L’infection à Mycoplasme en pédiatrie

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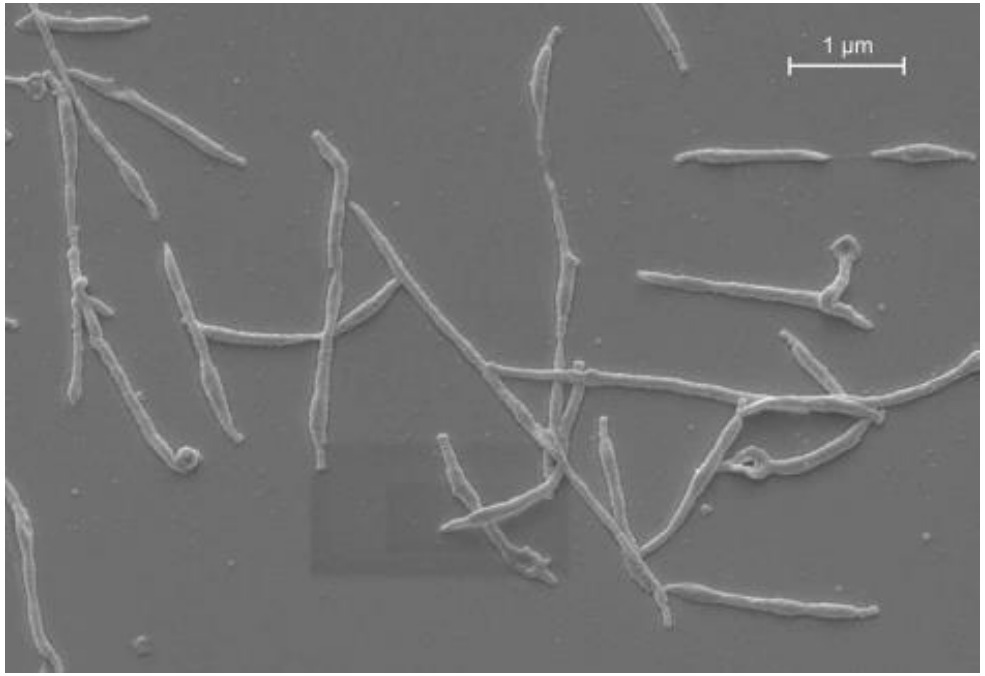
Mycoplasma pneumoniae



Pas de peptidoglycane
Pas d'efficacité des β-lactamines

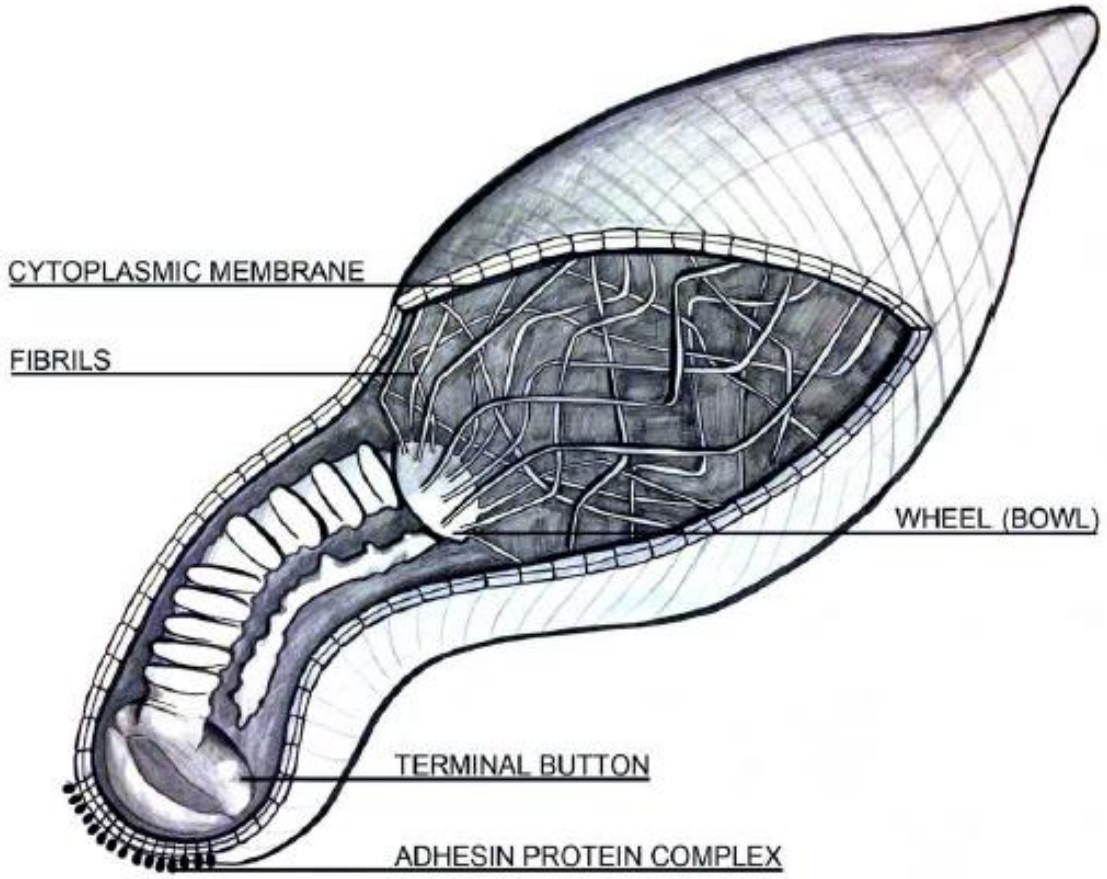
- Découvert en 1944 par Eaton
- Initialement considéré comme un virus

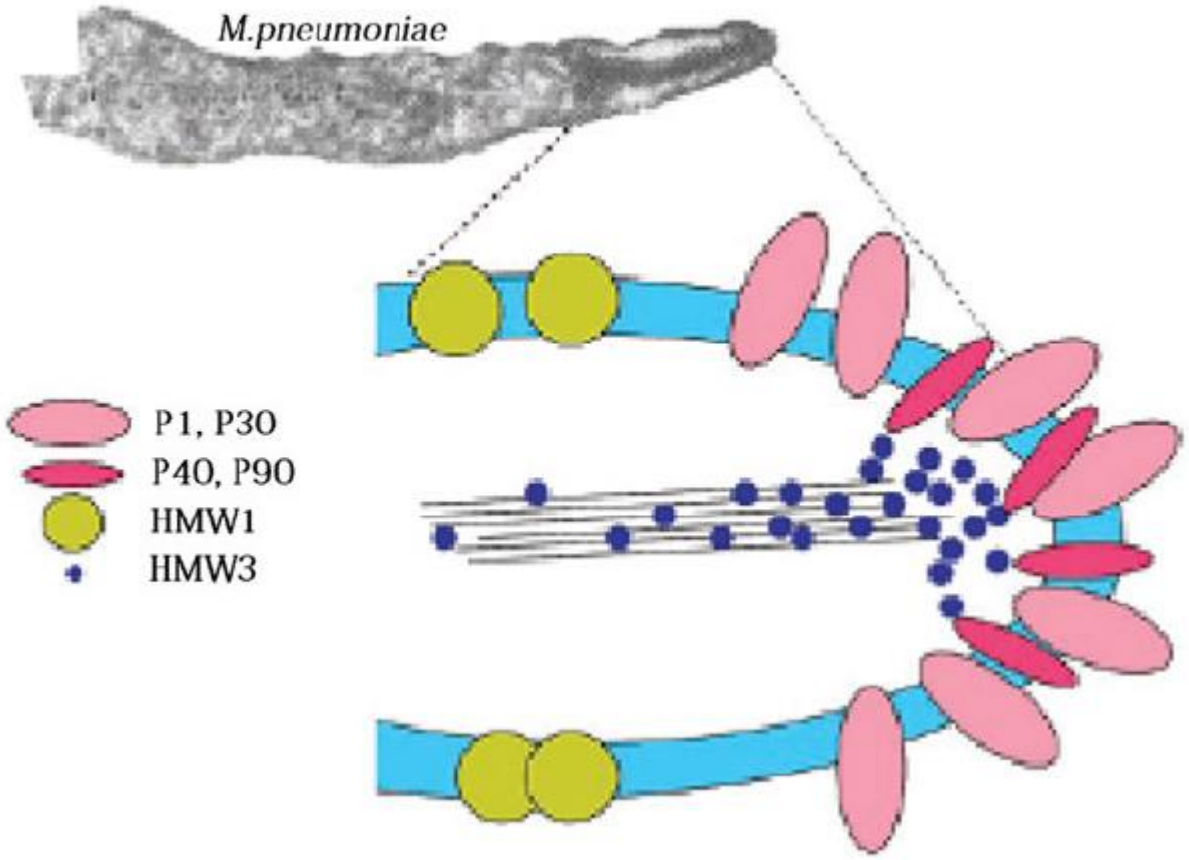
- 1950-1960 : déclenche des manifestations respiratoires hautes et basses chez des volontaires
- 1ère culture sur milieu acellulaire en 1962

- Taille : 1-2 µm x 0,1-0,2 µm
- Génome (1996) : 816 394 bp, 687 gènes

Front Microbiol 2016;7:329 et Front Microbiol 2016;7:513

L’organelle d’attachement





Front Microbiol 2016;7:205 et 329 et 513
Mol Med Rep 2016;14:4030-6

Pathogénicité

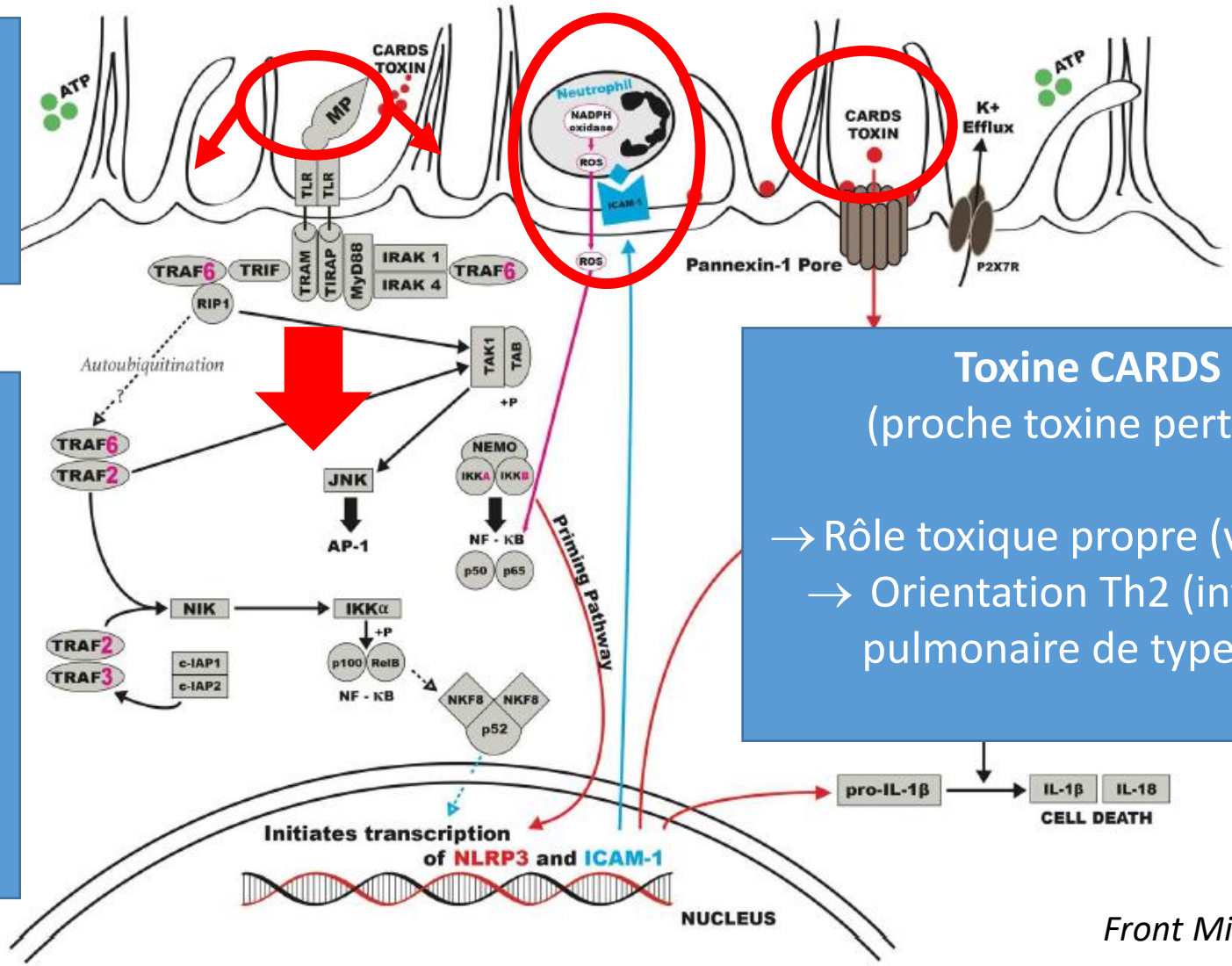
Production ions peroxydes et superoxydes

→ **Effet toxique direct**

Activation de la cascade inflammatoire

Production ICAM-1 (adhésion Mφ)

→ **Effet toxique indirect**



Toxine CARDS +++
(proche toxine pertussique)

→ Rôle toxique propre (vacuolisation)
→ Orientation Th2 (inflammation pulmonaire de type allergique)

Front Microbiol 2016;7:513

Données épidémiologiques

- Transmission par gouttelettes respiratoires
- 2 sous-types avec variants (recombinaisons entre séquences répétées RepMP2/3 et RepMP4 des gènes codant pour protéine P1)
- Immunité peu durable : réinfections, récurrences
- Évolution cyclique tous les 3-7 ans

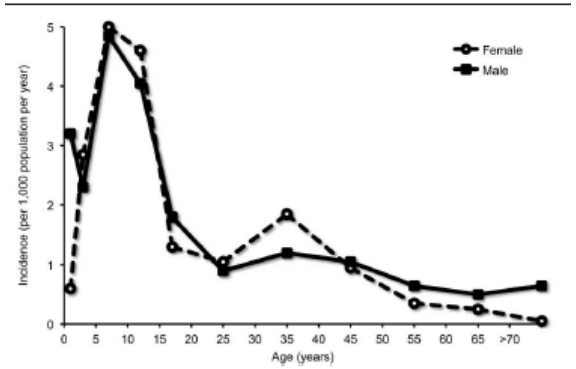


FIGURE 2 | Detection of *M. pneumoniae* in community-acquired pneumonia (CAP) according to age group. Infection was diagnosed by culture of respiratory specimens and/or a fourfold titer rise in complement fixation test (CFT). Adapted with permission from Foy et al. (1979).

- Prévalence difficile à établir :
  - Selon la technique de dépistage : PCR, sérologie
  - Selon la gravité : beaucoup de patients traités en ambulatoire
  - Selon l'âge : rare avant 4 ans, pathologie du grand enfant et de l'adolescent
  - Portage asymptomatique

Front Microbiol 2016;7:513

Modalités du diagnostic

Diagnostic : sérologie

- IgM (IgA) : 1ère semaine de la maladie, pic à 3 semaines
- IgG : séroconversion à 3-8 semaines

- Techniques : enzyme immunoassays (EIA) les plus évalués

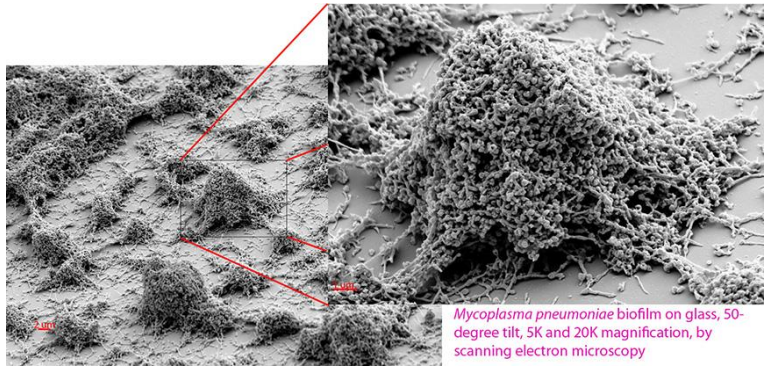
- Inconvénients :
  - Manque de sensibilité
  - Faux positifs entre différentes espèces de *Mycoplasma*
  - Délai de 2 semaines ou plus avant séroconversion
  - Faux négatifs chez immunodéprimés

Front Microbiol 2016;7:329 et Front Microbiol 2016;7:513

Diagnostic : biologie moléculaire (PCR)

- **Différentes techniques**
  - PCR conventionelle
  - Nested PCR (réamplification par un 2ème jeu de primers) : ↑ Sensibilité
  - PCR quantitative en temps réel : distingue les sous-types, différencie (?) infection aiguë et le portage
  - PCR multiplex : permet diagnostic de plusieurs germes (pathologie respiratoire)
  - PCR LAMP : technique plus simple... mais moins sensible

- **Différentes cibles**
  - ARN 16S
  - Protéine d'adhésion P1
  - Gènes de l'opéron ATPase
  - Toxine CARDS


Mycoplasma pneumoniae biofilm on glass, 50-degree tilt, 5K and 20K magnification, by scanning electron microscopy

Front Microbiol 2016;7:329 et Front Microbiol 2016;7:513

Method	Test	Target/antigen	Antibodies	Specimen(s)	Performance	Value	Comments
Direct identification of *M. pneumoniae*	Polymerase chain reaction (PCR)	Different target genes (e.g., P1 gene, 16S rDNA, 16S rRNA, RepMP elements etc.)	–	Respiratory specimen Cerebrospinal fluid (CSF) Other bodily fluids or tissues	High sensitivity, high specificity	RD	- Validation and standardization required for routine diagnostic (Loens et al., 2010); - Epidemiological differentiation of clinical strains on the basis of differences in the P1 gene by PCR (Spuesens et al., 2009) or in the number of repetitive sequences at a given genomic locus by multiple-locus variable-number tandem repeat analysis (MLVA) (Chalker et al., 2015).
	Culture	–	–	Respiratory specimen	Low sensitivity, high specificity	AD	- Special enriched broth or agar media; - Isolation takes up to 21 days.
Non-specific serological tests for *M. pneumoniae*	Cold agglutinin test ("bedside test")	Erythrocytes (I antigen)	Cold agglutinins (IgM)	Serum	Low sensitivity, low specificity	–[1]	- Cold agglutinins target the I antigen of erythrocytes; - Positive in only about 50% and in the first week of symptoms; - Less well studied in children; - Cross-reactivity with other pathogens and non-infectious diseases.
Specific serological tests for *M. pneumoniae*	Complement fixation test (CFT)	Crude antigen extract with glycolipids and/or proteins	Igs (no discrimination between isotypes)	Serum	Sensitivity and specificity comparable to EIA	–[1]	- Positive criteria: fourfold titer increase between acute and convalescent sera or single titer ≥1:32; - Cross-reactivity with other pathogens and non-infectious diseases.
	Particle agglutination assay (PA)		IgM and IgG simultaneously			–[1]	
	Enzyme immunoassay (EIA)	Proteins (e.g., adhesion protein P1) and/or glycolipids	IgM, IgG, IgA	Serum CSF[2]	Moderate-high sensitivity, Moderate-high specificity	RD	- The sensitivity depends on the time point of the first serum and on the availability of paired sera (for seroconversion and/or rise in titer); - "Gold standard": fourfold titer increase as measured in paired sera.
	Immunoblotting				High sensitivity, high specificity	AD	- Confirmatory assay (Dumke et al., 2012).
	Immunofluorescent assay (IFA)				Less sensitive and less specific than EIA	AD	- Subjective interpretation.

Front Microbiol 2016;7:329

Le portage sain

La problématique du portage (sain)

Carriage of *Mycoplasma pneumoniae* in the Upper Respiratory Tract of Symptomatic and Asymptomatic Children: An Observational Study

- Rotterdam (Pays Bas)
- Enfant 3 mois – 16 ans, sans pathologie chronique
- 2008-2011
- Asymptomatiques (n = 405)

  ou infection des VA (n = 321)
- rt-PCR pharynx, naso-pharynx + sérologie

- Rt-PCR positive
  - Asymptomatiques : 21,2%
  - Symptomatiques : 16,2%

  $p = 0,11$
- Chez symptomatiques :
  - VAS : 15,9%
  - VAI : 15,6%

  $p = 0,85$

Plos Med 2013;10:e1001444

La problématique du portage (sain)

Plos Med 2013;10:e1001444

Table 2. Results from the multiple logistic regression analysis for a positive *M. pneumoniae* PCR result in the asymptomatic group.

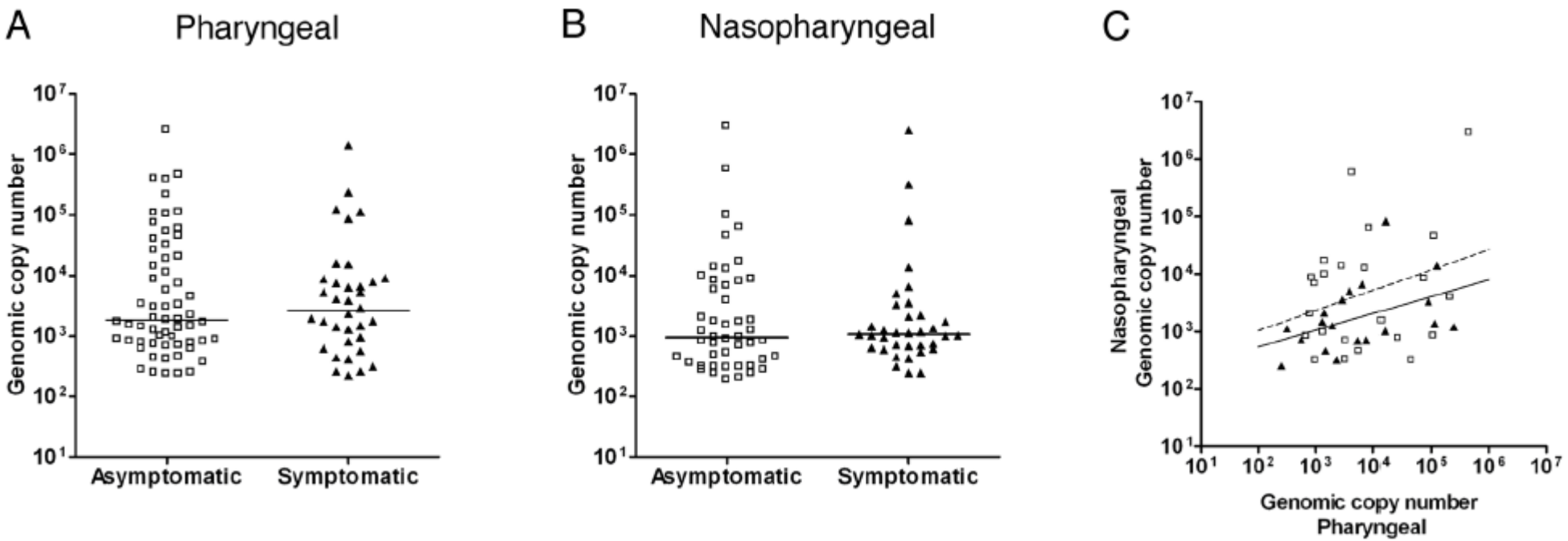
Variable	Odds Ratio (95% CI)	*p*-Value
Age (≥5 y)	0.96 (0.47–1.96)	0.91
Gender (female)	1.44 (0.81–2.56)	0.22
Season		<0.001 (overall)
Spring versus winter	0.81 (0.33–1.97)	0.64
Summer versus winter	7.43 (3.09–17.85)	<0.001
Autumn versus winter	2.90 (1.26–6.70)	0.01
Year (2009 versus 2010 and 2011)	3.31 (1.75–6.27)	<0.001
Family size (≥5 family members)	1.55 (0.77–3.13)	0.22
Smoking (active or passive)	0.70 (0.38–1.26)	0.23
Presence or history of wheezing	2.30 (0.69–7.61)	0.17
Day-care attendance	0.82 (0.38–1.77)	0.62
RTI prior to enrollment	0.95 (0.50–1.79)	0.86
RTI post-enrollment	0.59 (0.29–1.20)	0.15

Table 3. Results from the multiple logistic regression analysis for a positive *M. pneumoniae* PCR result in the symptomatic group.

Variable	Odds Ratio (95% CI)	*p*-Value
Age (≥5 y)	1.56 (0.60–4.02)	0.36
Gender (female)	0.93 (0.46–1.87)	0.84
Season		0.87 (overall)
Spring versus winter	0.80 (0.35–1.81)	0.59
Summer versus winter	0.54 (0.11–2.67)	0.45
Autumn versus winter	0.85 (0.39–2.16)	0.74
Year (2009 versus 2010 and 2011)	5.80 (1.94–17.35)	0.002
Family size (≥5 family members)	1.63 (0.74–3.61)	0.23
Smoking (active or passive)	0.61 (0.30–1.23)	0.17
Presence or history of wheezing	1.96 (0.93–4.13)	0.08
Day-care attendance	0.84 (0.37–1.89)	0.67
Diagnosis (lower RTI)	1.05 (0.46–2.42)	0.91
Hospitalization	1.54 (0.52–4.60)	0.44

Portage vs infection : type de prélèvement

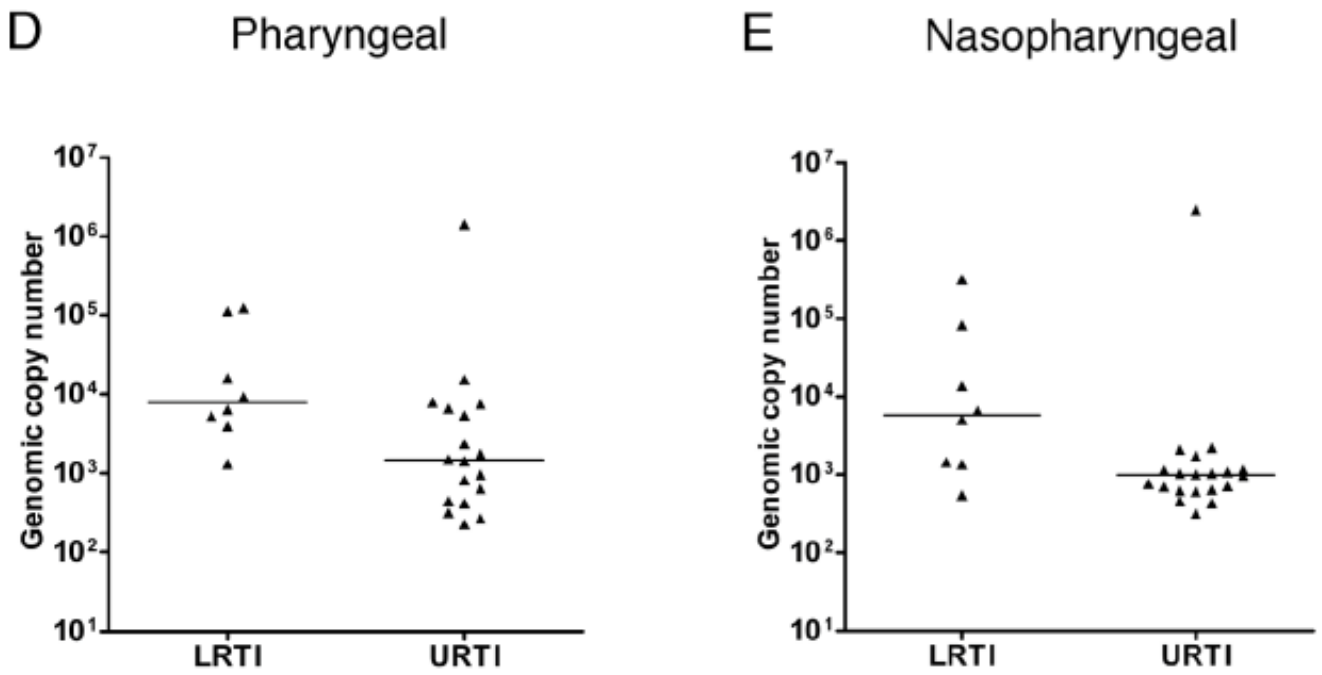
Plos Med 2013;10:e1001444



Pas de différence selon le type de prélèvement pour portage et infection

Charges virales selon le type d'infection

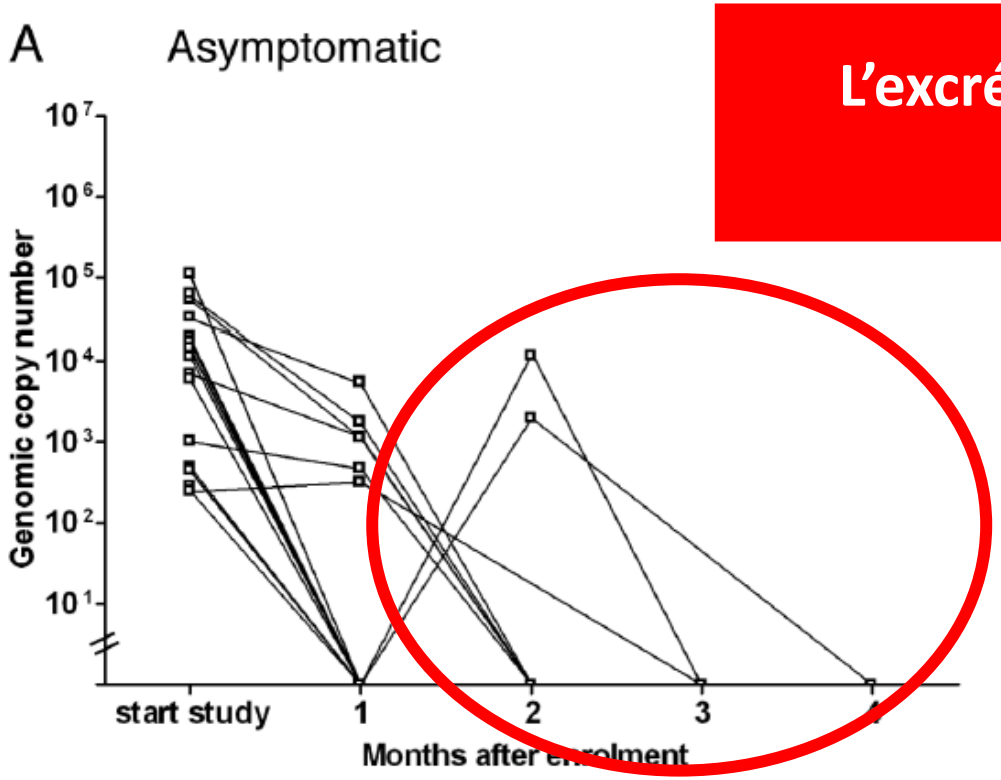
Plos Med 2013;10:e1001444



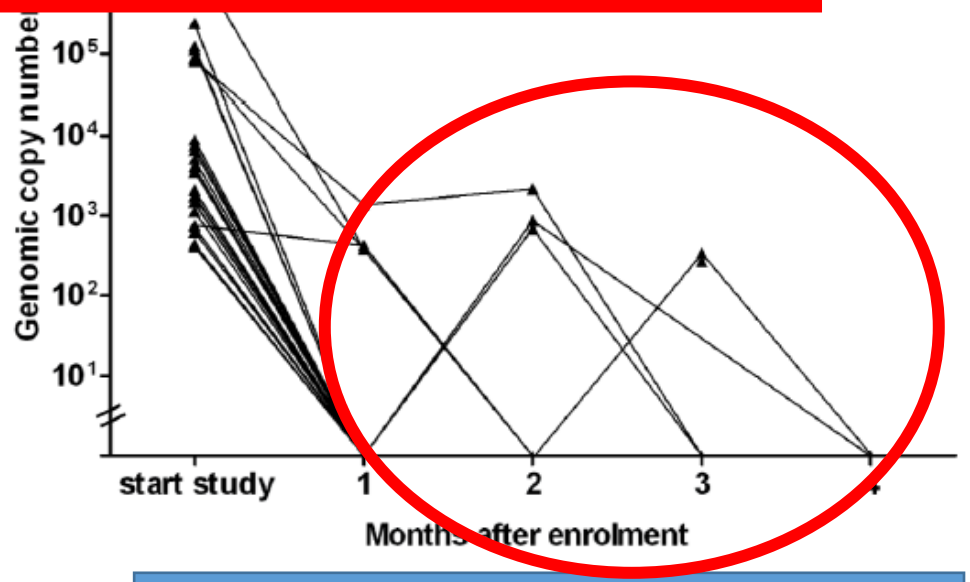
CV médiane + élevée pour infection VAI,
mais distributions larges dans les deux types d'infections

Durée de portage (étude ancillaire)

Plos Med 2013;10:e1001444



L'excrétion peut être prolongée chez certains patients



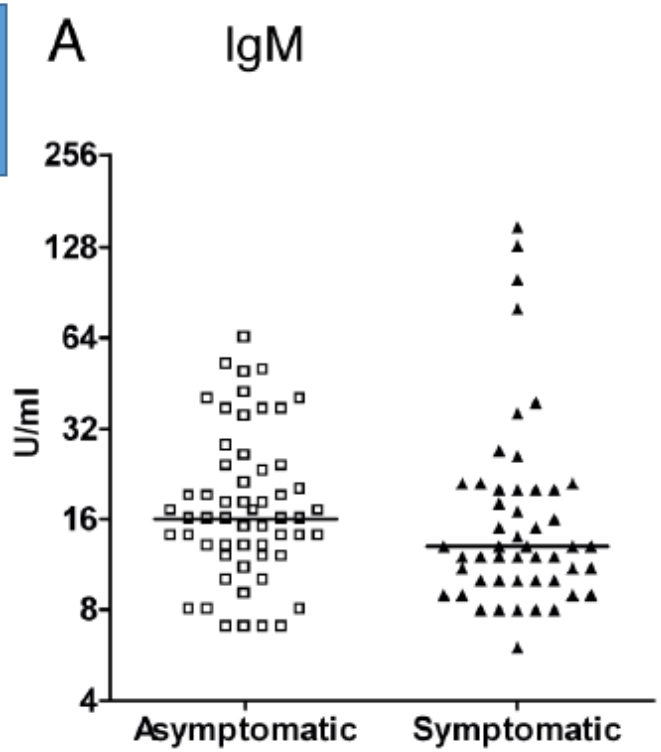
71% négatifs à 1 mois

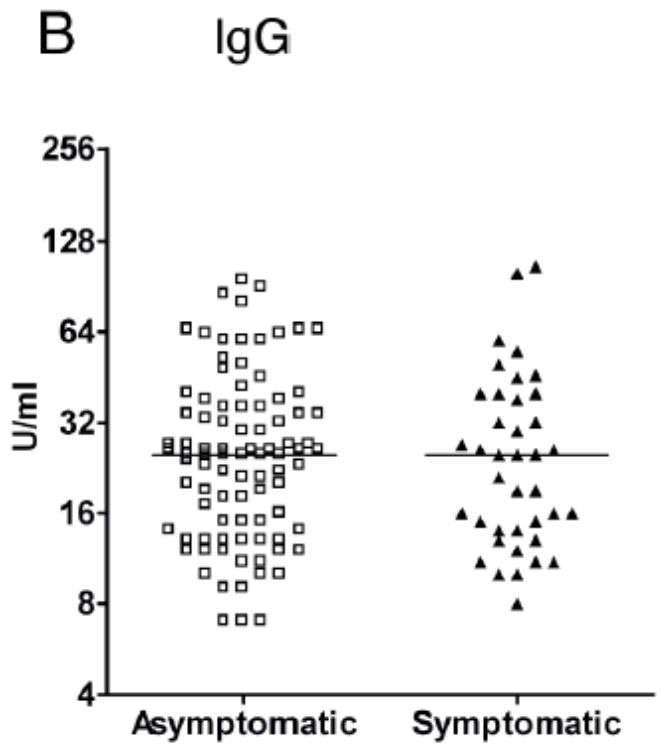
86% négatifs à 1 mois

Portage vs infection : sérologie

Plos Med 2013;10:e1001444

Titre Ac





Positivité de la sérologie

12,6% vs 9,2%
***P* = 0,23**

25,1% vs 14,2%
***P* < 0,001**

Portage versus infection : conclusions

- Mycoplasma pneumoniae est un germe de portage
- Très peu de corrélation entre PCR et sérologie
- Excrétion peut être prolongée

L'interprétation d'un test positif doit être précautionneuse !

Rôle exact des germes que l'on trouve ?

Table 6. Virology results in 202 study participants.

Virus	Asymptomatic Participants (n = 112)		Symptomatic Participants (n = 90)		p-Value
	Ct Value, Median (IQR)	n (Percent)	Ct Value, Median (IQR)	n (Percent)	
Influenza A virus	20.1	1 (0.9)	23.0 (18.0–33.8)	6 (6.7)	0.03
Coronavirus OC43	35.6 (28.7–37.3)	5 (4.5)	29.0 (24.1–32.9)	5 (5.6)	0.72
Coronavirus NL63	37.5 (34.8–38.6)	6 (5.4)	27.5 (27.0–38.0)	7 (7.8)	0.49
Bocavirus	30.9 (26.5–34.0)	16 (14.3)	32.0 (28.8–34.0)	3 (3.3)	0.008
Adenovirus	31.9 (27.9–33.8)	17 (15.2)	27.0 (26.2–30.5)	9 (10.0)	0.28

Deux pathogènes ou plus chez 55,5% des symptomatiques
... et 56% des asymptomatiques !

Mycoplasme et atteinte respiratoire

Infections respiratoires hautes

Portage ?

- Pharyngite non streptococcique : n = 184 enfants
- Réalisation PCR/sérologie mycoplasme :

Eur J Clin Microbiol Infect Dis 2002;21:607-10

- **24 %** PCR et/ou sérologie mycoplasme positive
- ATCD : > 3 épisodes de pharyngites dans les 6 mois :
  - 54,2% groupe mycoplasme +
  - 2,8% groupe mycoplasme -

Mais 3,8% dans autre étude espagnole

Enferm Infecc Microbiol Clin 2009,27(7):403-5

Pour la pratique : !

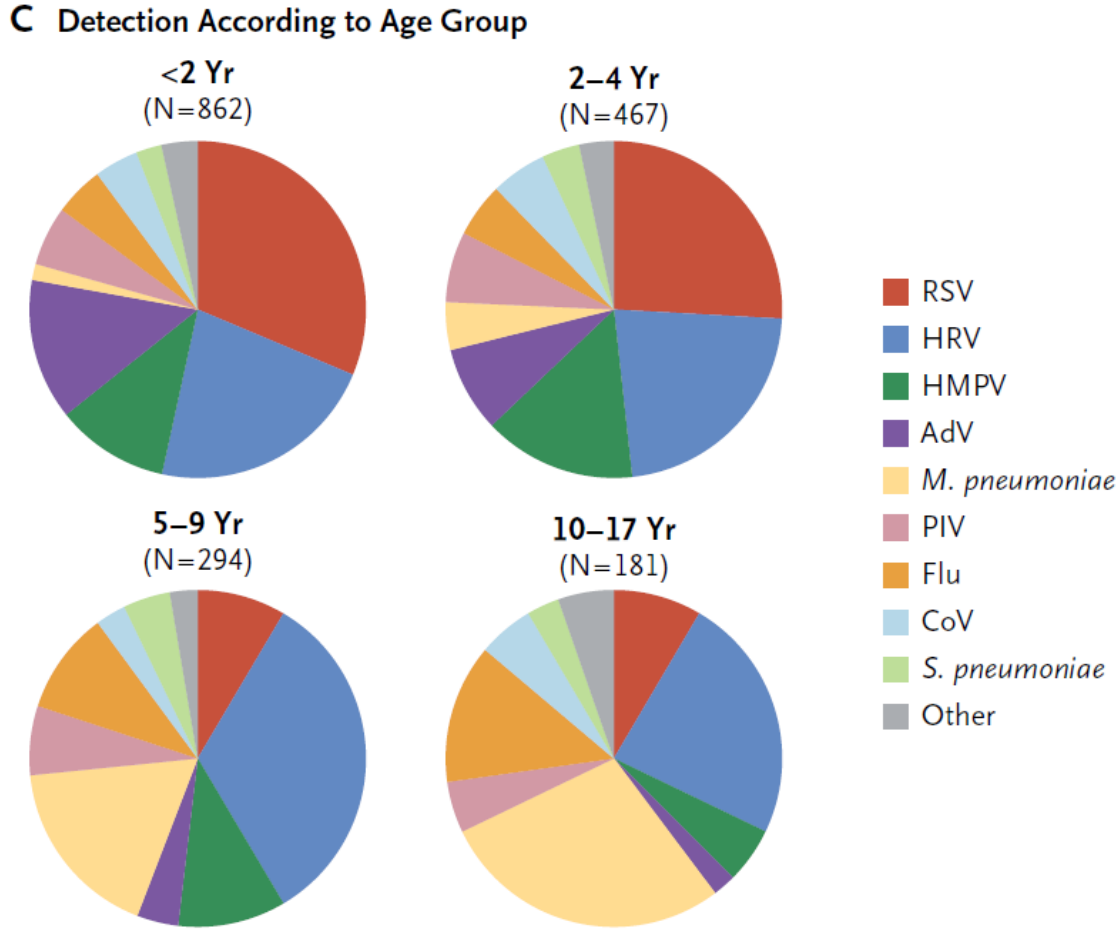
Pas de recherche de mycoplasme devant une pharyngite même récidivante

M. pneumoniae et pathologie respiratoire

- 10-40% des infections respiratoires basses en pédiatrie

- 1ère bactérie des pneumopathies communautaires hospitalisées aux USA (TN, UT), surtout chez 10-17 ans

- Clinique : toux qui traîne...



N Engl J Med 2015;372:835-45

Clinical symptoms and signs for the diagnosis of Mycoplasma pneumoniae in children and adolescents with community-acquired pneumonia (Review)

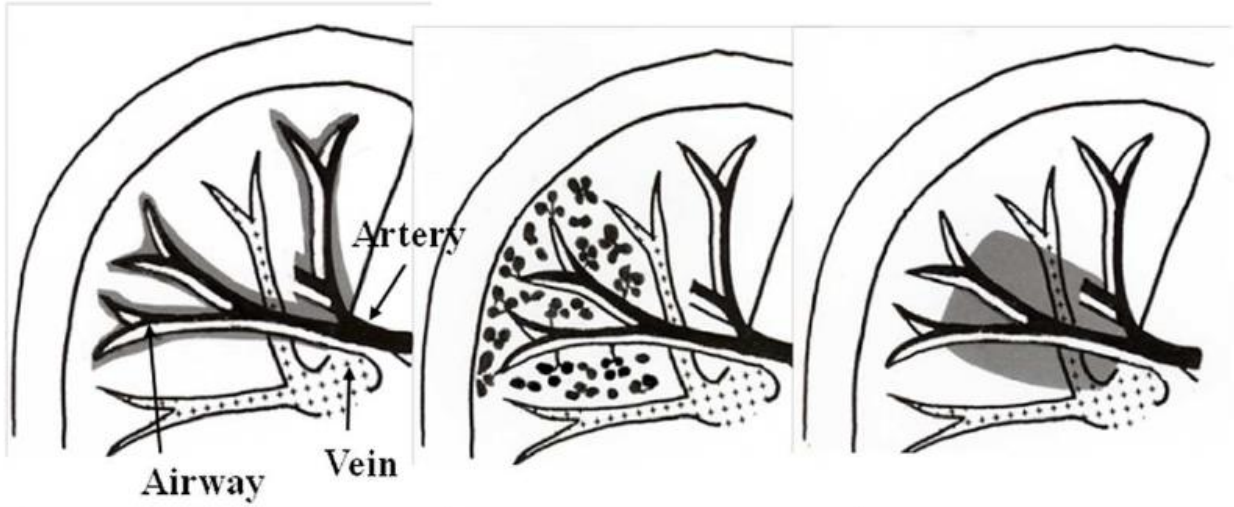
AUTHORS' CONCLUSIONS

Implications for practice

This review has found that *M. pneumoniae* cannot be reliably diagnosed in children and adolescents with community-acquired pneumonia based on the absence or presence of individual clinical symptoms and signs. Although the absence of wheeze is a statistically significant diagnostic indicator, it does not have sufficient diagnostic value to guide empirical macrolide antibiotic treatment published. Clinicians should therefore consider other factors, including previous antibiotic use and population-based data on *M. pneumoniae* incidence, to help them estimate the likelihood of *M. pneumoniae* infection in the context of a clinical consultation.

Cochrane Database Syst Rev 2012;10:CD006175

Quelles anomalies radiographiques ?



Radiological images: CT scan	Bronchovascular bundles thickening	Centrilobular nodules	Consolidation, Ground-glass attenuation
Pathological findings: biopsy specimen	Bronchitis characterized by inflammatory cells and plasma cells in the large airway walls	Cellular bronchitis in the small airways with exudate in the lumen	Neutrophils and exudate within bronchiolar and alveolar lumens
Frequency (n= 91)	75%	65%	66%

Front Microbiol 2016;7:695

M. pneumoniae chez < 1an

Portage ?

Chine : 21

pneumoniae

Parameters	<12 months (= 36)	P
Clinical symptoms		
Cough (n [%])	(97.22%)	1.00[a]
Tachypnea (n [%])	5.56%)	0.089[a]
Clinical signs		
Fever (>37.5 °C) (n [%])	(63.89%)	0.006
Maximum temperature >	(41.67%)	0.033[a]
Length of fever ≥3 days	(44.44%)	0.013[a]
Wheezing (n [%])	(50%)	0.49
Gastrointestinal symptom	25%)	0.68

Table 6 Pathogens detected in respiratory tract co-infection.

Pathogens	Number
M. pneumonia + respiratory syncytial virus	5
M. pneumoniae + adenovirus	2
M. pneumoniae + parainfluenza virus 3	2
M. pneumoniae + parainfluenza virus1	1
M. pneumoniae + influenza virus A + hBov	1
M. pneumoniae + hBov	2
M. pneumoniae + hMPV	1
M. pneumoniae + parainfluenza virus 2	1
M. pneumoniae + parainfluenza virus 3 + hBov	1
M. pneumoniae + hMPV + hBov	1

rate

Respir Med 2015;109:751-7

Mycoplasme et asthme

Table 2. Clinical and spirometric data for children hospitalized for their first asthma attack.

Variable	*M. pneumoniae*– or *C. pneumoniae*–positive patients ($n = 29$)	*M. pneumoniae*– or *C. pneumoniae*–negative patients ($n = 22$)
No. of male subjects/no. of female subjects	15/14	15/7
Age, mean years	5.7	5.5
Familial asthma	12 (41)	15 (68)
Atopic dermatitis	2 (7)[a]	12 (55)[a]
Serum IgE of >200 IU/mL	11 (30)[a]	15 (68)[a]
Relapse of asthma ⩽1 year after first attack	18 (62)[a]	6 (27)[a]

Clin Infect Dis 2004;38:1341-6

M. Pneumoniae et risque asthme

- Etude natio
- 1591 infecti
  année
- Score prope

2000-2008)

infectés sur genre, âge,

ıt ou après âge de 12 ans)

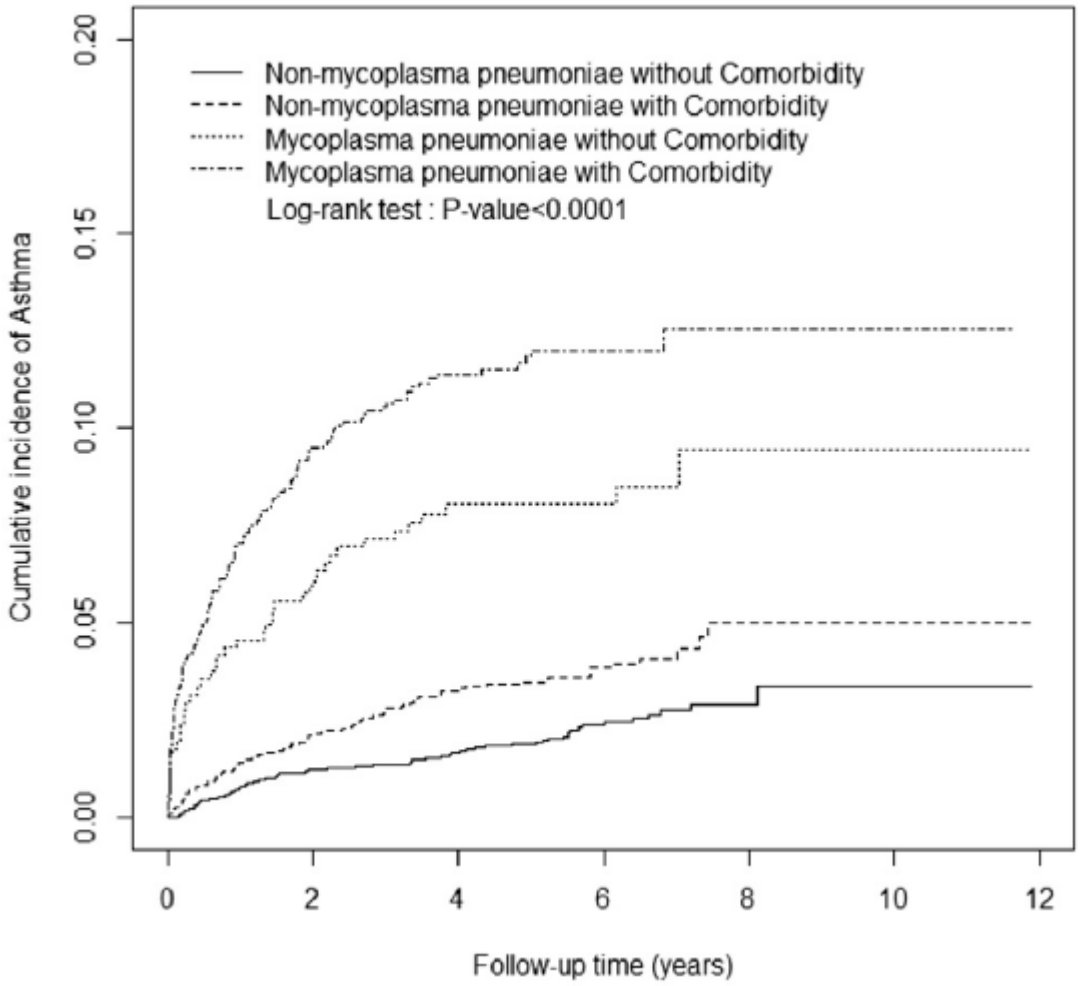


TABLE E3. Incidence a
matching

ımoniae cohorts after propensity score

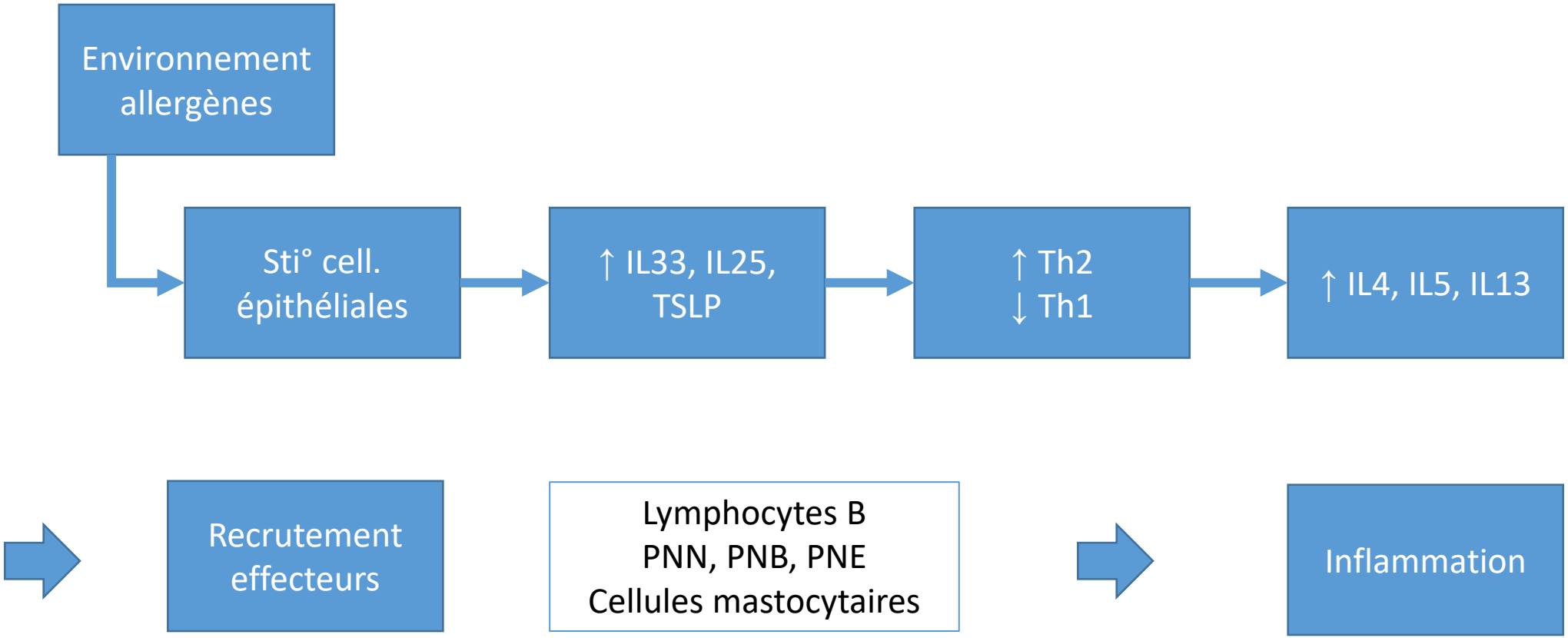
Variables		Compared with non–*M pneumoniae*	
	ıte	IRE (95% CI)	HR (95% CI)
Overall asthma	.6	3.63 (3.07-4.29)*	3.86 (2.94-5.09)*
Early-onset asthma	.4	3.54 (2.96-4.24)*	3.78 (2.66-5.38)*
Late-onset asthma	.23	3.76 (3.15-4.49)*	4.00 (2.57-6.20)*

Early-onset asthma, Age at dia
years).
*$P < .001$.

ter than 12 years; *Rate*, incidence rate (per 1000 person

J Allergy Clin Immunol 2016;137:1017-23

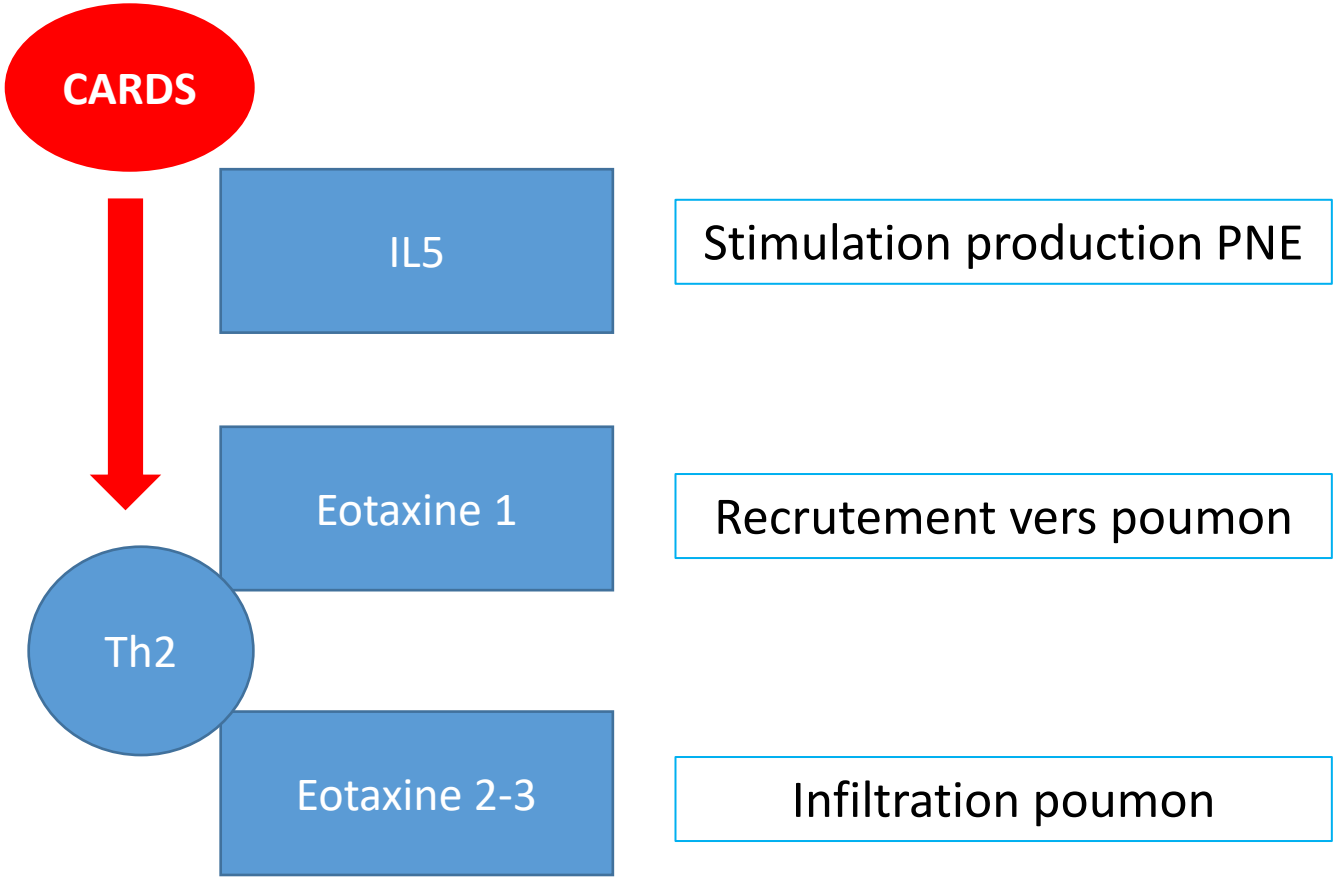
M. pneumoniae et exacerbation d'asthme



J Clin Cell Immunol 2018;9(4)

Les PNE dans l'asthme

J Clin Cell Immunol 2018;9(4)



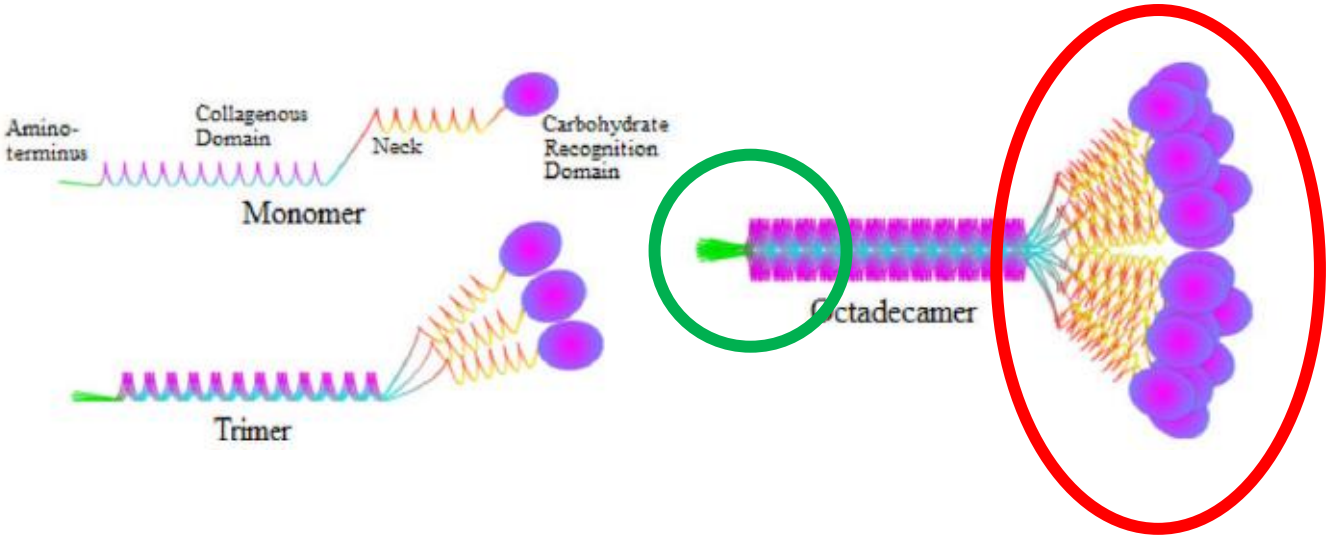
- Granules cytotoxiques
  - Major basic protein (MBP)
  - Eosinophil cationic protein (ECP)
  - Eosinophil peroxydase (EPO)
  - Eosinophil-derived neurotoxin (EDN)

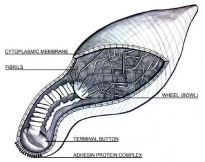
Dégranulation mastocytes, PNB

- Cellules présentatrice Ag

Régulation Th1 / Th 2

Protéine A du surfactant pulmonaire (SP-A)





↓ Production EPO par PNE

Stimule les macrophages alvéolaires

Sert de ligand aux micro-organismes, allergènes et cellules apoptotiques

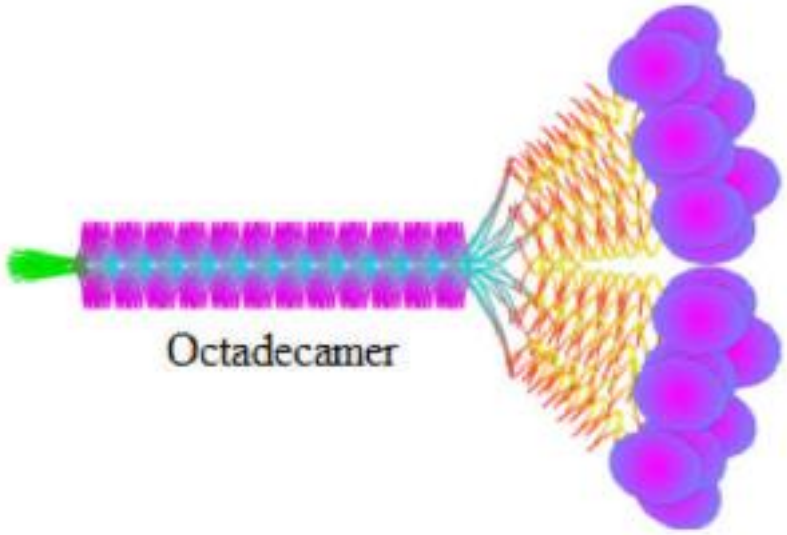
Moins d'inflammation

J Clin Cell Immunol 2018;9(4)

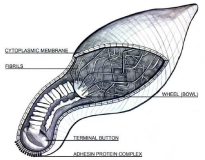
Mutation SP-A et M. pneumoniae

Mutation Q223 / K223
Dans gène SP-A2

Gènes SP-A1
et SP-A2



Balance pro-inflammatoire
= Asthme



↓ Production EPO par PNE

J Clin Cell Immunol 2018;9(4)

Une place pour les macrolides devant wheezing ?

- Une action sur mycoplasme (retrouvé associé au wheezing)

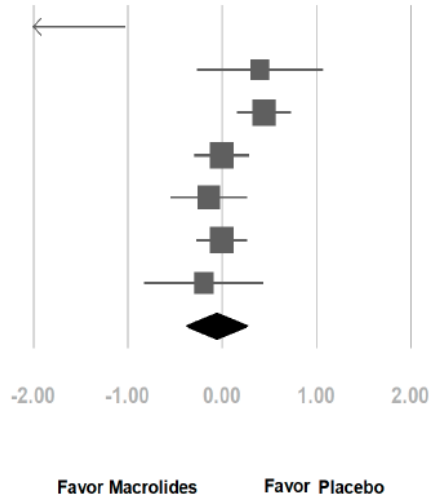
- Une action anti-inflammatoire
  - ↓ PNN, IL8, IL6, IL1, TNF, ECP
  - Action sur balance Th1/2 : ↓ IL4, IL5, IL6

→ **Utilité en systématique ?**

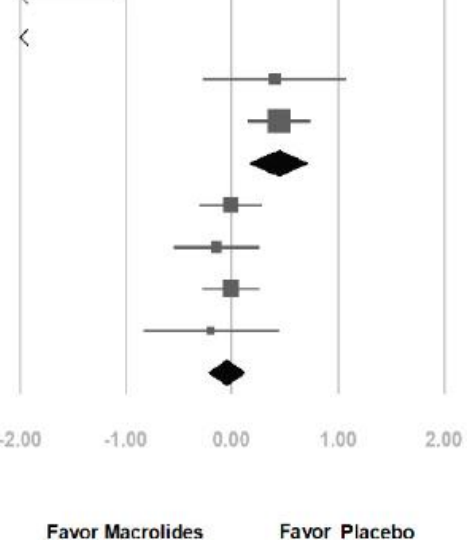
J Clin Med 2018;7:432

Une place pour les macrolides devant wheezing ?

Study name	Std diff in means	Lower limit	Upper limit	p-Value	Relative weight
2007 Tahan	-2.107	-3.181	-1.034	0.000	6.39
2008 Rasul, C. H.	0.407	-0.256	1.070	0.229	11.23
2009 Kabir	0.450	0.167	0.734	0.002	18.15
2012 Pinto	0.000	-0.289	0.289	1.000	18.05
2013 McCallum	-0.136	-0.537	0.265	0.505	15.95
2015 McCallum	0.000	-0.265	0.265	1.000	18.47
2015 Beigelman	-0.192	-0.821	0.437	0.550	11.77
	-0.051	-0.377	0.274	0.756	



Group by Type of Macrolides	Study name	Std diff in means	Lower limit	Upper limit	p-Value	Relative weight
a. Clarithromycin	2007 Tahan	-2.107	-3.181	-1.034	0.000	100.00
a. Clarithromycin		-2.107	-3.181	-1.034	0.000	
b. Erythromycom	2008 Rasul, C. H.	0.407	-0.256	1.070	0.229	15.47
b. Erythromycom	2009 Kabir	0.450	0.167	0.734	0.002	84.53
b. Erythromycom		0.444	0.183	0.704	0.001	
c. Azithromycin	2012 Pinto	0.000	-0.289	0.289	1.000	34.21
c. Azithromycin	2013 McCallum	-0.136	-0.537	0.265	0.505	17.81
c. Azithromycin	2015 McCallum	0.000	-0.265	0.265	1.000	40.75
c. Azithromycin	2015 Beigelman	-0.192	-0.821	0.437	0.550	7.23
c. Azithromycin		-0.038	-0.207	0.131	0.658	

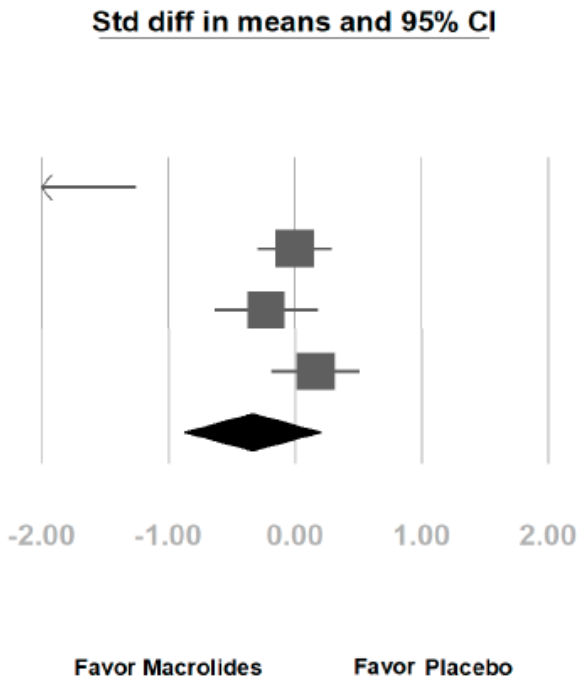


Aucun bénéfice sur durée d'hospitalisation

J Clin Med 2018;7:432

Une place pour les macrolides devant wheezing ?

Study name	Std diff in means	Lower limit	Upper limit	p-Value	Relative weight
2007 Tahan	-2.381	-3.506	-1.256	0.000	13.38
2012 Pinto	0.000	-0.289	0.289	1.000	29.97
2013 McCallum	-0.225	-0.627	0.176	0.271	27.71
2015 McCallum	0.164	-0.179	0.507	0.348	28.94
	-0.333	-0.868	0.201	0.221	



Aucun bénéfice sur durée de besoin en oxygène

J Clin Med 2018;7:432

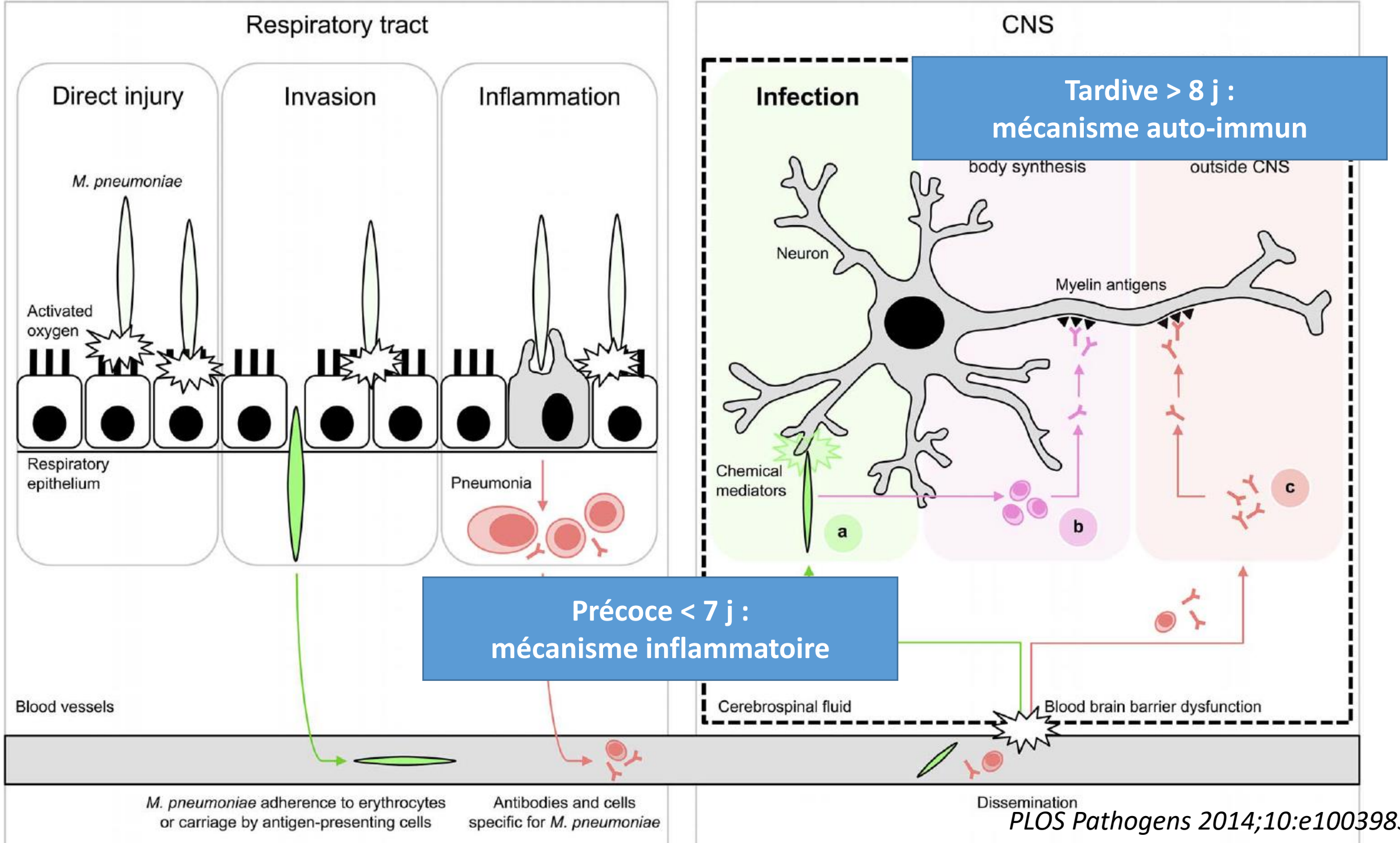
Mycoplasme et atteinte neurologique

M. pneumoniae et atteinte neurologique

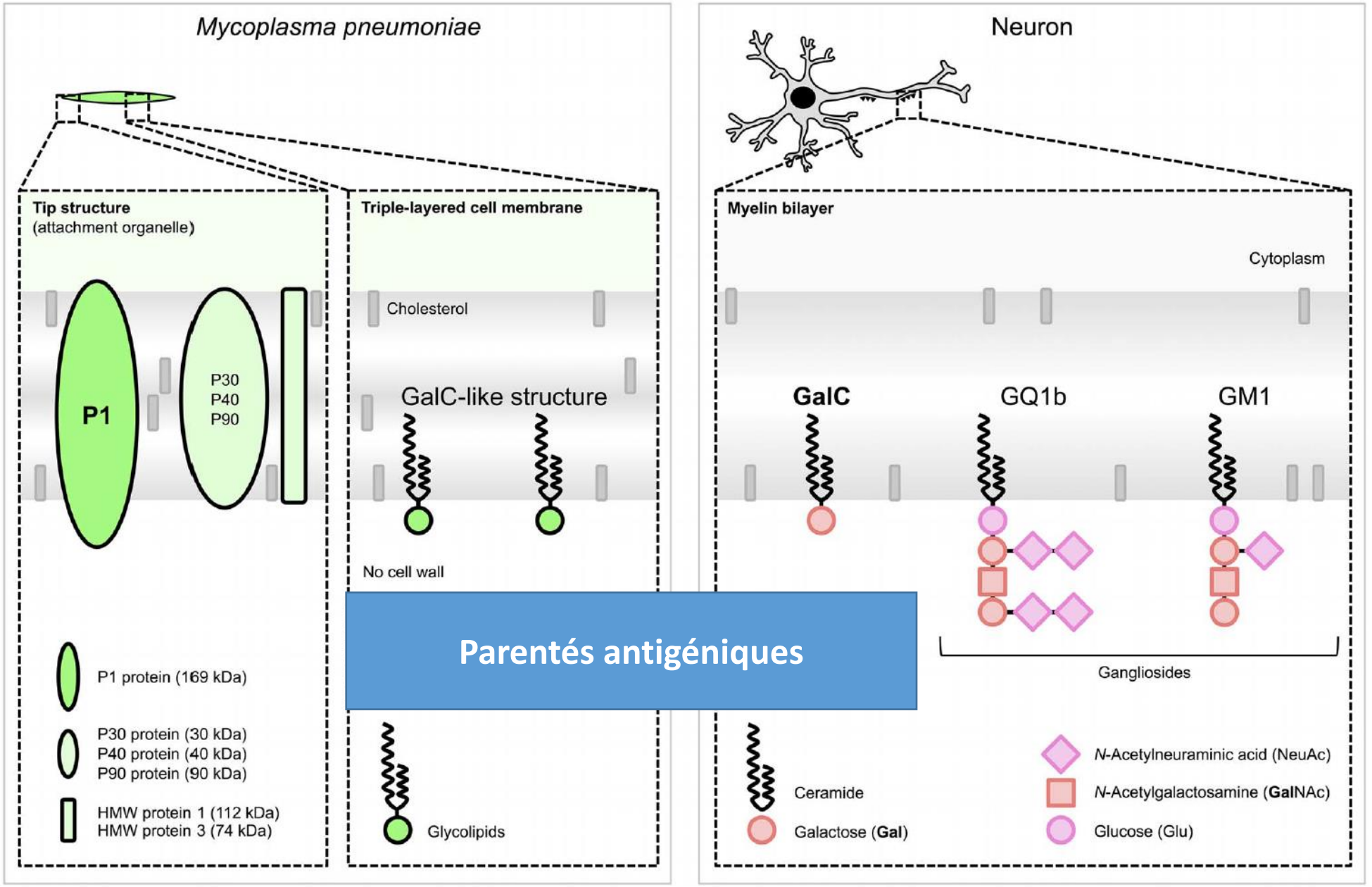
- 5-10% des patients avec atteinte fébrile du SNC sont Mp+

- Encéphalite ++
- Méningite aseptique, myélite transverse, Guillain-Barré, AVC...

- Sérologie positive dans LCR (74% encéphalites à Mp), voire PCR+

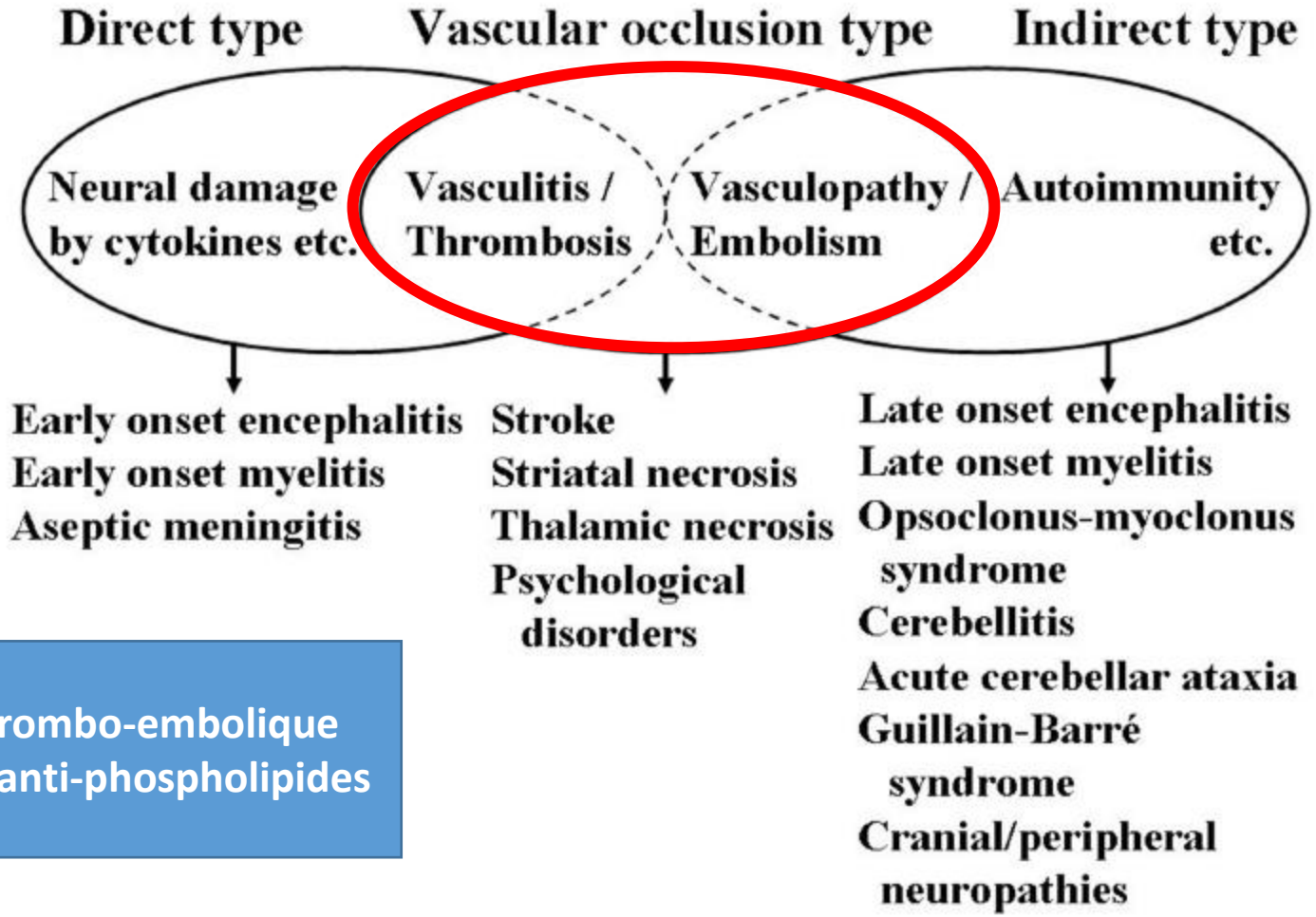


PLOS Pathogens 2014;10:e1003983



Parentés antigéniques

PLOS Pathogens 2014;10:e1003983



Atteinte vasculaire, thrombo-embolique
Complexes immuns, Ac anti-phospholipides

Front Microbiol 2016;7:23

Mycoplasme
et atteinte cutanéo-muqueuse

Atteintes cutanéo-muqueuses

- 1-5% des infections à Mp
- Exanthème dans 17% des pneumonies à Mp
- Du rash... au Steven-Johnson
- « *Mycoplasma pneumoniae* – associated mucositis » (MPAM) ou syndrome de Fuchs

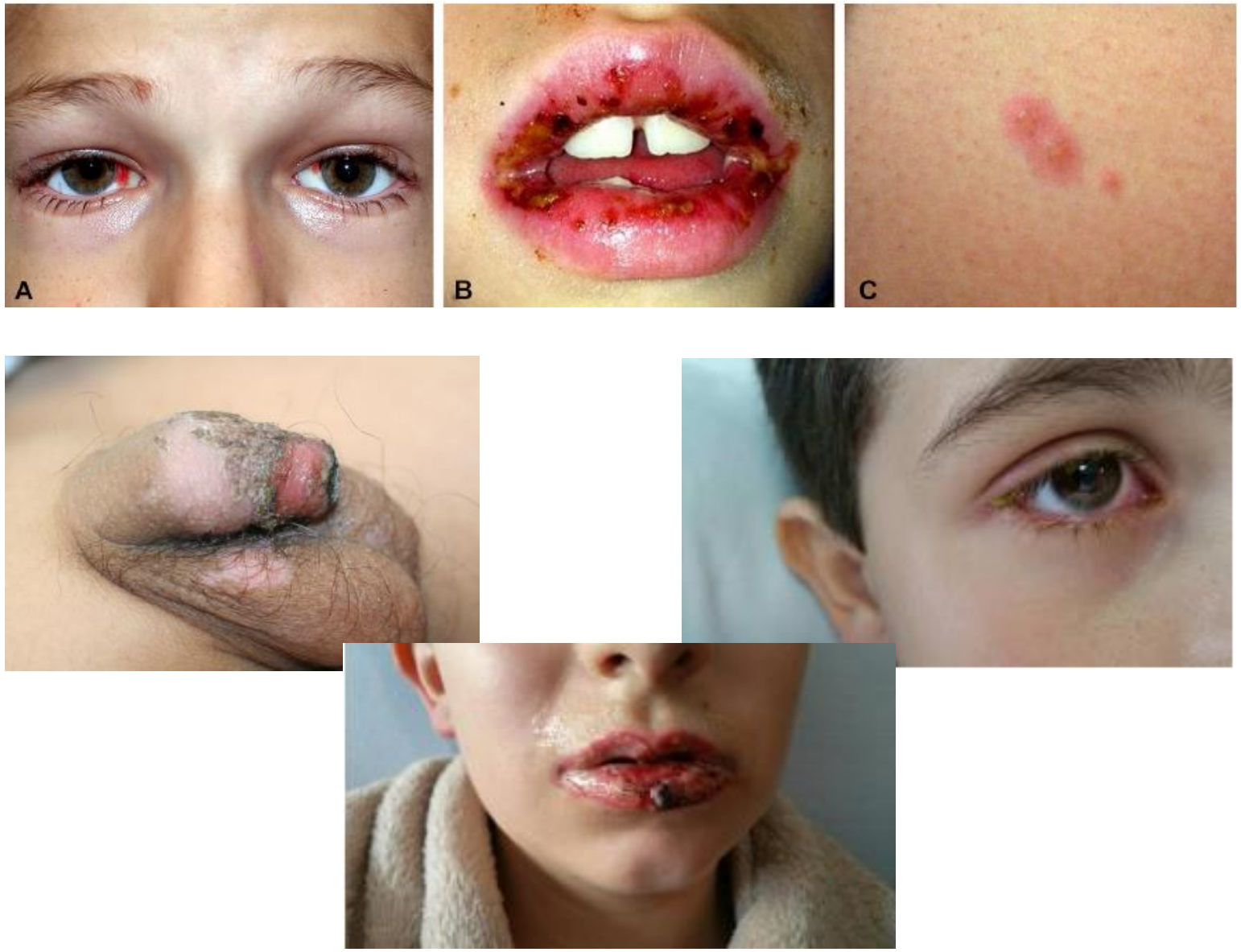
	Fuchs' syndrome	Varicella-like eruption	Vascu-litis	Erythema nodosum
Patients, n	37	8	21	11
Age, years				
Childhood	21	5	14	8
Adulthood	16	3	7	3
Gender				
Male	32[a]	6[a]	12	2[b]
Female	5[a]	2[a]	9	7[b]

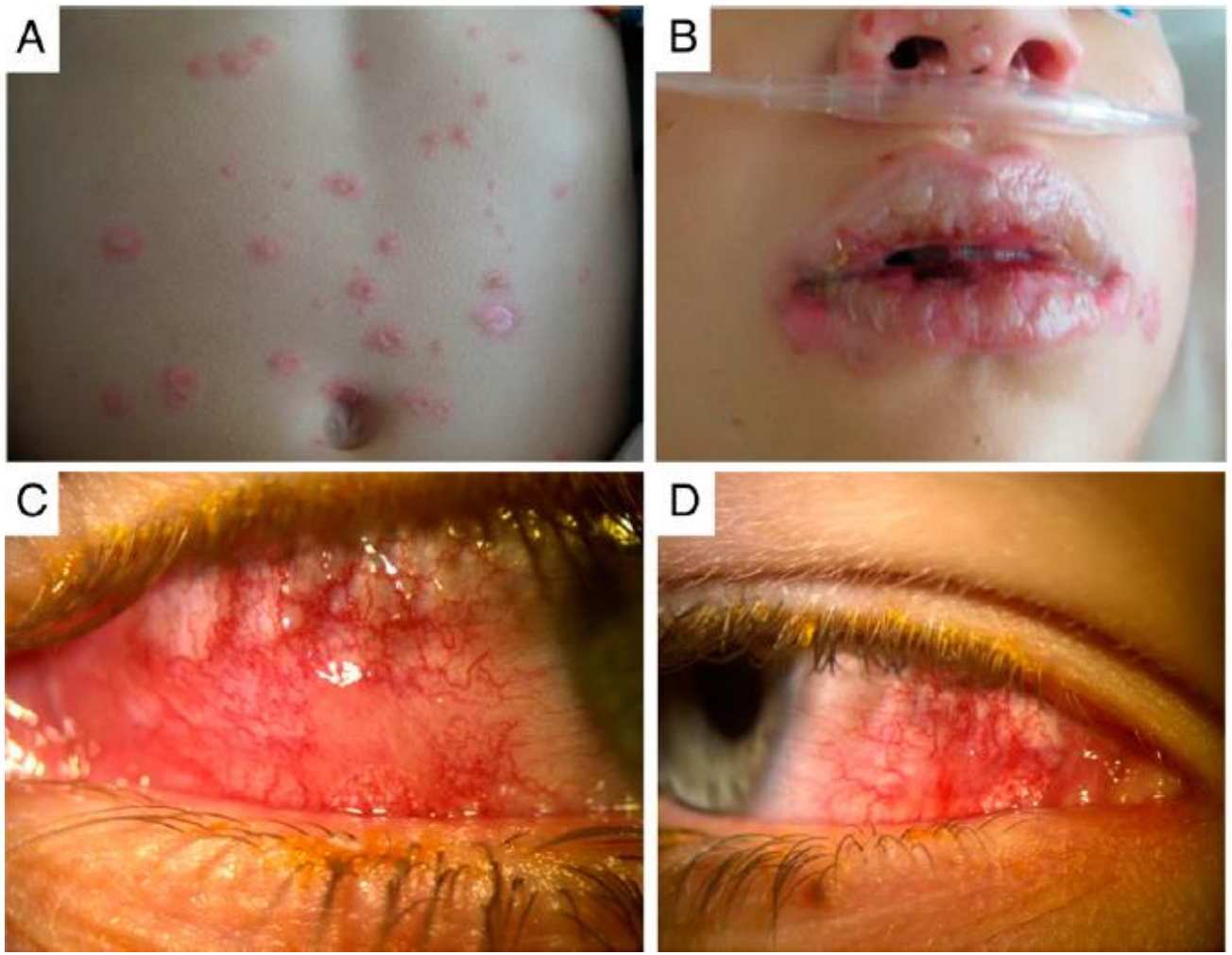
Dermatology 2015;231:152-7

Table I. Clinical characteristics of *Mycoplasma*-induced rash and mucositis

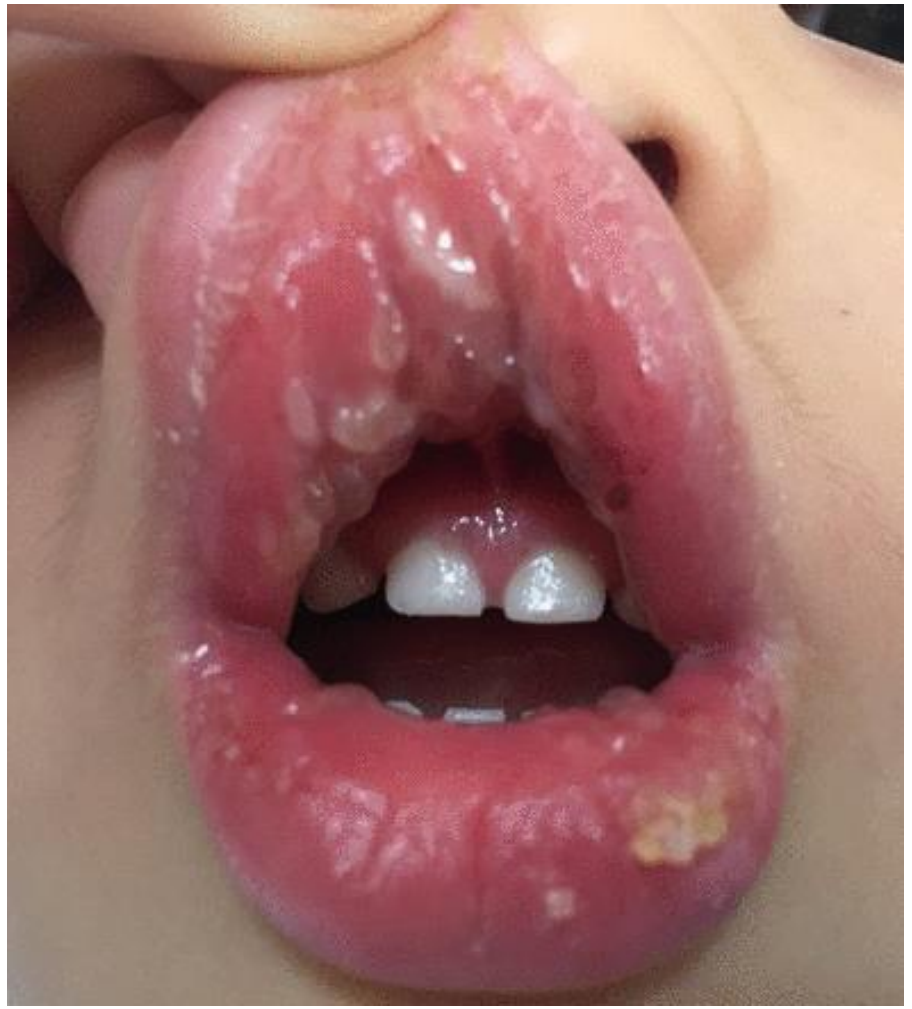
Age, y	11.9 ± 8.8
Gender	
Male	121 (66)
Female	62 (34)
Unknown	19 (10)
Morphology*	
Vesiculobullous	72 (77)
Targetoid or atypical targetoid	45 (48)
Papules	13 (14)
Macules	11 (12)
Morbilliform	9 (9)
Cutaneous involvement	
Sparse	61 (47)
Absent	42 (34)
Moderate†	24 (19)
Cutaneous distribution	
Acral	42 (46)
Generalized	29 (31)
Truncal	21 (23)
Mucosal involvement	
Oral	168 (94)
Ocular	147 (82)
Urogenital	112 (63)
No mucositis	4 (2)
Clinical outcomes	
Full recovery	104 (81)
PIPA	7 (6)
Mucosal complications‡	13 (10)
Recurrence	10 (8)
Death	4 (3)

J Am Acad Dermatol 2015;72:239-45 et Clin Case Rep 2018;6(3):551-2





Pediatrics 2015;136:e386

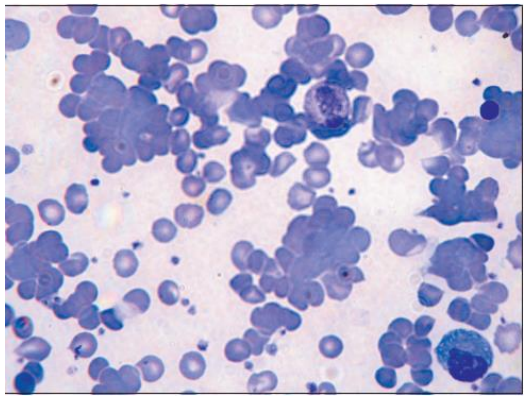


BMJ Case Reports 2018; doi:10.1136/bcr-2017-223321

Autres atteintes liées au Mycoplasme

Anémie hémolytique à agglutinines froides

- Présence agglutinines froides : 50-60% des infections Mp
- Précoces (1 semaine jusqu'à 2-6 semaines)
- Le plus souvent anémie pauci-symptomatique (réticulocytose)
- Mécanisme direct (lyse paroi des GR) ou indirect (agglutination)
- Médié par le complément



- **Spécificité anti-I**
  - Présent sur GR
  - Présent sur sialo-oligosaccharides des cellules bronchiques (récepteur Mp)

Braz J Infect Dis 2009;13:77-9

TABLE 1 | Extrapulmonary manifestations due to *M. pneumoniae* infection classified according to the involved pathomechanisms.

Manifestations	Direct type[a]	Indirect type[b]	Vascular occlusion type[c]	Undetermined[d]
Cardiovascular system	Pericarditis, Endocarditis	Myocarditis, Kawasaki disease	Cardiac thrombus, Aortic thrombus	
Dermatological		Erythema multiforme, Urticaria, Anaphylactoid purpura, EN, CLV, SJS, MPAM, SPD		
Digestive organ	Early onset hepatitis	Late onset hepatitis	Pancreatitis	
Hematological/ Hematopoietic system		Autoimmune hemolytic anemia, Hemophagocytic syndrome, Thrombocytopenic purpura, Infectious mononucleosis	Disseminated intravascular coagulation, Splenic infarct	
Musculoskeletal system	Arthritis			Rhabdomyolysis
Neurological	Early onset encephalitis, Early onset myelitis, Aseptic meningitis	Late onset encephalitis, Late onset myelitis, Guillain-Barré syndrome, Cranial/peripheral neuropathies, Cerebellitis, Acute cerebellar ataxia, Opsoclonus-myoclonus syndrome	Stroke, Psychological disorders, Striatal necrosis, Thalamic necrosis	Acute disseminated encephalomyelitis
Respiratory system			Pulmonary embolism	
Sensory organ	Otitis media	Conjunctivitis, Iritis, Uveitis	Sudden hearing loss	
Urogenital tract		Glomerulonephritis, IgA nephropathy	Priapism, Renal artery embolism	

Front Microbiol 2016;7:23

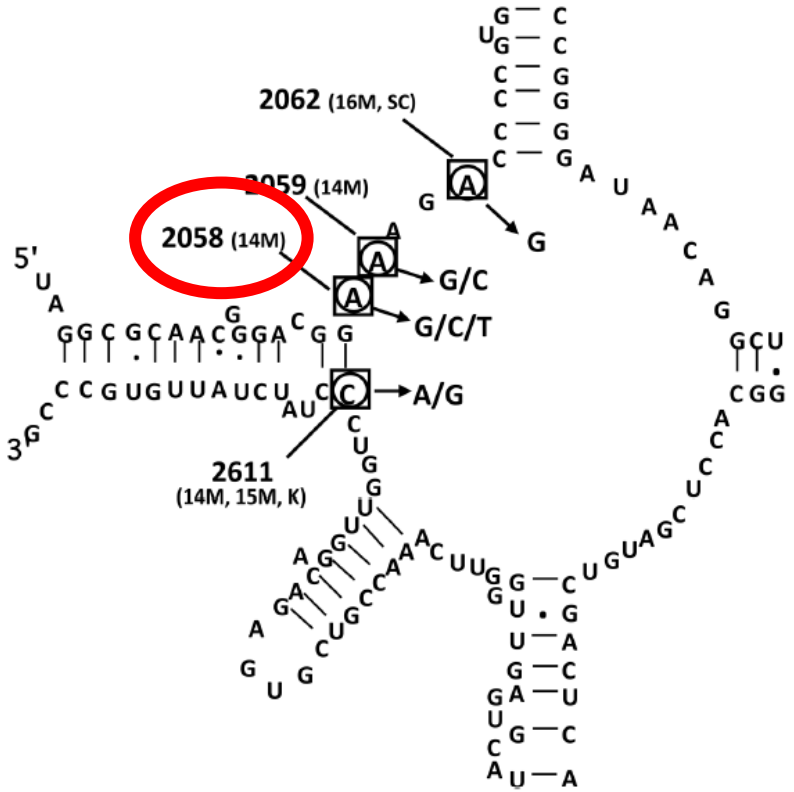
Le traitement

Traitement ATB infections à *M.pneumoniae*

- Pas de paroi : R^{ce} beta-lactamines, glycopeptides, fosfomycine
- Résistance naturelle : sulfamides, rifampicine, linezolide, polymyxine
- Sensibilité
  - MLSK ++
  - Tétracycline
  - FQ surtout moxifloxacine (Izilox®) et lévofloxacine (Tavanic ®)

Front Microbiol 2016;7:974

Résistance macrolides



- Résistance par mutation 23S rARN et protéines ribosomales L4 et L22
- A2058G et A2059G : haut niveau résistance aux macrolides en C14 (clarithro) et 15 (azithro) (C16 (josa) aussi pour A2059G)
- Pas de résistance croisée avec tétracyclines et FQ
- Expression clinique : persistance des signes
- Options : doxycycline ou minocycline, FQ, pristinamycine?

Front Microbiol 2016;7:974

Messages

- *Mycoplasma pneumoniae* est un germe de portage
- Sérologie et PCR performantes... Mais à interpréter avec précaution
- Physiopathologie : toxicité directe, indirecte ou par Ac auto-immuns
- Rôle de protéine P1 et de toxine CARDS
- **Grande diversité clinique ++**