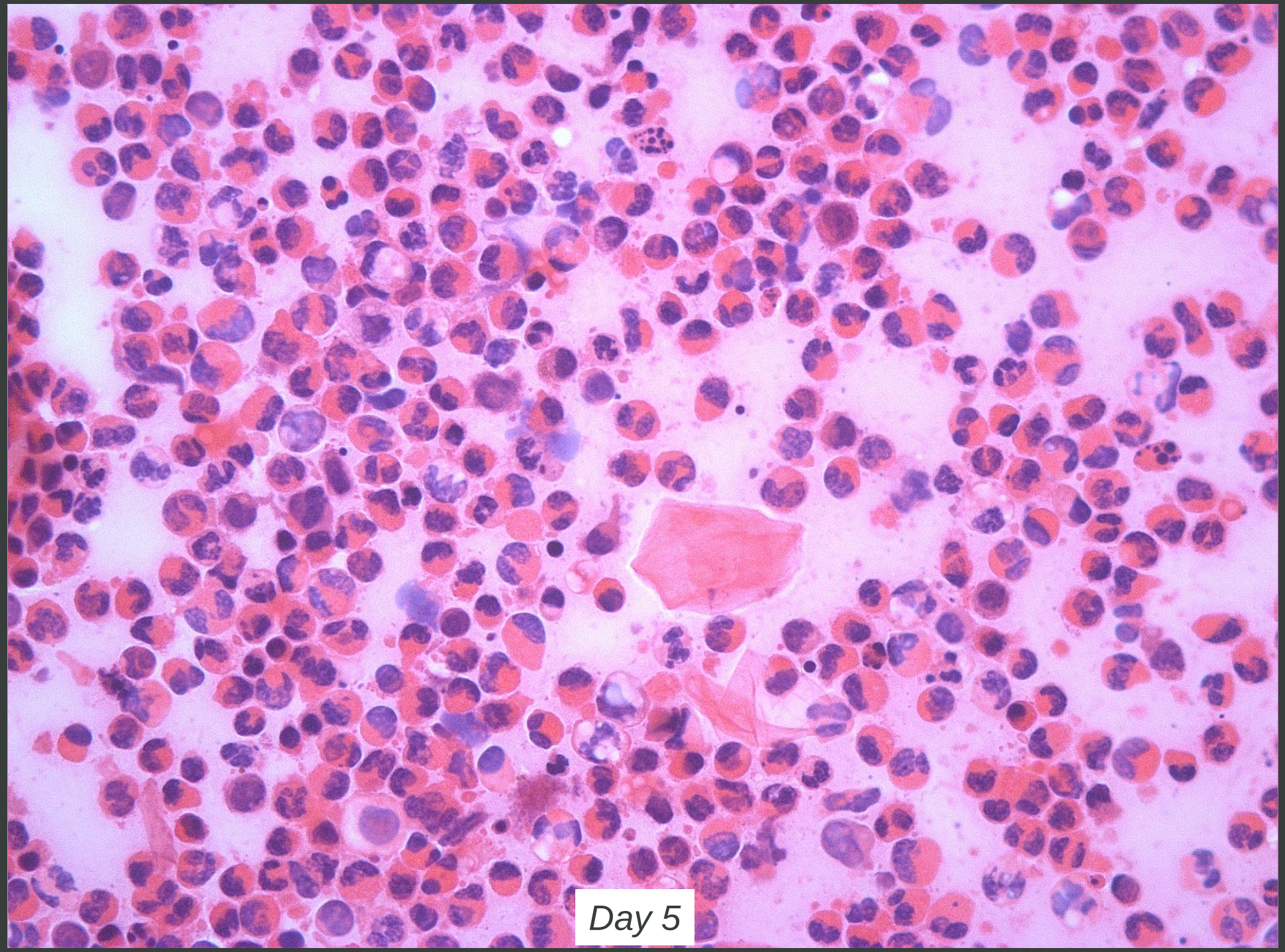
Day 2


HSV 2 positive

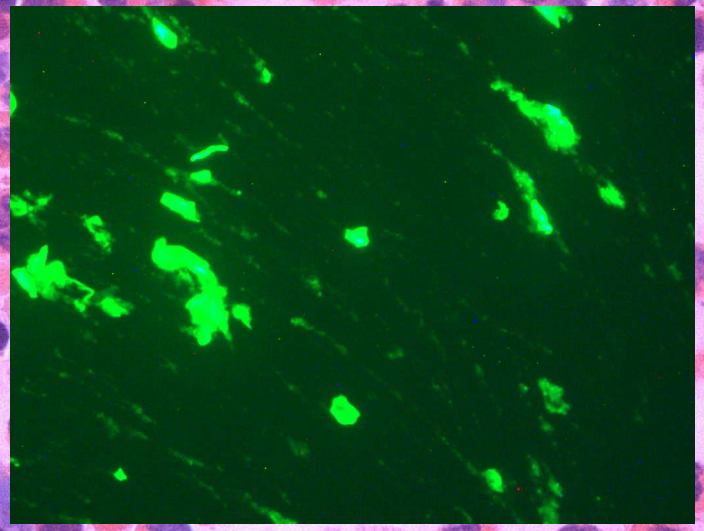
Blood counts of the first 15 days

Städtisches Krankenhaus Kiel GmbH
Laboratoriumsmedizin und Mikrobiologie
Kinderklinik Kiel

HAMATOLOGIE	Tag 1		Tag 6	Tag 9	Tag 13	Tag 15			
Material:	EDTA-V		EDTA-V	EDTA-V	EDTA-V	EDTA-V			
Leukozyten	+22.7		+18.8	+18.3	+20.8	+23.5		1000/µl	6.5 - 15
Erythrozyten	5.3							Mio/µl	4.3 - 6.3
Erythrozyten			5.2	4.9	4.8	4.7		Mio/µl	3.9 - 5.9
Hämoglobin	18.6							g/dl	15.2 - 23.5
Hämoglobin			17.7					g/dl	15.0 - 24.0
Hämoglobin				16.7	15.9	15.8		g/dl	11.7 - 18.7
Segmentkernige	62							%	39 - 74
Segmentkernige			28	39	33			%	20 - 60
Segmentkernige						21		%	15 - 60
Segmentkernige, abs.	+14.1		5.3	7.1	6.9			1000/µl	2,0 - 10,0
Segmentkernige, abs.						4.9		1000/µl	1,5 - 6,5
Lymphozyten	18		35	36	43			%	18 - 55
Lymphozyten						35		%	18 - 65
Monozyten	13		13	11	9			%	2 - 20
Monozyten						17		%	5 - 20
Eosinophile	5		+13	+12	+15			%	0 - 8
Eosinophile						+27		%	0 - 5
Basophile	0		0	0	0			%	0 - 2.5
Basophile						0		%	0 - 1.2
Stabkernige	-2		-3					%	7 - 11


Day 5

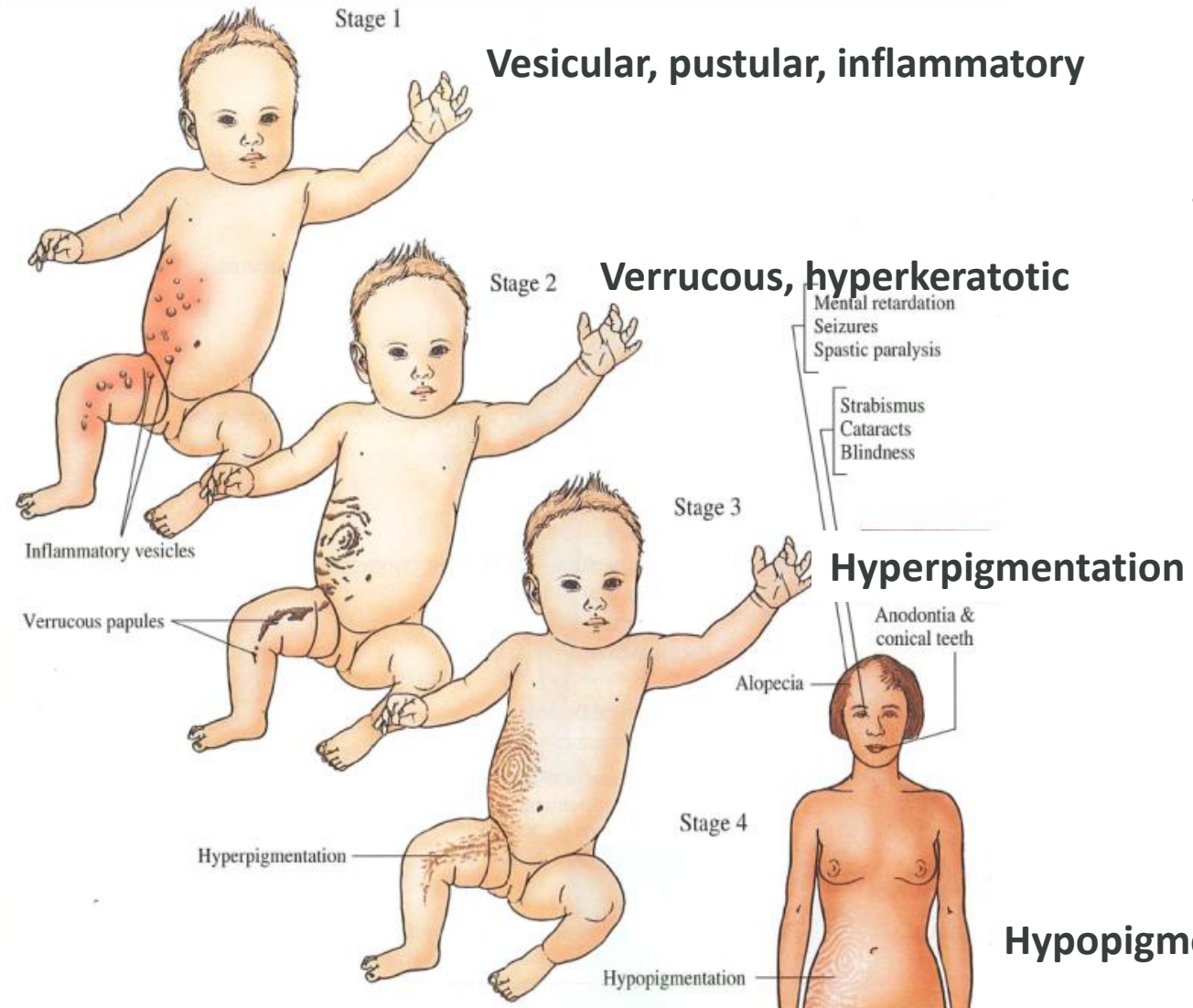
When using the diagnostics of immunofluorescence, fluorescein (isothiocyanate) binds to the major basic protein of the eosinophils, this leads to non-specific fluorescence and thus to a **false positive result**. Therefore, a **herpes PCR is essential** for definitive differentiation, that was negative.



Detlefs RL et al, Pediatr Dermatol 1987
Rosenthal A-C, Fölster-Holst R, JDDG

Day 5

Stages



Vesicular, pustular, inflammatory

Verrucous, hyperkeratotic

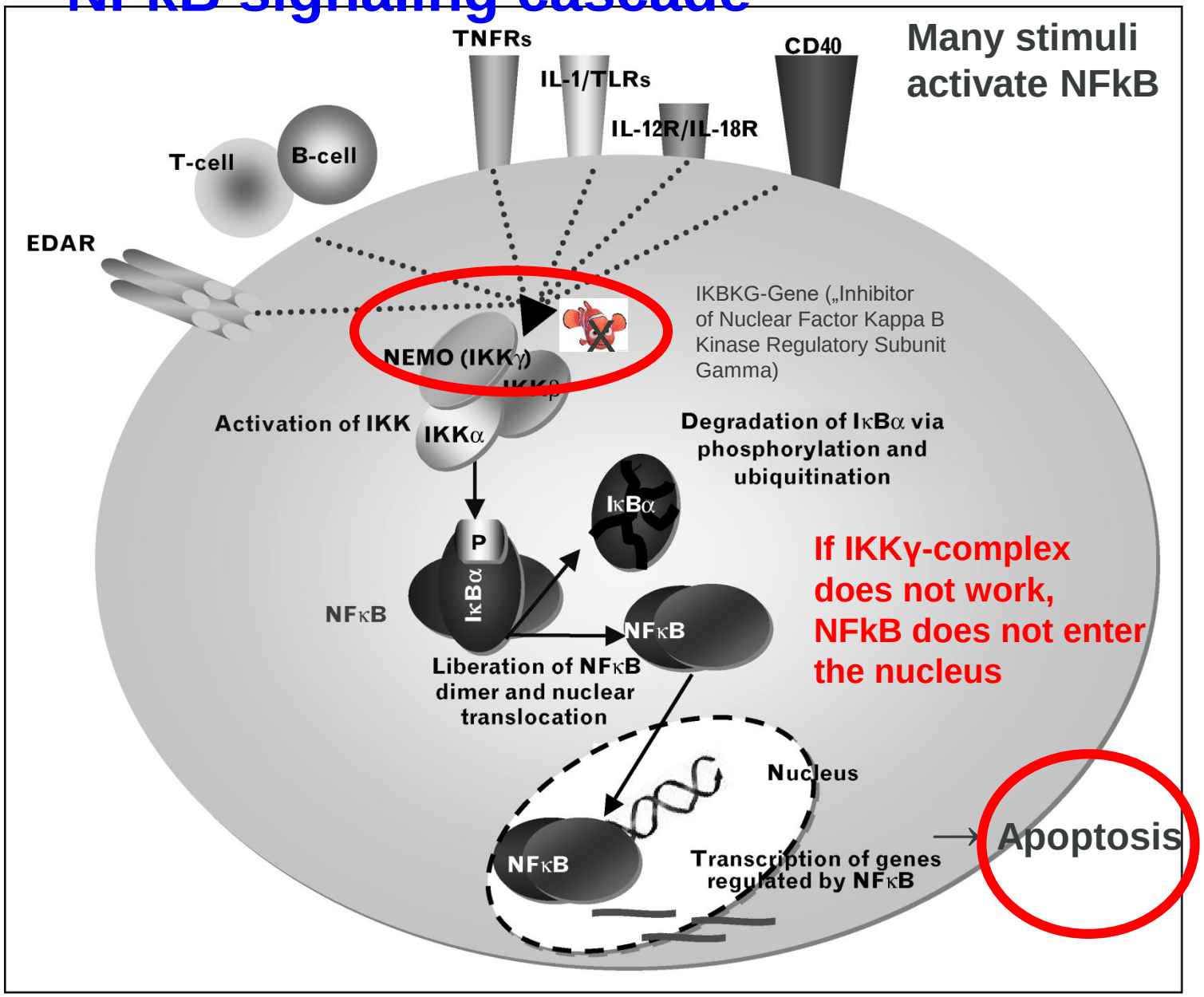
Hyperpigmentation

Hypopigmentation

Check-up

Differential blood
Ophthalmology
Teeth
EEG/MRI
Echocardiography
Orthopedic

NFkB signaling cascade



Uzel, Current Opinion in Allergy and Clinical Immunology 2005

Direct inoculation

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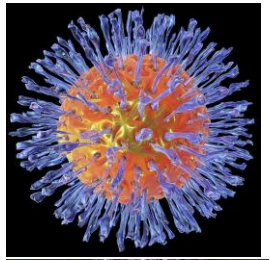

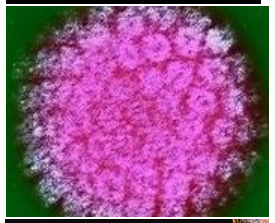

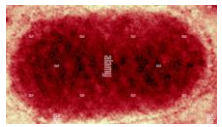

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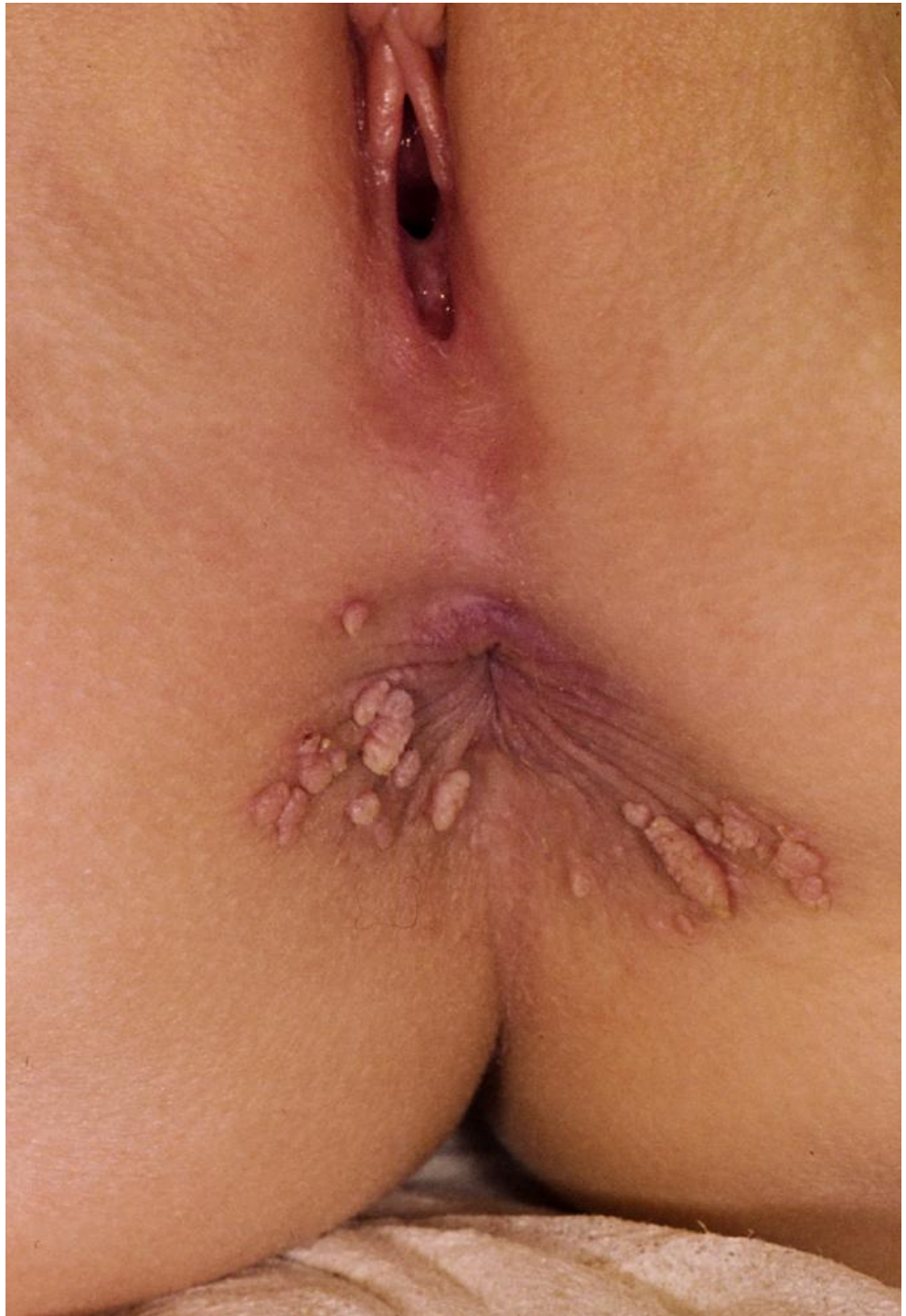
Heck disease
(Focal epithelial Hyperplasia)

- Benign familiar disease of the oral mucosa, more common in Asien as in Europe
- Cause: **HPV**, v.a. **13** und **32**
- Multiple verrucous, white papules
- **High spontaneous regression**
- Treatment modalities: Topical imiquimod, intralesional interferons, surgical excision, diathermy, CO_2 laser, diode laser, systemic retinoids

Thangaraj R, Misra S. Indian Pediatr. 2023



Condylomata acuminata (HPV 6,11) in childhood

- HPV 2 is also a common cause
- Routes of transmission
  - Autoinoculation
  - Heteroinoculation
  - mainly non-sexual transmission of genital HPV-types
- Therapy
  - Watchful waiting
  - Imiquimod
  - Curettage

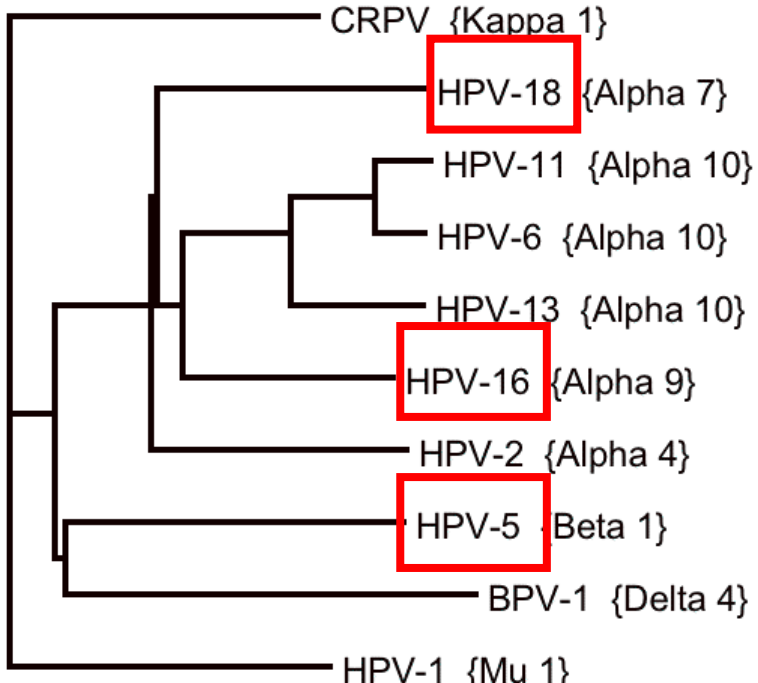
Verrucae and association to HPV types

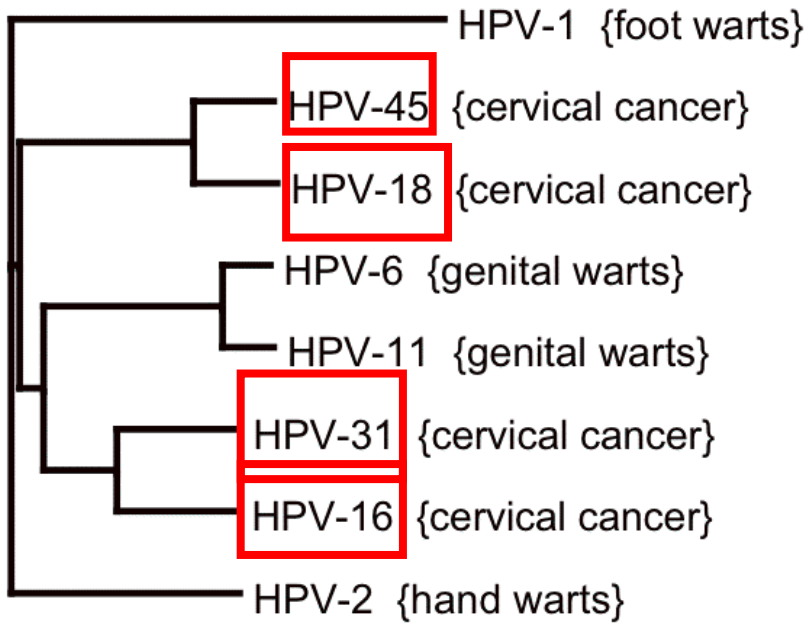
- Common warts: HPV types 2,4 (most common), followed by types 1, 3, 27, 29, 57
- Flat warts: HPV types 3, 10, 28
- Deep palmoplantar warts: HPV 1 (most common) followed by types 2, 3, 4, 27, and 57
- Condylomata acuminata types 6,11
- Focal epithelial hyperplasia: HPV 13, 32
- Butcher's warts: HPV 7

Al Aboud AM et al, Wart. 2021. In: StatPearls [Internet].

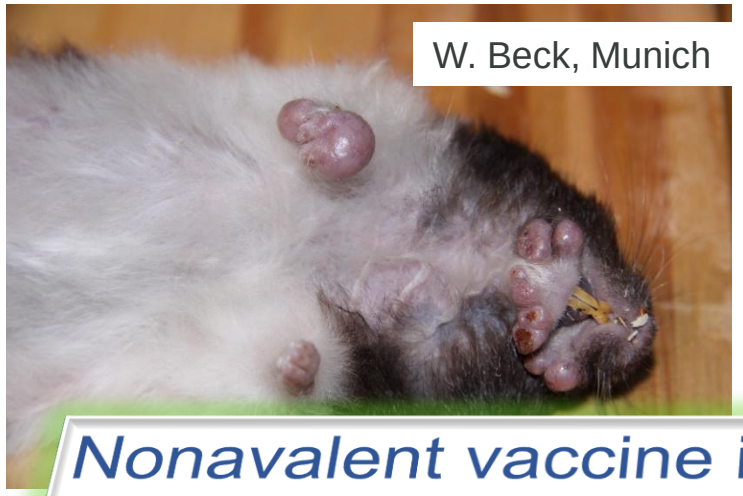
Carcinogenic HPV types

16, 18 and
31, 33, 35, 39, 45,
51,52, 56, 58, 59



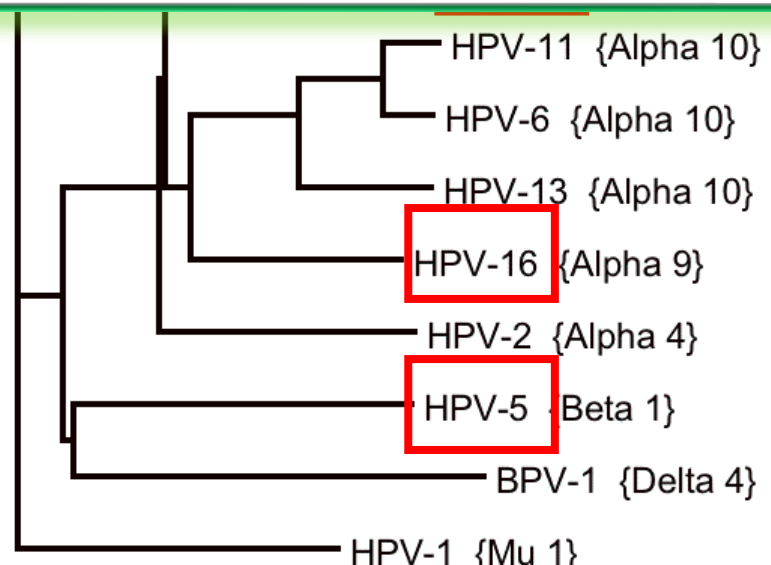


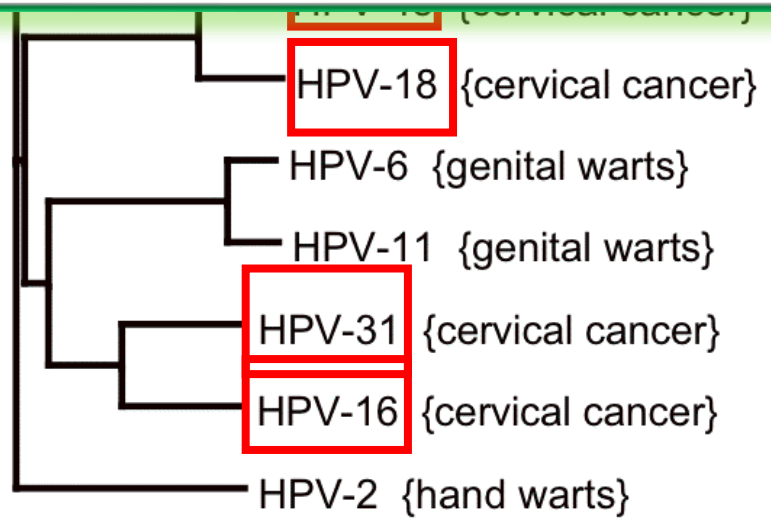
Carcinogenic HPV types



16, 18 and
31, 33, 35, 39, 45,
51,52, 56, 58, 59

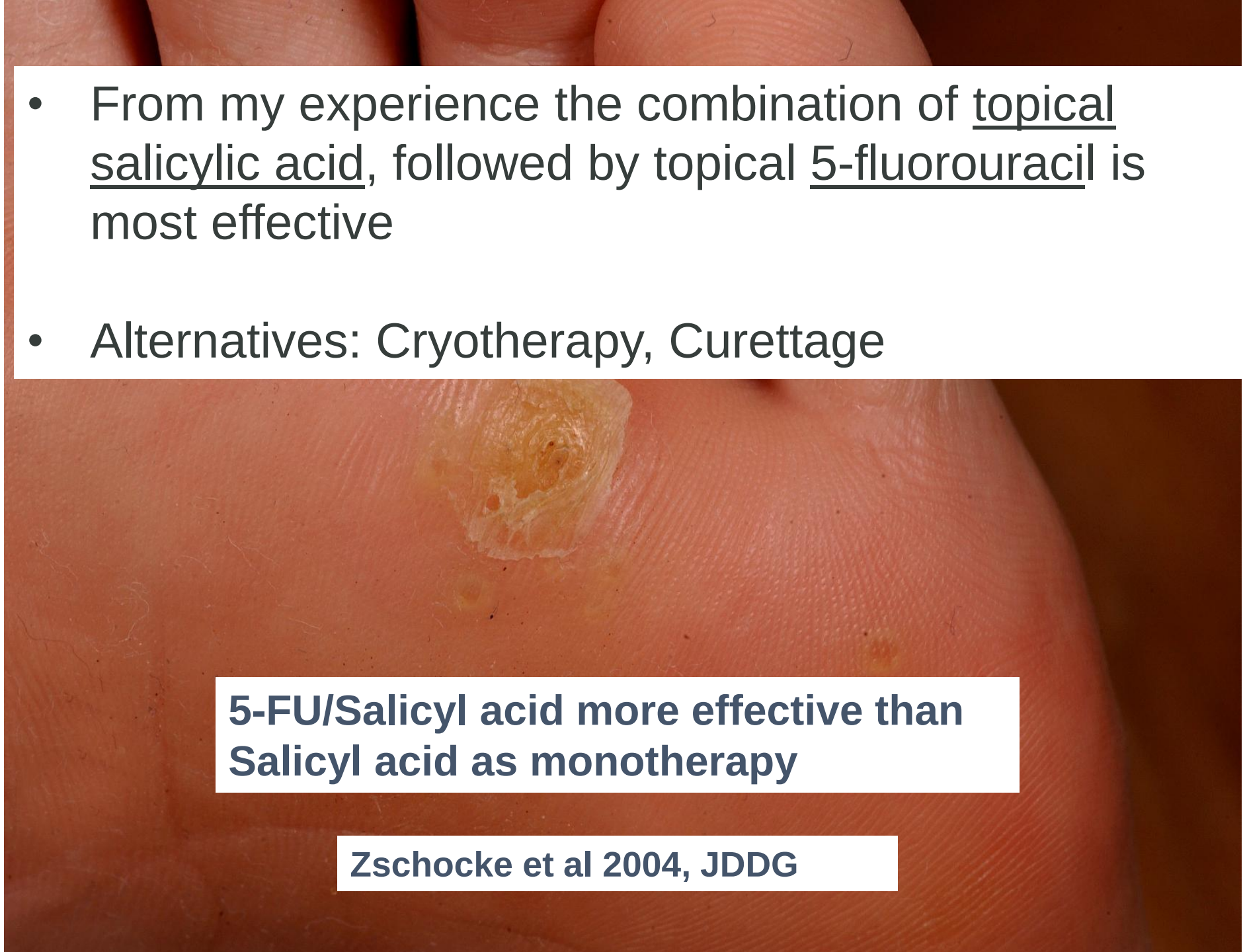
Nonavalent vaccine includes: 6,11,16,18, 31,33,45, 52,58
Recommendation for girls and boys at the age of 9-14 y
Significant reduction of genital warts and cervical cancers





Treatment of cutaneous viral warts –
(2/3 of warts disappear spontaneously within 24 mo!!!)

- Destructive methods
- Topical virucidal agents
- Antimitotic drugs
- Immunostimulants



- From my experience the combination of topical salicylic acid, followed by topical 5-fluorouracil is most effective

- Alternatives: Cryotherapy, Curettage

5-FU/Salicyl acid more effective than Salicyl acid as monotherapy

Zschocke et al 2004, JDDG

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(2/3 of warts disappear spontaneously within 24 mo!!!)

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A Comparative Prospective Study to Assess Efficacy of Intralesional MMR (Measles, Mumps, Rubella) Vaccine and Intralesional Vitamin D3 in Treatment of Nongenital Warts

Health Science Reports, 2025

Bibisha Baaniya | Suchana Marahatta | Raunak Dahal | Nidhi Shah

Elimination of HPV-infected cells by triggering a delayed-type hypersensitivity reaction

- MMR: stimulating a Th1-type immune response, promoting TNF-α, IL-2, IL-4, IL-5, and IFN-γ
- Vit. D3: activating toll-like receptors on macrophages, enhancing the expression of vitamin D receptor (VDR) and 1α-hydroxylase

Adverse events

- **Pain** was universal
- Swelling (60%)
- Hyperpigmentation (30%)
- Pruritus (16.7%) were more common with vitamin D3

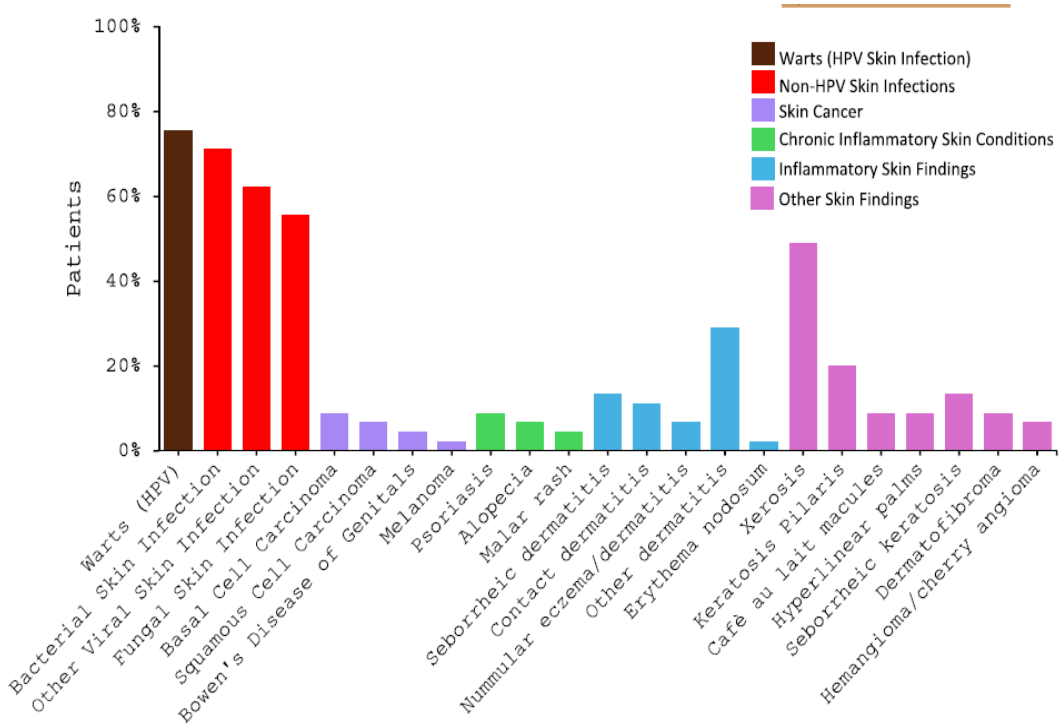
Complete clearance,
3 sessions **MMR 80.6%**

Complete response,
3 sessions **vitamin D3 73.4%,**
scar of previous electrocautery

WHIM (**W**arts, **H**ypogammaglobulinaemia, **I**nfections, **M**yelokathexis) Syndrome

- Autosomal dominant immunodeficiency, cause: mutations in the chemokine receptor gene ***CXCR4***, resulting in receptor hyperactivity

- In addition to HPV-related infections, various other **inflammatory, neoplastic and infectious diseases**

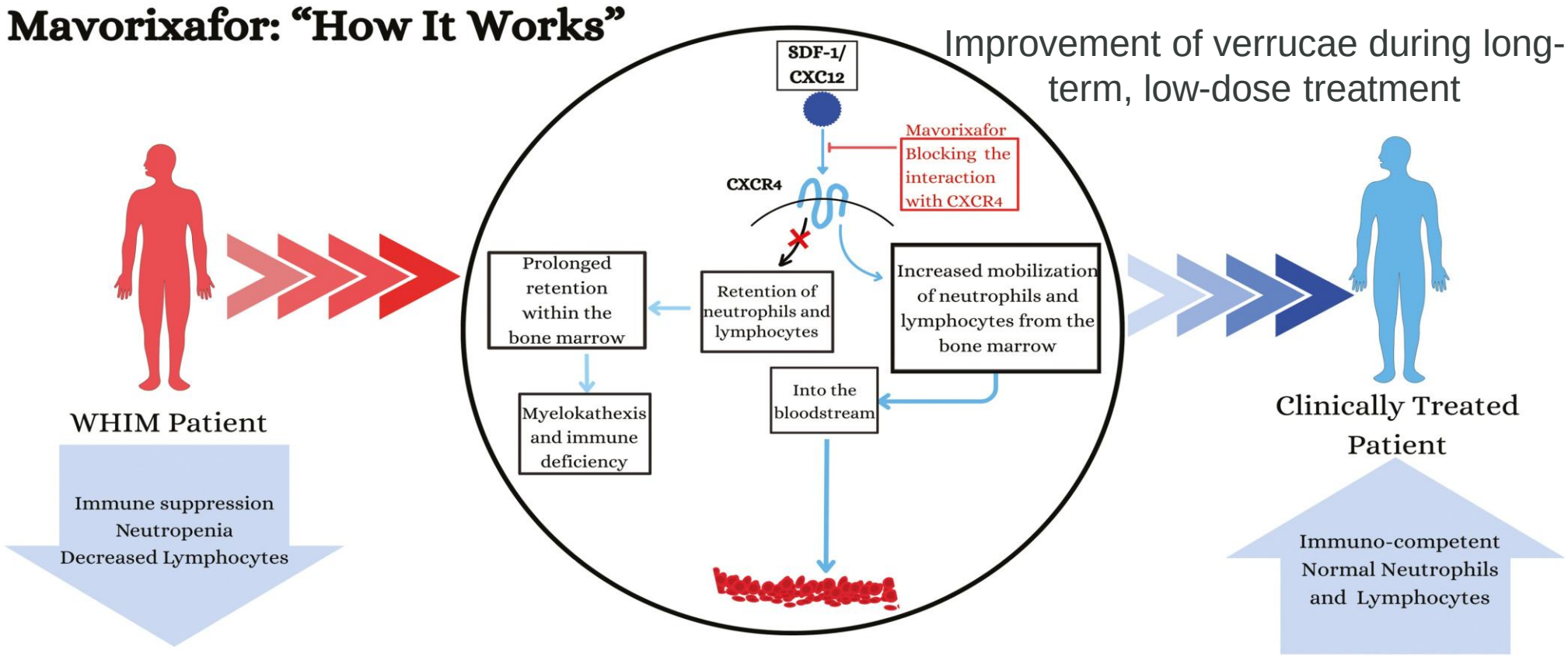


Cutaneous manifestations of WHIM Syndrome

- HPV 76% (main dermatological symptom)
- Other viruses 60% Bacteria 71%, fungi
- 56% inflammatory dermatoses (13% seborrhoeic dermatitis, 11% contact eczema, 9% psoriasis, 7% nummular eczema, 29% other eczematous dermatoses)
- 16% skin neoplasms
- Treatment: HPV vaccination, G-CSF, GM-CSF, IVIG, CXCR4 antagonist (plerixafor, mavorixafor), in exceptional cases bone marrow transplants

Adhanom et al, Dermatol. 2025

Significant increasing of Neutrophils and Lymphocytes, leading of reduction of infectious rates by 60%; severe infections occurred over 75% less frequently. Reduction in the number of verrucae by 75%.



Khan MS et al, Clin Exp Immunol. 2025

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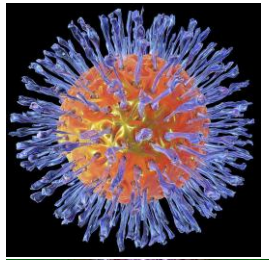

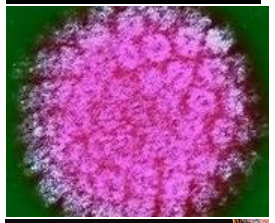

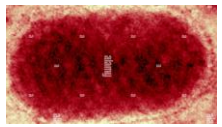

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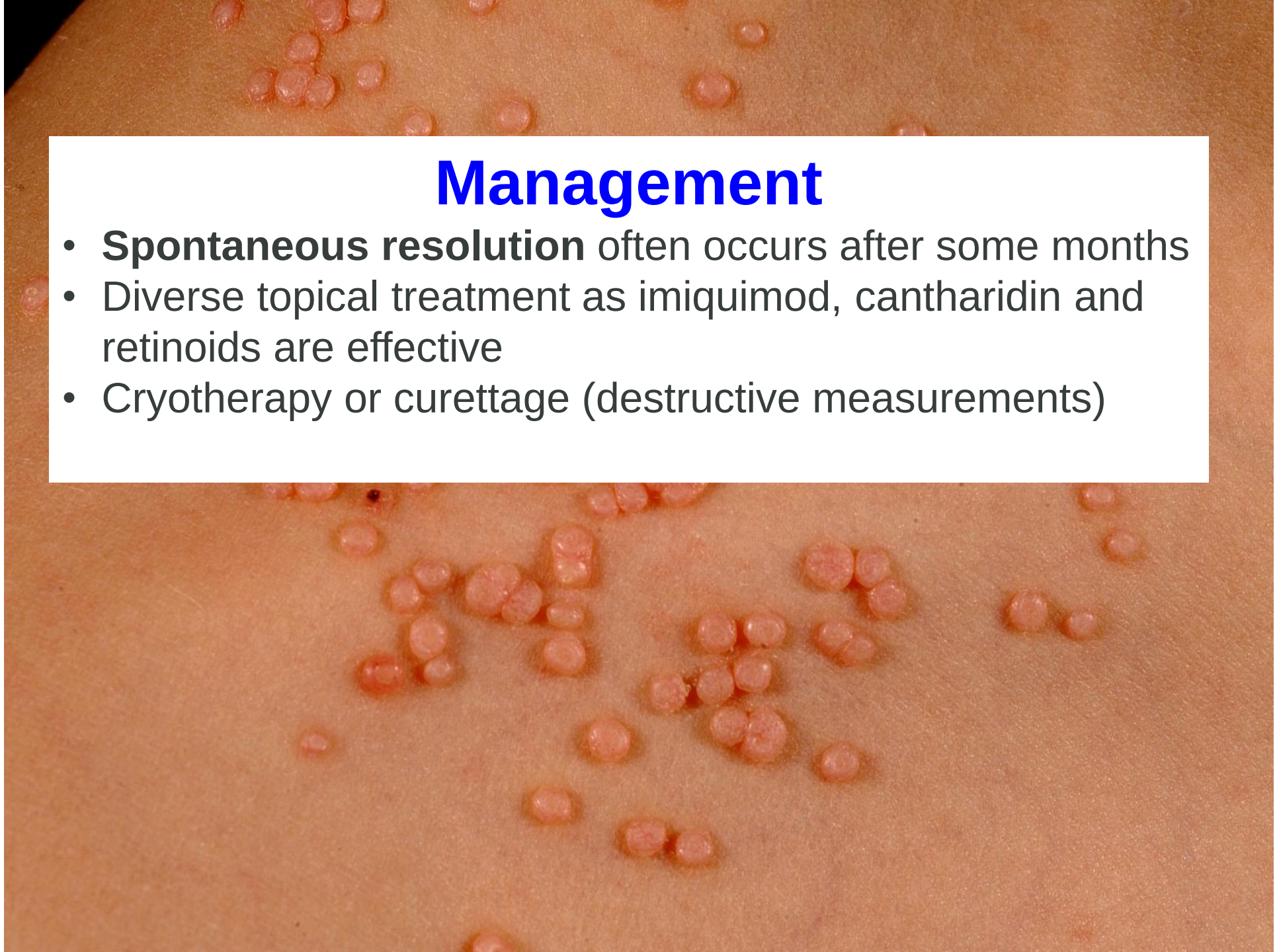


Management

- **Spontaneous resolution** often occurs after some months
- Diverse topical treatment as imiquimod, cantharidin and retinoids are effective
- Cryotherapy or curettage (destructive measurements)

SCIENTIFIC LETTER

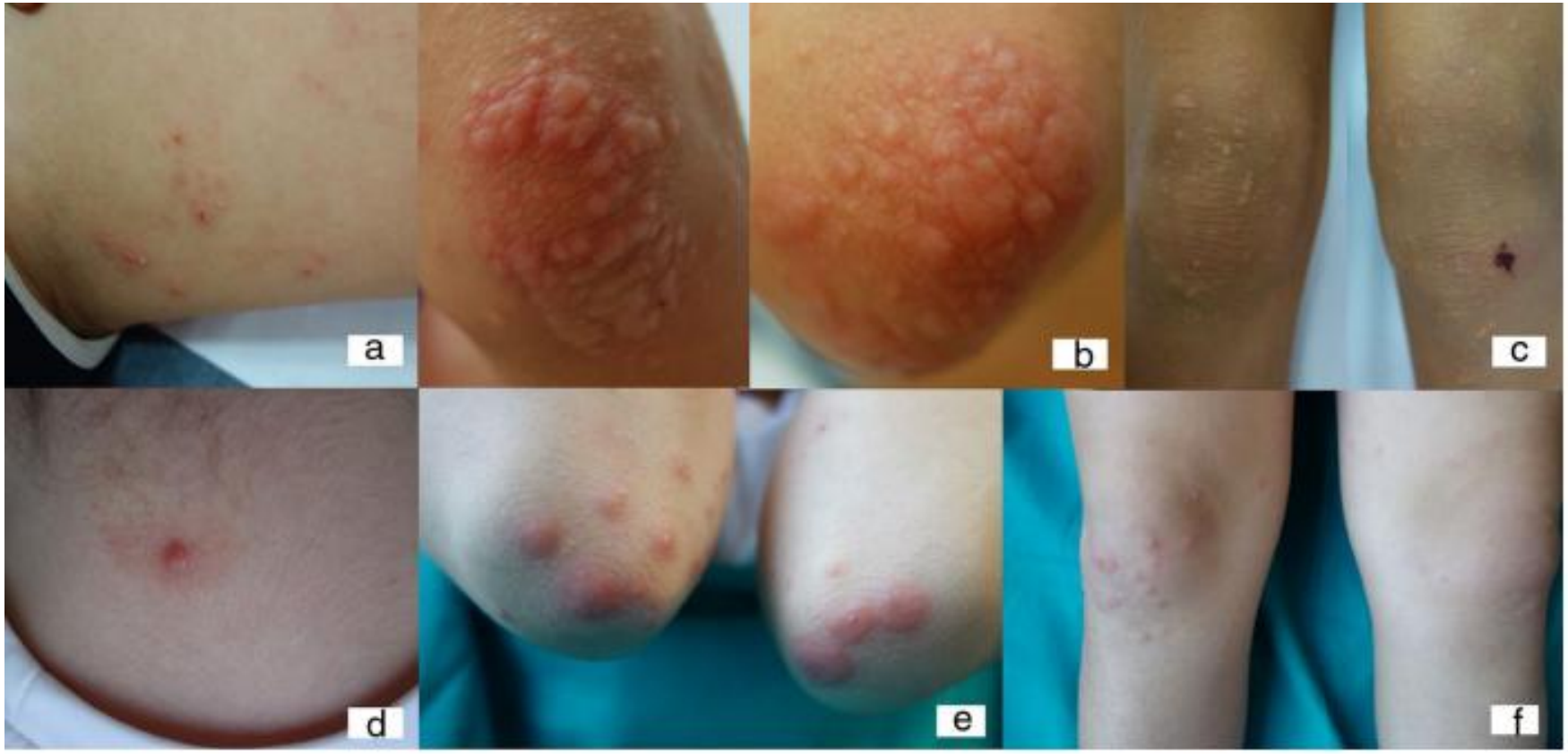
GIANOTTI-CROSTI SYNDROME-LIKE REACTION SECONDARY TO MOLLUSCUM CONTAGIOSUM☆

SÍNDROME GIANOTTI-CROSTI LIKE SECUNDARIO A MOLLUSCUM CONTAGIOSUM

Estébanez A, An Pediatr 2020

Gianotti-Crosti Syndrome like reaction vs classic GCS

- Id-Reaktion to molluscum contagiosum viruses
- Up to 5 % of children are affected
- More localised (extensor extremities)



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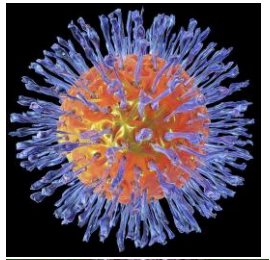

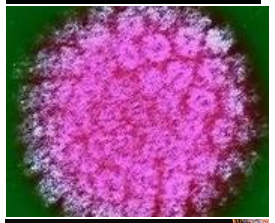

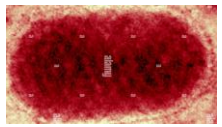

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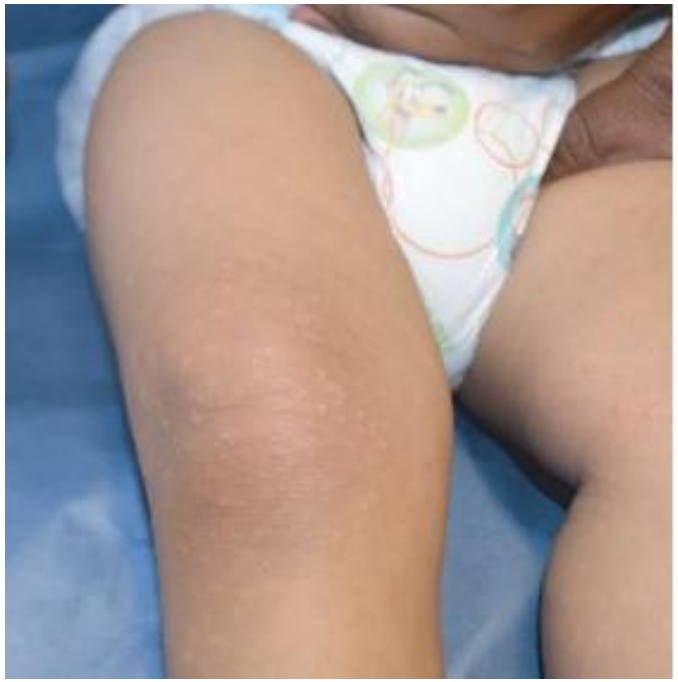
https://c8.alamy.com/comp/CT4NGA/orf-virus-tem-CT4NGA.jpg

2017 WILEY Pediatric Dermatology

Extensive orf infection in a toddler with associated id reaction

Ellen S. Haddock AB, MBA[1] | Carol E. Cheng MD[2] | John S. Bradley MD[3,4,5] | Christopher H. Hsu MD, PhD, MPH[6,7] | Hui Zhao MD[6] | Whitni B. Davidson MPH[6] | Victoria R. Barrio MD[5,8,9]

13-mo-old boy with necrotic orf lesions (after goat bite)



followed by a generalized rash some days later(goat bite)

Diagnosis of Orf is based on clinical appearance and typical history, confirmed by PCR (Parapox virus)

Orf (Ecthyma contagiosum)

- *Parapoxvirus ovis (Orf virus)*
- Disease of sheep and others (goats), developing oral and perioral lesions (scabby mouth)
- Diagnosis is made by typical history of exposure and clinical appearance (usually solitar, clinical stages: macule, papule, vesicle, pustule, papilomatous or warty lesions)
- Healing occurs over 4-8 wks, in cases of secondary bacterial infection antibiotics are recommended

Orf (contagious ecthyma) transmitted by a cat

Victoire Laumondais[1] | Muriel Delhomme[2] | Laurent Misery[1]

JEADV Clin Pract. 2024;1–2.

Focal points

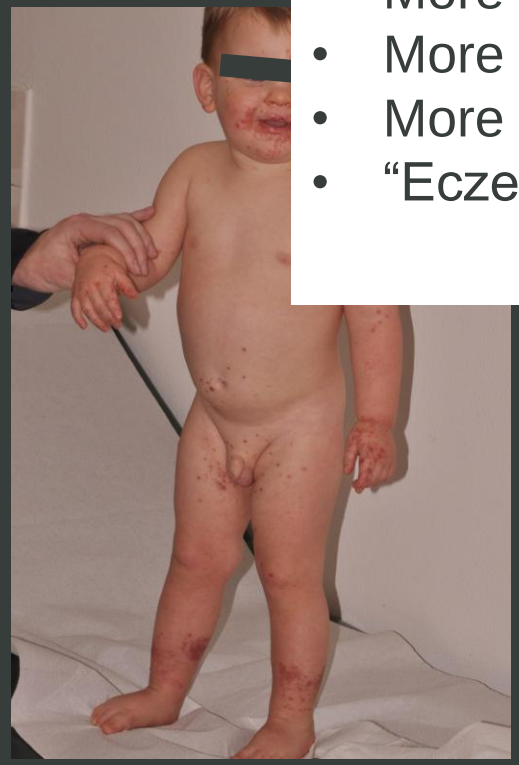
- Direct inoculation of viruses
- Exanthems
- Viruses in relation to other diseases

Exanthems by Enteroviruses

CoxA6 (atypical)

vs CoxA16 (classical)

- More common
- More polymorph
- More extended
- More severely impaired general condition
- “Eczema coxsackium” in patients with Atopy



Fölster-Holst, Acta Derm Venereol. 2018 Mar 13;98(3):303.
Thielking, Fölster-Holst, J Dtsch Dermatol Ges. 2017 Feb;15(2):224-226.

Incontinentia pigmenti (IP) coxsackium

- Infections (including Coxsackie A6), fever and vaccines are trigger factors for reactivation of IP
- The skin lesions of atypical HFME occur in the previously vesicular areas of the IP
- Barrier defects and a reduced immune response are discussed as causes

Jefferson, Grossberg, Pediatr Dermatol. 2016 Sep;33(5):e280-1.

Paraviral Exanthems

- Response of the immune system to an infection
- Distinct diseases
- Many different viruses are associated with exanthem

Paraviral exanthems

- Gianotti-Crosti-Syndrome
- Pityriasis rosea
- Pityriasis lichenoides
- Asymmetric periflexural Exanthema
- Papular purpuric gloves and socks syndrome
- Eruptive Pseudoangiomatosis
- Eruptive Hypomelanosis

Fölster-Holst, Expert Rev Anti Infect Ther. 2016

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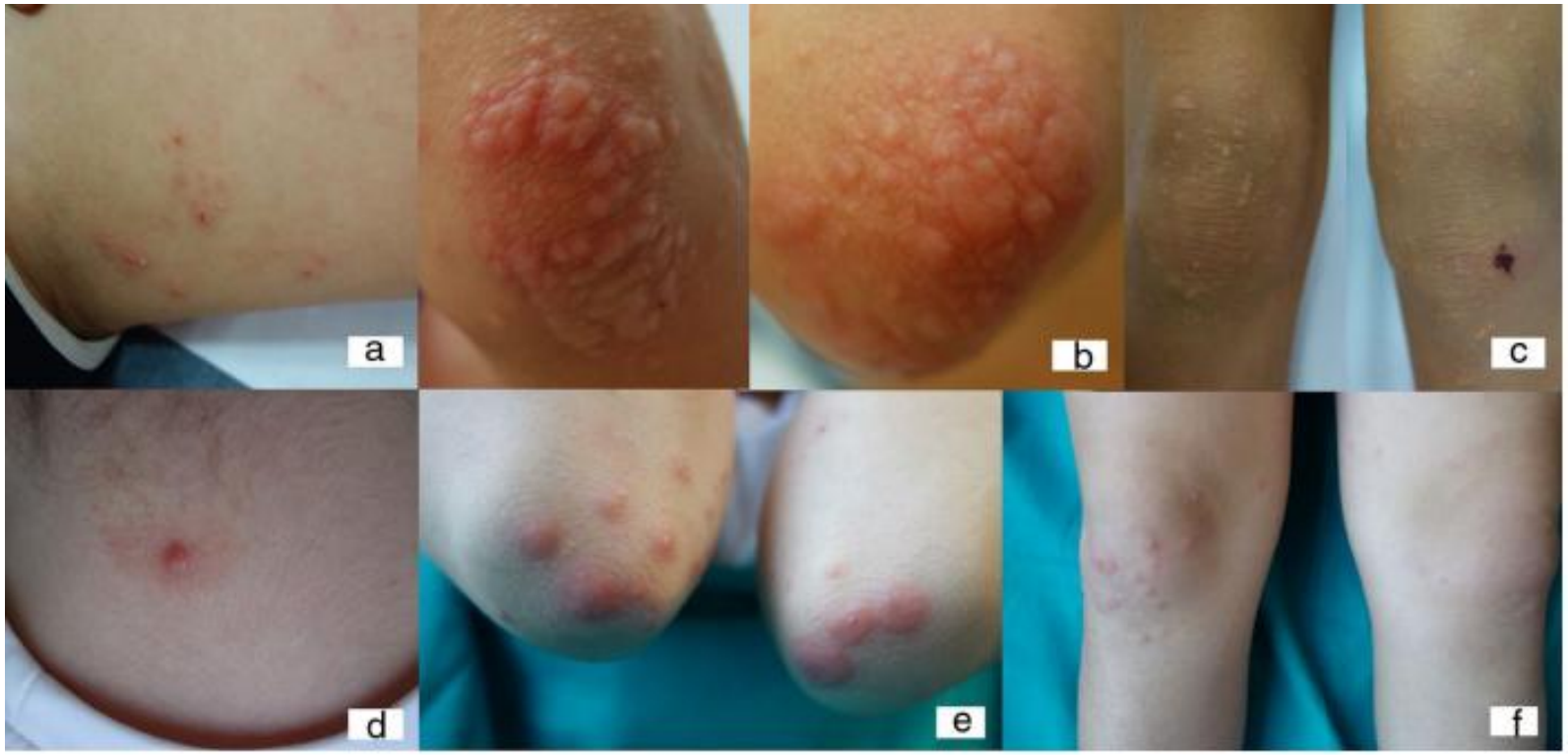
- **Id-reaction to mollusca contagiosa viruses**
- More localized
- More itchy

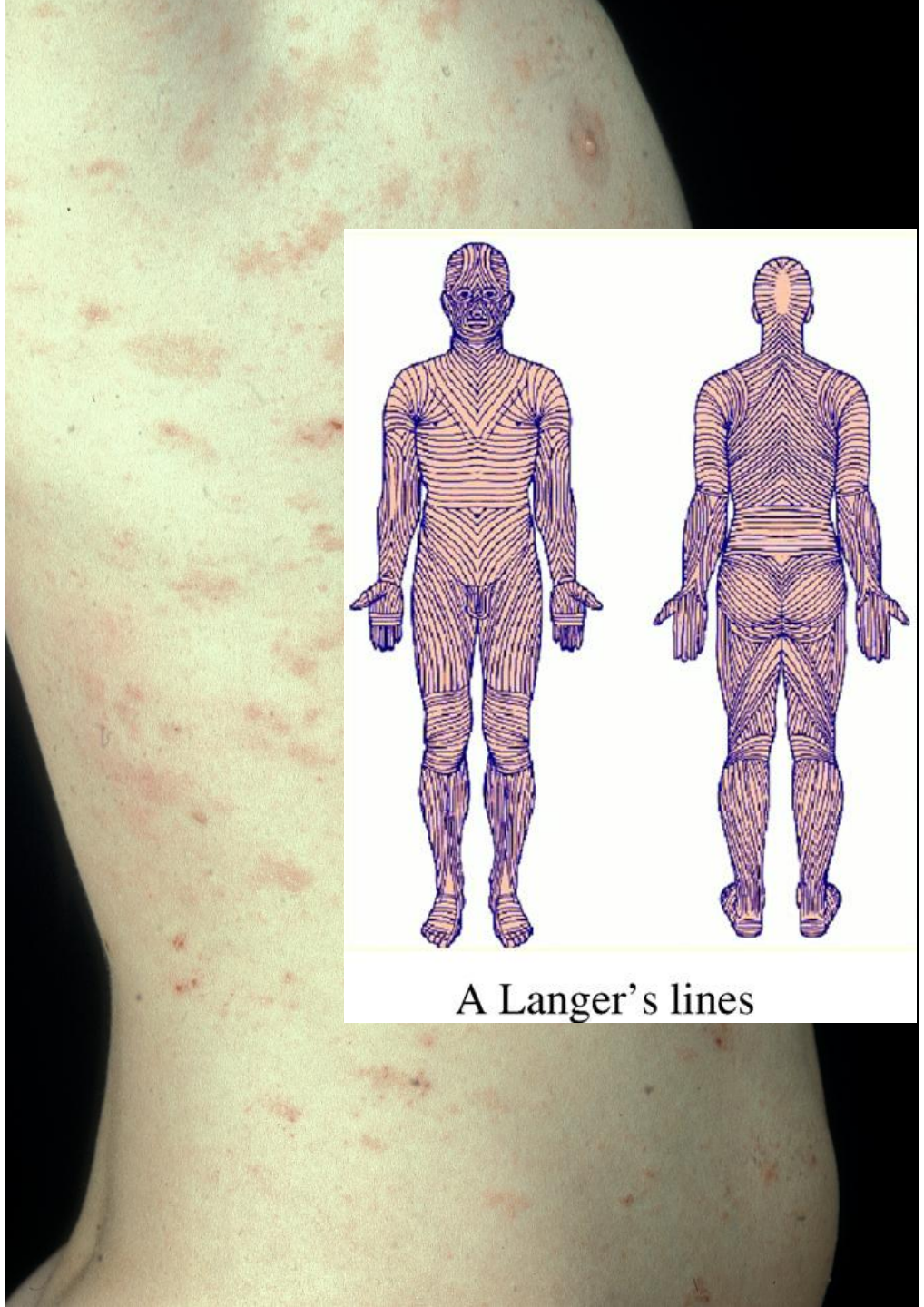


Estébanez A et al., An Pediatr (Engl Ed). 2020 Jul;93(1):49-50

Paraviral exanthemas

- Gianotti-Crosti-Syndrome
- Pityriasis rosea
- Pityriasis lichenoides
- Asymmetric periflexural Exanthema
- Papular purpuric gloves and socks syndrome
- Eruptive Pseudoangiomatosis
- Eruptive Hypomelanosis

Fölster-Holst, Expert Rev Anti Infect Ther. 2016



Fölster-Holst, R., Christophers, E. Exantheme im Kindesalter Teil I: Exantheme durch Viren. Hautarzt 50, 515–531 (1999).

Paraviral exanthemas

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International Journal of TROPICAL DISEASE & Health
13(3): 1-4, 2016, Article no.IJTDH.22992
ISSN: 2278–1005, NLM ID: 101632866

SCIENCEDOMAIN *international*
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Unilateral Mediothoracic Exanthem – Report of the Third Patient in the Literature

Antonio Chuh[1*] and Vijay Zawar[2]

Eruptive Pseudoangiomatosis

Associated with Echo-, Adeno-, EBV- and Parvovirus B19, spontaneous regression after 4-6 wks

Paraviral exanthemas

- Gianotti-Crosti-Syndrome
- Pityriasis rosea
- Pityriasis lichenoides
- Asymmetric periflexural Exanthema
- Papular purpuric gloves and socks syndrome
- Eruptive Pseudoangiomatosis
- Eruptive Hypomelanosis

Fölster-Holst, Expert Rev Anti Infect Ther. 2016

Eruption of hypopigmented maculae in siblings 1-2 wks after infection of the upper respiratory tract… *Chuh, Clin Exp Dermatol 2016*

Findings support a viral etiology

- Prodrome of coryzal symptoms
- Spontaneous recovery in 2–4 wks
- Main age 1–9 years
- The virus has not been identified yet

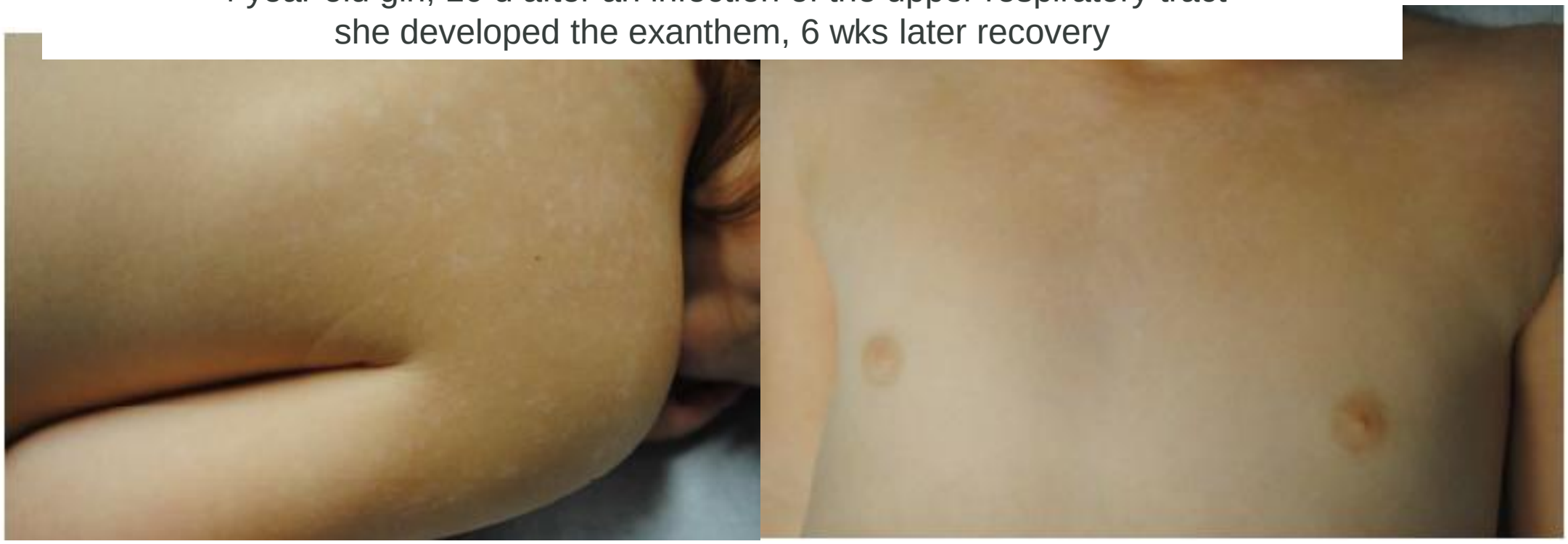
Eruptive Hypomelanosis

JDDG Journal of the German Society of Dermatology

Donne M , Fölster-Holst R, van Gysel D 2018

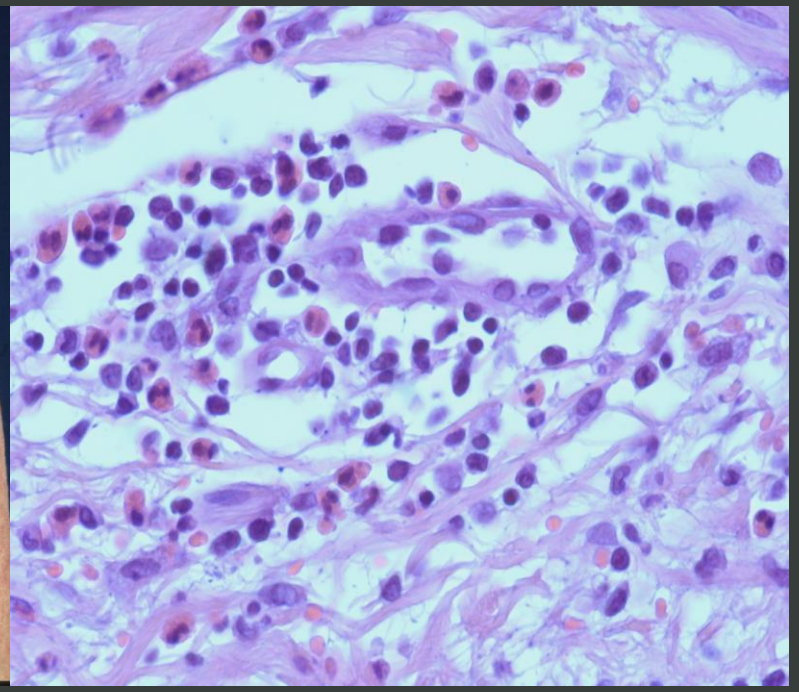
Eruptive Hypomelanosis – First case reported outside Asia

4 year old girl, 10 d after an infection of the upper respiratory tract
she developed the exanthem, 6 wks later recovery



Focal points

- Direct inoculation of viruses
- Exanthems
- Viruses in relation to other diseases



DRESS-Interaction with viruses

1. Viral reactivation and visceral infections (liver, lung, gastrointestinal tract, skin) are associated with DRESS
2. Viral antibody levels correlate with the severity of DRESS.
3. Antiviral therapy is recommemded, but only in combination with systemic CS

Viral diagnostics should be done in severe DRESS-cases for the following viruses:
HHV-6, HHV-7, CMV, EBV

WILEY Dermatology

Use of antiviral medications in drug reaction with eosinophilia and systemic symptoms (DRESS): A case of infantile DRESS

Maggie L. Chow MD, PhD | David Kim MD, MS | Sonia Kamath MD | David Peng MD, MS | Minnelly Luu MD

2018

3-mo old toddler with Sturge-Weber Syndrome.
Acute seizures→ anticonvulsants, 4 weeks later: morbilliform rash, eosinophilia, fulminant liver failure → liver transplant planned

Diagnostics: Serum CMV PCR↑, intrahepatic CMV inclusions

WILEY Pediatric Dermatology

2018

Use of antiviral medications in drug reaction with eosinophilia and systemic symptoms (DRESS): A case of infantile DRESS

Maggie L. Chow MD, PhD | David Kim MD, MS | Sonia Kamath MD | David Peng MD, MS | Minnelly Luu MD

Ganciclovir iv. 5 mg/kg all 12 h for 3 wks, followed by low dose CS and Ganciclovir, led to regression.

Skin manifestations reported in association with COVID-19 infection

JDDG 2020

Makulopapular exanthem
Urticaria, EEM
Varice3lla like exanthems,
Livedo reticularis Chilblain-like
Acro ischemia

Manifestation	Clinical description	Relative frequency*	Similarity to skin rashes of other infections	References
Maculopapular exanthem	Acute erupting, widespread distribution of multiple small, round to oval erythematous macules and/or papules with different degrees of confluence. Mostly trunk, low pruritus.	47 %	Unspecific for COVID-19; infections are common elicitors for maculopapular exanthem	[3, 4, 5, 6, 7, 8]
Urticaria	Sudden appearance of wheals with a fleeting nature. Continual appearance and disappearance of new lesions is characteristic.	19 %	Unspecific for COVID-19; infections are common elicitors for acute urticaria	[3, 6, 8, 9, 10, 11]
Erythema multiforme	Acute erupting, targetoid macules/plaques, sometimes with central blistering. Often affecting the palms, but also widespread distribution possible. Occurring > 12 days after onset of COVID-19 symptoms	Individual case reports	Unspecific for COVID-19; infections, especially herpes simplex virus and mycoplasma common elicitors for erythema multiforme	[12, 13]
Varicella-like exanthem	Monomorphic papulovesicular skin eruption. Erythematous papules and vesicles bilaterally and symmetrically mostly on the trunk.	9 %	May be more specific, vesicles are quite uncommon for virus exanthems and more specific for varicella	[3, 8, 15, 16]
Livedo reticularis	Transient macular erythema in a broad reticular pattern on thigh unilaterally.	6 % together with cutaneous acro-ischemia	Unclear, may be more specific, if causality can be confirmed	[8, 11, 16, 17]
Chilblain-like lesions	Acute-onset, violaceous, infiltrated and painful plaques on the toes and lateral feet. Vesicles and erosions may be present.	19 %	Probably more specific, often occurs in asymptomatic and younger patients.	[8, 18, 19, 20, 21]
Symmetrical drug-related intertriginous exanthema (SDRIFE)	Flexural erythematous maculopapular exanthem on axillary lesions and trunk +/–antecubital fossae.	Individual case reports	Untypical for infectious exanthems	[22]
Purpuric rash	Skin rash with petechiae	Individual case report	Untypical for infectious exanthems, except e.g. Parvovirus 19 and Coxsackie virus.	[24]
Pruritic plaques on both heels	Confluent, erythematous-yellowish papules in both heels	Individual case report	Untypical for infectious exanthems	[25]
Cherry angiomas	Not specified in the literature	Individual case report	Untypical for infectious exanthems	[11]
Acro-ischemia	Livid macules and plaques with finger/toe cyanosis, skin bulla and dry gangrene.	6 % together with livedo reticularis	Typical for severely ill patients with sepsis	[8, 26]

DOI: 10.1111/pde.14831

Pediatric Dermatology WILEY

Acral manifestations associated with infection

Quentin Jordens MD[1,2] | Hannelore De Maeseneer MD[1] | Charlotte De Crem MD[1,3] | Regina Fölster-Holst MD, PhD[4] | Dirk Van Gysel MD, PhD[1,5]

CORONA-toes

Most common

Multisystemic inflammatory syndrome (MIS-C)

- **Postviral** (SARS-CoV-2), wks later
- Like **Kawasaki-Syndrome**
- High **fever, cardial a**nd **gastrointestinal** symptoms, **Conjunctivitis**, cutaneous lesions
- High **inflammatory parameters**

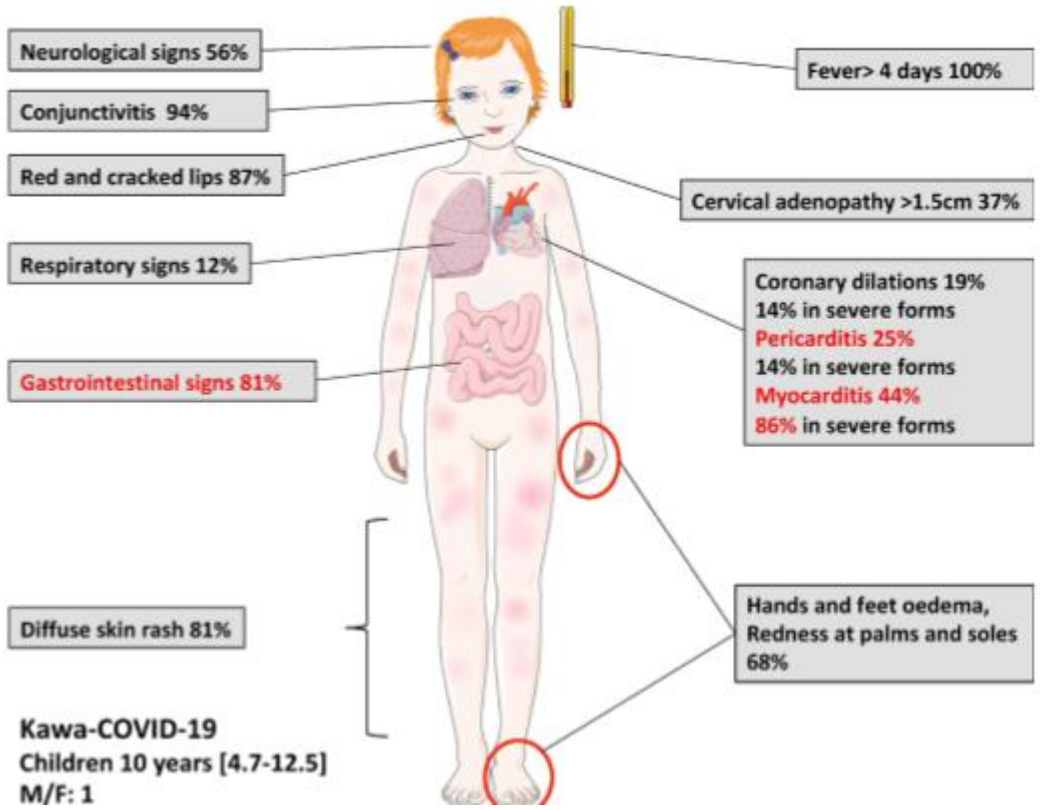
Paediatric multisystem inflammatory syndrome temporally associated with SARS-CoV-2 mimicking Kawasaki disease (Kawa-COVID-19): a multicentre cohort

Pouletty M, et al. Ann Rheum Dis 2020

Table 2 Comparison between Kawa-COVID-19 cohort and historical cohort in the Paris region

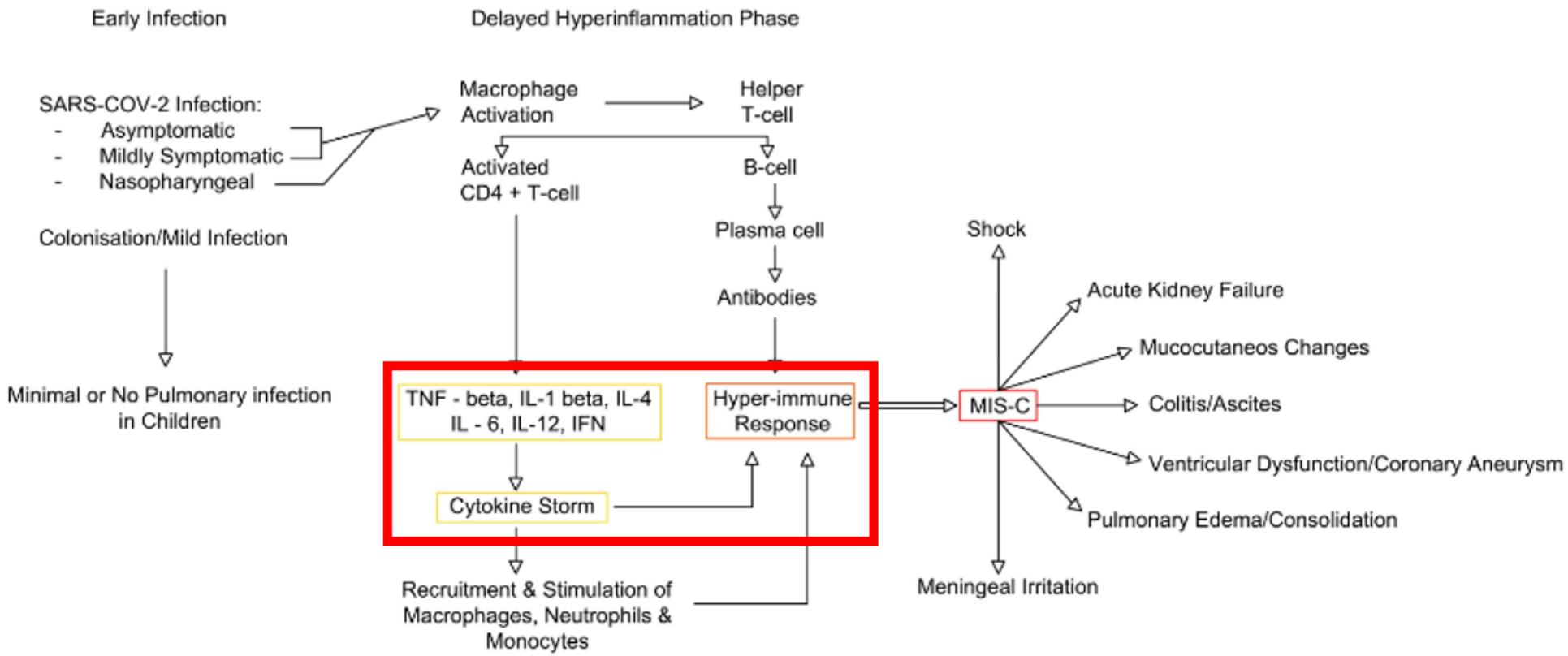
	Historical cohort (n=220)	Kawa-COVID-19 cohort (n=16)	P value
Median age (IQR)	2 (1.2 to 3.6)	10 (4.7 to 12.5)	<0.0001
Male gender	128/220 (58%)	8/16 (50%)	0.63
Clinical features: n (%)			
Skin rash	187/220 (85%)	13/16 (81%)	0.718
Hands and feet erythema/ oedema	120/220 (54%)	11/16 (68%)	0.099
Conjunctivitis	176/220 (80%)	15/16 (94%)	0.342
Dry cracked lips	189/220 (85%)	14/16 (87%)	1
Cervical lymphadenopathy	114/220 (52%)	6/16 (37%)	0.309
Complete Kawasaki disease: n (%)	142/220 (64%)	10/16 (62%)	1
Biological results: median (IQR)			
CRP (mg/L)	142 (95 to 197)	207 (162 to 236)	0.006
Platelets (G/L)	383 (289 to 491)	188 (164 to 244)	<0.0001
Lymphocytes (G/L)	3.08 (1.86 to 4.77)	1.15 (0.8 to 1.7)	<0.0001
Natraemia (mmol/L)	135 (134 to 137)	130 (127 to 134)	0.0003
Albumin (g/L)	25 (22 to 28)	21 (19 to 23)	0.024
Echocardiography abnormalities: n (%)	54/220 (26%)	11/16 (69%)	0.0004
Myocarditis	3/220 (1%)	7/16 (44%)	0.0001
Coronary dilations	42/220 (19%)	3/16 (19%)	1
Pericarditis	15/220 (7%)	4/16 (25%)	0.029
Resistance to single IVIg	45/220 (20%)	10/16 (62%)	0.004
Origin:			0.164
Afro-Caribbean	67/187 (36%)	10/16 (62%)	0.056
Middle East	44/187 (23%)	2/16 (12%)	0.532
European	48/187 (27%)	4/16 (25%)	1.0
Asia	28/187 (15%)	0/16	0.136

In red: higher frequencies than classical Kawasaki disease



MIS-C: Immunopathogenesis

(delayed hyperinflammation with cytokine storm)



Lupu A et al. Multisystem inflammatory syndrome in children and Kawasaki disease. Front Immunol. 2025

Differences MIS-C and Kawasaki-Syndrom

Comparison	MIS-C	Kawasaki disease
Age	6–12 years	6 months to 5 years
Sex	Male predominance	Male predominance
Race or ethnicity	African, Hispanic, and South Asian	Japanese and Asian
Similarities	Fever, rash, cervical lymphadenopathy, neurological symptoms, and extremity changes	
Differences	Relatively high incidence of gastrointestinal symptoms, myocarditis, shock, and coagulopathy	Relatively high incidence of conjunctival injection and oral mucous membrane changes
Cardiovascular involvement	Left ventricle dysfunction	Coronary aneurysm

Older children
Gastrointestinal Symptoms
Myocarditis
Schock
Coagulopathy
Dysfunction of the left ventricle

Infants and preschool children
Conjunctional Injection
Oral involvement

Coronary aneurysms

Therapy: MIS-C and Kawasaki-Syndrome

	MIS-C	Kawasaki disease	
		Responsive Kawasaki disease	*Refractory Kawasaki disease*
Intravenous immunoglobulin	2 mg/kg based on ideal body weight	2 g/kg every 12 hours along with oral aspirin	2 g/kg/day
Glucocorticoids	1–2 mg/kg/day methylprednisolone or IV pulse 10–30 mg/kg/day		
Anakinra	>4 mg/kg/day		
Infliximab	5–10 mg/kg IV for 1 dose		5 mg/kg single-dose infusion
Aspirin	3–5 mg/kg/day orally once daily to a maximum dose of 81 mg/day unless the platelet count is <80,000, fibrinogen < 100 mg/dL, active bleeding, or high risk of bleeding	30–100 mg/kg/day High dose: 50–100 mg/kg/day	
Enoxaparin	1 mg/kg Subcutaneous (SUBQ) every 12 hours (up to a maximum of 30 mg for ages >2 months and <18 years)	1 mg/kg/dose subcutaneously every 12 h	
Etanercept			0.4–0.8 mg/kg subcutaneous weekly for 3 doses

13-y old boy, developed **JDM** shortly after a confirmed **influenza B** infection. Progressive proximal **muscle weakness, classic cutaneous findings.**

Blood: elevated muscle enzymes, myositis-specific Ab. **Influenza B** suggests as a possible **environmental factor in JDM pathogenesis by inducing a strong type I interferon** response. We should be aware of post-viral autoimmune conditions that guide further research into the mechanisms of virus-induced autoimmunity.

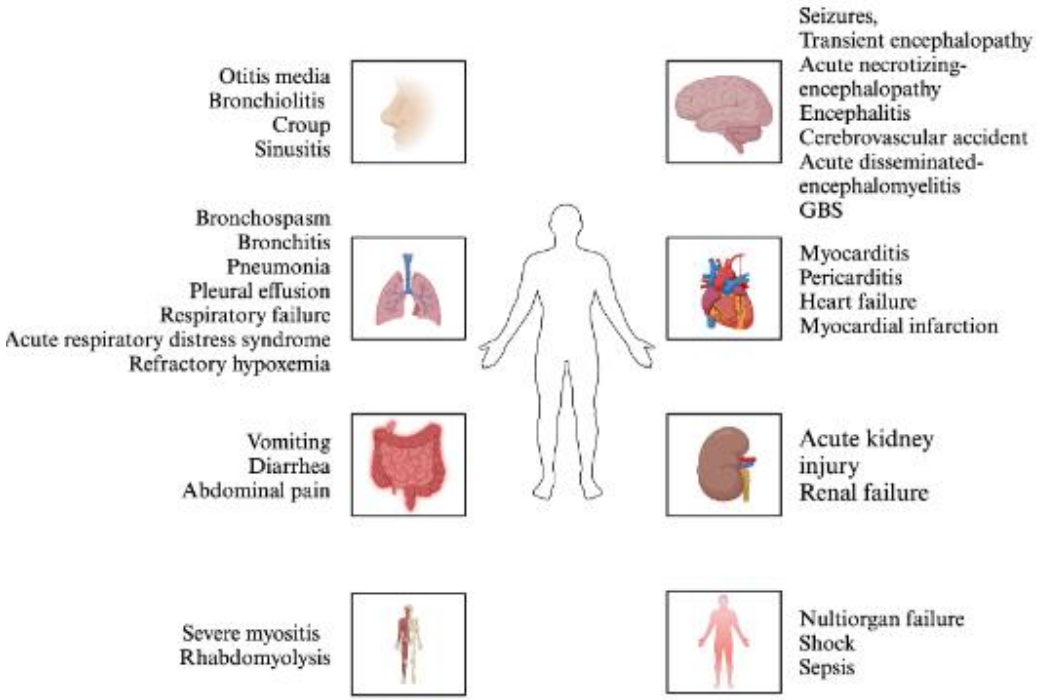
Dans-Caballero et al, Pediatric Dermatology, 2025

Sundaresan et al, Viruses 2023

Autoimmune diseases for which a viral cause is proposed

Autoimmune Disease	Virus	Target Cells or Self-Peptides	Immune Cells or Cytokines	Pathomechanism	Ref.
Rheumatoid Arthritis	HTLV	Synovial cells	IL1, IL6, TNF-α	Autonomous proliferation of synovial cells and inflammation	[163–165]
	EBV	Collagen and keratin	Autoreactive T cells	Molecular mimicry	[166–168]
Multiple Sclerosis	Herpes simplex virus (HSV1, HSV2)	Peripheral sensory nerves, sensory ganglia in CNS	Cytotoxic T lymphocyte, IL-6	Molecular mimicry of HSV-1 glycoprotein gB epitope and a brain-specific factor	[169,170]
	Epstein–Barr Virus (EBV)	CNS, myelin basic protein (MBP), anoctamin 2, glial cell adhesion molecule (GlialCAM)	$CD4^+$ and $CD8^+$ T cells	Antibodies against EBV antigens viral capsid antigen (VCA), Epstein–Barr nuclear antigen 1 (EBNA1), and early antigen (EA), Epstein–Barr latent membrane protein 1 (LMP1), molecular mimicry	[127,171–176]
	Human Herpesvirus 6 (HHV-6)	Oligodendrocyte, MBP	T cells	Molecular mimicry of virus peptide U24 with MBP	[177–179]
	Varicella-Zoster Virus (VZV)	Ganglia in CNS, peripheral blood mononuclear cells (PBMCs)	$CD4^+$ and $CD8^+$ T cells	-	[180]
	Human Endogenous Retroviruses (HERVs)	CNS in white matter lesion, (PBMCs)	TNF-α	Induction of free radicals, ER stress	[169,170,181,182]
Systemic Lupus Erythematosus	EBV	B- and epithelial cells; autoantibodies: SmB and Ro60	EBV-specific T cells	Molecular mimicry	[183–185]
Diabetes Mellitus Type 1	Coxsackie B4	GAD65 in the beta-cells of pancreas	IFN-γ/type-1-IFN, IL-4	Molecular mimicry	[186]
	Rubella	GAD65/67 of the pancreatic islets	$CD4^+$ and $CD8^+$ T cells	Molecular mimicry	[187,188]
	Rotavirus	Tyrosine phosphatase IA-2	Type I IFN	Molecular mimicry and Bystander activation	[189,190]

Xie et al, Front Immunol. 2025



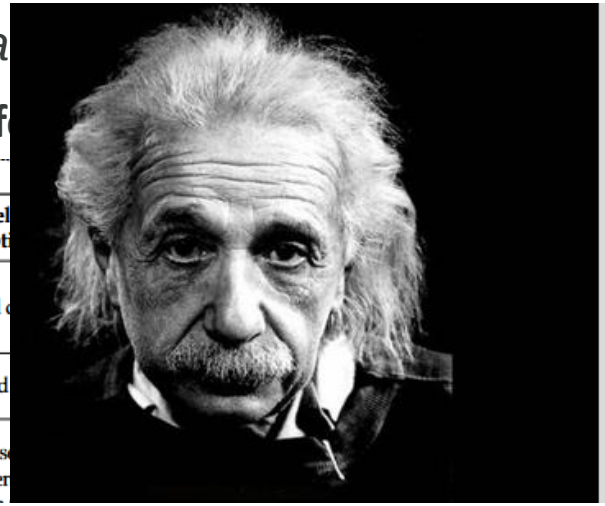
Manifestations of influenza, upper resp.tract and lung is the most common manifestation.

Viruses initiate autoimmunity via several pathways including molecular mimicry, epitope spreading, bystander activation and/or immortalization of infected B cells.

Sundaresa *Front Immunol. 2025*

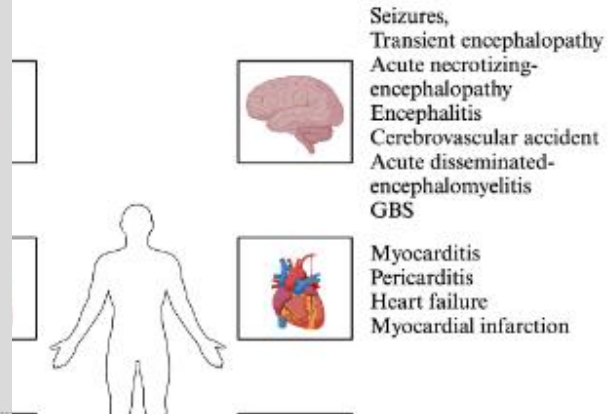
Autoimmune diseases f

Autoimmune Disease	Virus	Target Cel Self-Pepti
Rheumatoid Arthritis	HTLV	Synovial
	EBV	Collagen and
Multiple Sclerosis	Herpes simplex virus (HSV1,	Peripheral s nerves, ser



„Everything should be made as simple as possible. But not simpler."

Albert Einstein



However, this may be an oversimplification, there is also a protective role of viruses against autoimmunity, where viral infections lead to the activation of regulatory immune responses, consequently suppressing the development of autoimmune reactions.

Lupus Erythematosus	EBV	autoantibodies: SmB and Ro60	EBV-specific T cells	Molecular mimicry	[183–185]
Diabetes Mellitus Type 1	Coxsackie B4	GAD65 in the beta-cells of pancreas	IFN-γ/type-1-IFN, IL-4	Molecular mimicry	[186]
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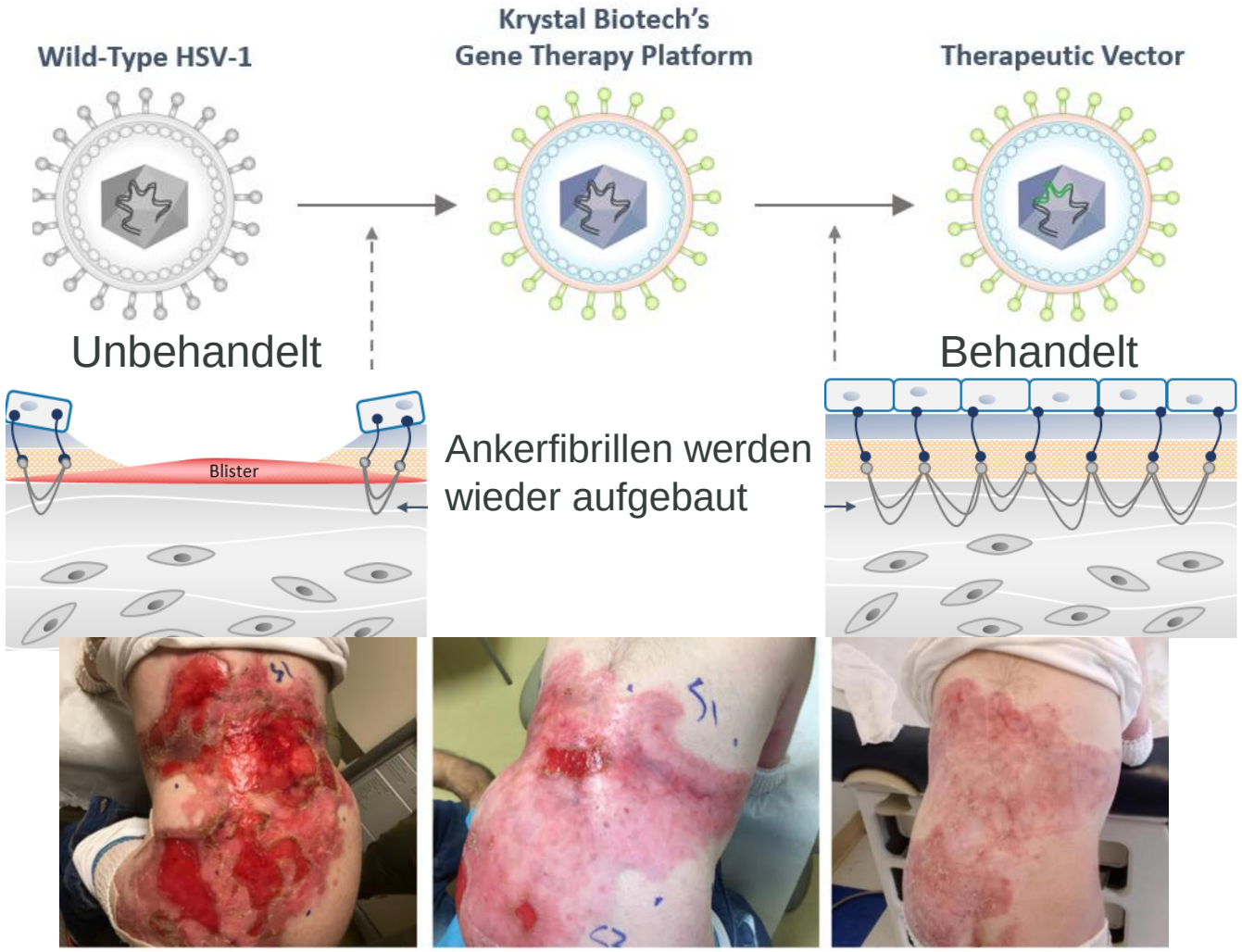
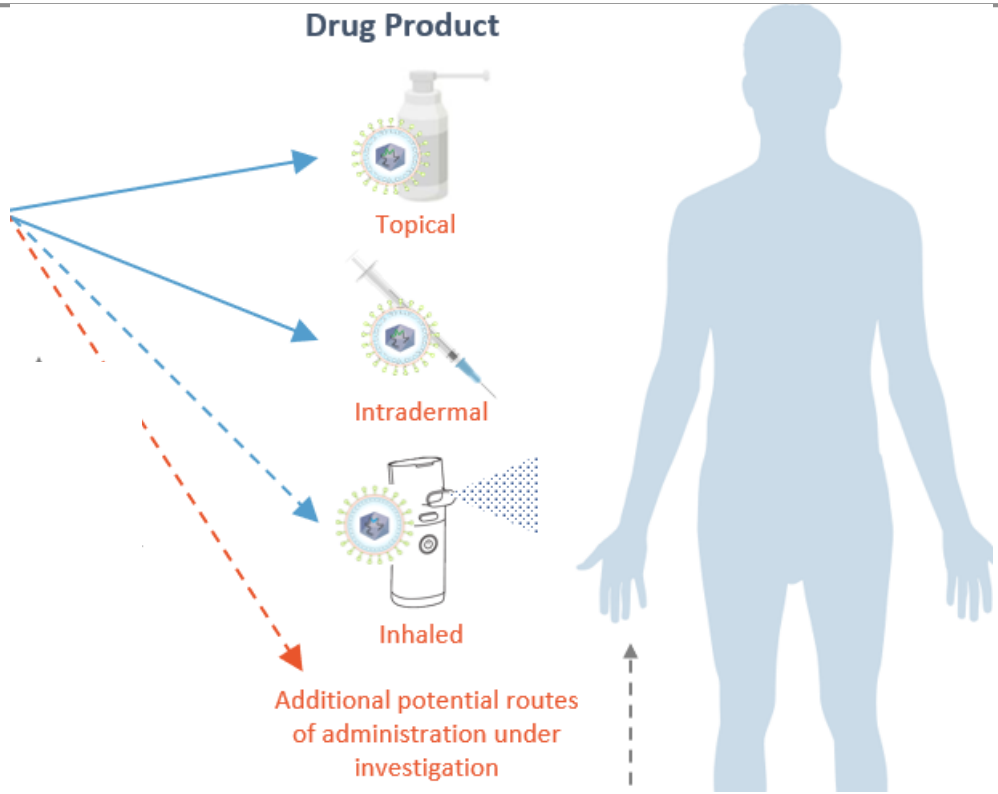
	Rotavirus	Tyrosine phosphatase IA-2	Type I IFN	Molecular mimicry and Bystander activation	[189,190]

including molecular mimicry, epitope spreading, bystander activation and/or immortalization of infected B cells.

Beremagene geperpavec-svdt (B-VEC, Firma Krystal) uses HSV1 as a vector, releasing *COL7A1* topically to woulds of dystrophic EB





- B-VEC 1x/wk on lesions
- after 112 wks c**omplete regression by 67%**
- Mild to moderate adverse events
- SCC only in lesions without treated wounds

Lachmann R. Int J Exp Pathol. 2004; Tognarelli EI, et al. Front Cell Infect Microbiol. 2019; Gurevich I, et al. Nat Med. 2022; Parry T, et al. Cell Gene Ther Insights. 2022;


VIRAL
SKIN
DISEASES

„The whole world is full of things, and it is rearly necessary, that somone find these things“

Pippi Langstrumpf (Swedish author Astrid Lindgren)