Pneumonie acquise sous ventilation mécanique

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Conflit d’intérêt en rapport avec la présentation

- Aucun

Homme de 50 ans hospitalisé pour une pancréatite aiguë nécrosante

- Tableau initial : SDRA et nécrose tubulaire aiguë
- À J6, amélioration significative
  - Ventilation en 50% PEP 8
  - Reprise de diurèse
- À J9, dégradation :
  - Fièvre 38,5°C
  - Sécrétions trachéobronchiques purulentes
  - Dégradation des échanges gazeux => FiO2 remontée à 70%

- Questions ?

Plan

- Quand suspectez une PAVM ?
- Quels prélèvements effectuer ?
- Quel délai pour débuter l’antibiothérapie ?
- Quelle antibiothérapie ? Donc quelle microbiologie ?
- Réévaluation ?
- Quelle durée d’antibiothérapie ?
- Quels moyens de prévention ?

Bibliographie

Intensive Care Med (2015) 41:34–48
DOI 10.1007/s00134-014-3564-5

REVIEW

Girish B. Nair
Michael S. Niederman

Ventilator-associated pneumonia: present understanding and ongoing debates

Clinical Infectious Diseases Advance Access published July 14, 2016

Clinical Infectious Diseases

IDSA GUIDELINE

IDSA Infectious Diseases Society of America

hivma hiv medicine association

OXFORD

Management of Adults With Hospital-acquired and Ventilator-associated Pneumonia: 2016 Clinical Practice Guidelines by the Infectious Diseases Society of America and the American Thoracic Society

Homme de 50 ans hospitalisé pour une pancréatite aiguë nécrosante

- Tableau initial : SDRA et nécrose tubulaire aiguë
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CDC définition for VAP

Radiographic criteria—two or more chest x-rays showing any of the following

1. New or progressive and persistent infiltrate
2. Consolidation
3. Cavitation

Systemic criteria—at least one of the following

1. Fever (>38 °C or >100.4 °F)
2. Leukopenia (4,000 WBC/mm^3) or leukocytosis (>12,000 WBC/mm^3)
3. For adults >70 years old, altered mental status with no other recognized cause

Pulmonary criteria—at least two of the following

1. New onset of purulent sputum, or change in character of sputum, increased respiratory secretions or increased suctioning requirements
2. Worsening gas exchange (e.g., desaturations, increased oxygen requirements, or increased ventilator demand)
3. New onset or worsening cough, or dyspnea, or tachypnea
4. Rales or bronchial breath sounds

Quand suspectez une PAVM ?

Component	Value	Points
Temperature (°C)	≥36.5 and ≤38.4	0
	≥38.5 and ≤38.9	1
	≥39.0 or ≤36.0	2
Blood leukoctyes (WBC/mm^3)	≥4,000 and ≤11,000	0
	<400 or >11,000	1
Tracheal secretion	Few	0
	Moderate	1
	Large	2
	Purulent	+1
Oxygenation PaO_2/FiO_2	>240 or presence of ARDS	0
	≤240 and absence of ARDS	2
Chest radiograph	No infiltrate	0
	Patchy or diffuse infiltrate	1
	Localized infiltrate	2

C PIS

Clinical pulmonary infection score

Nouvelles définitions du CDC : Ventilator-associated events

Ventilator-associated complication	*At least one* of the following indicators of *worsening oxygenation* 1. Minimum daily FiO_2 values increase $\geq$0.20 (20 points) over baseline and remain at or above that increased level for $\geq$2 calendar days 2. Minimum daily PEEP values increase $\geq$3 cmH_2O over baseline and remain at or above that increased level for $\geq$2 calendar days
Infection-related ventilator-associated complication	Patient has VAC and also fits *both* of the two following criteria 1. Temperature greater than 38 °C or WBC greater than 12,000 or less than 4,000/mm^3 2. A new antimicrobial agent is started and is continued for 4 or more calendar days
Possible VAP	On or after calendar day 3 of mechanical ventilation and within 2 calendar days before or after the onset of worsening oxygenation, *one* of the following criteria is met 1. Purulent respiratory secretions (defined as secretions from the lungs, bronchi, or trachea that contain >25 neutrophils and <10 squamous epithelial cells per low power field [lpf, ×100]; If the laboratory reports semiquantitative results, those results must be equivalent to the above quantitative thresholds) 2. Positive culture (qualitative, semiquantitative, or quantitative) of sputum, endotracheal aspirate, bronchoalveolar lavage, lung tissue, or protected specimen brushing
Probable VAP	On or after calendar day 3 of mechanical ventilation and within 2 calendar days before or after the onset of worsening oxygenation, *one* of the following criteria is met 1. Purulent respiratory secretions (from one or more specimen collections—and defined as for possible VAP) and one of the following: positive culture of endotracheal aspirate, $\geq 10^5$ CFU/ml or equivalent semiquantitative result, or positive culture of bronchoalveolar lavage, $\geq 10^4$ CFU/ml or equivalent semiquantitative result, or positive culture of lung tissue, $\geq 10^4$ CFU/ml or equivalent semiquantitative result, or positive culture of protected specimen brush, $\geq 10^3$ CFU/ml or equivalent semiquantitative result 2. One of the following (without requirement for purulent respiratory secretions): positive pleural fluid culture (where specimen was obtained during thoracentesis or initial placement of chest tube and *not* from an indwelling chest tube), or positive lung histopathology, or positive diagnostic test for *Legionella* spp., or positive diagnostic test on respiratory secretions for influenza virus, respiratory syncytial virus, adenovirus, parainfluenza virus

Nouvelles définitions du CDC : Ventilator-associated events

Ventilator-associated complication

Infection-related ventilator-associated complication

Possible VAP

Probable VAP

VAC

Après au moins deux jours d'amélioration:

- Augmentation Fi02 d'au moins 20%
- Augmentation PEP d'au moins 3 cmH20
- Pendant au moins 2 jours

Nouvelles définitions du CDC : Ventilator-associated events

Ventilator-associated complication
Infection-related ventilator-associated complication
Possible VAP
Probable VAP

IVAC => VAC et :

- Fièvre >38°C
- Leucocytes > 12000 ou < 4000/mm3
- Introduction d'un ttt anti-infectieux pour au moins 4 jours

Nouvelles définitions du CDC : Ventilator-associated events

Ventilator-associated complication	
Infection-related ventilator-associated complication	
Possible VAP	IVAC et : · Sécrétions purulentes ou · Culture respiratoire positive
Probable VAP	IVAC et : · Sécrétions purulentes et culture respiratoire positive (semi quantitative ou quantitative) ou · Prélèvement spécifique (AgU légionelle, grippe, VRS, adénovirus +, ou culture pleurale +)

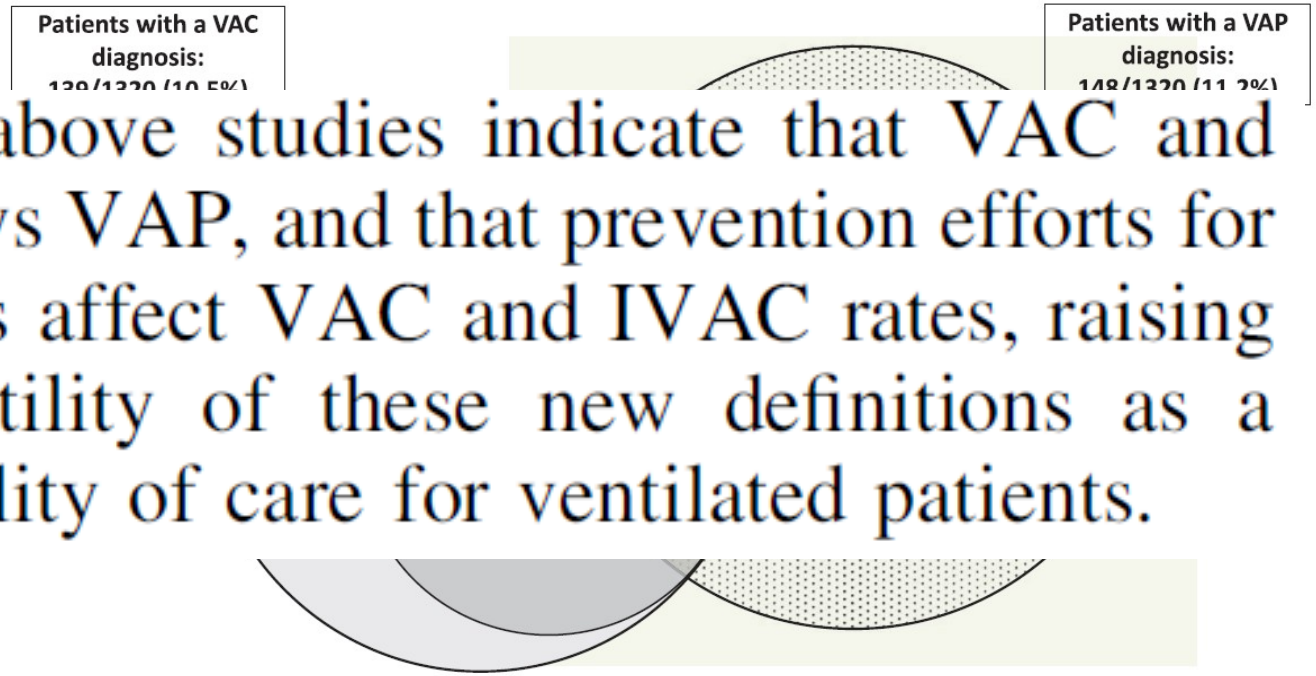
Pas d'imagerie

Intérêt de ces nouvelles définitions ?

CHEST Original Research
CRITICAL CARE

The Clinical Impact and Preventability of Ventilator-Associated Conditions in Critically Ill Patients Who Are Mechanically Ventilated

John Muscedere, MD; Tasnim Sinuff, MD, PhD; Daren K. Heyland, MD; Peter M. Dodek, MD, MHSc; Sean P. Keenan, MD; Gordon Wood, MD; Xuran Jiang, MSc; Andrew G. Day, MSc; Denny Laporta, MD; and Michael Klompas, MD, MPH; for the Canadian Critical Care Trials Group



Data from the above studies indicate that VAC and IVAC are not always VAP, and that prevention efforts for VAP do not always affect VAC and IVAC rates, raising doubt about the utility of these new definitions as a measure of the quality of care for ventilated patients.

FIGURE 1. The relationship between VAP, VAC, and iVAC. iVAC = infection-related ventilator-associated complication; VAC = ventilator-associated condition; VAP = ventilator-associated pneumonia.

Diagnostic d’une PAVM

- Difficile
- Aucun critères spécifiques (sauf peut-être l’anapath…) :
  - Fièvre
  - Hyperleucocytose
  - Dégradation des échanges gazeux
  - Sécrétions purulentes
  - Prélèvements respiratoire
- Doute fréquent entre trachéobronchite (VAT) et PAVM (VAP)
  - Est-ce grave ?

Plan

- Quand suspectez une PAVM ?
- **Quels prélèvements effectuer ?**
- Quel délai pour débuter l'antibiothérapie ?
- Quelle antibiothérapie ? Donc quelle microbiologie ?
- Réévaluation ?
- Quelle durée d'antibiothérapie ?
- Quels moyens de prévention ?

Cochrane Library
Cochrane Database of Systematic Reviews

Comparison 1. Quantitative versus qualitative culture

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Mortality	3	1240	Risk Ratio (M-H, Fixed, 95% CI)	0.91 [0.75, 1.11]
2 Antibiotic change	2	827	Risk Ratio (M-H, Random, 95% CI)	1.53 [0.54, 4.39]
3 Duration on mechanical ventilation (days)	2	827	Mean Difference (IV, Fixed, 95% CI)	0.58 [-0.51, 1.68]
4 ICU stay (days)	3	1240	Mean Difference (IV, Fixed, 95% CI)	0.95 [-0.14, 2.04]

Comparison 2. Invasive versus non-invasive method

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Mortality	5	1367	Risk Ratio (M-H, Fixed, 95% CI)	0.93 [0.78, 1.11]
2 Antibiotic change	4	954	Risk Ratio (M-H, Random, 95% CI)	1.67 [0.87, 3.21]
3 Duration on mechanical ventilation (days)	4	954	Mean Difference (IV, Fixed, 95% CI)	0.61 [-0.47, 1.68]
4 ICU stay (days)	5	1367	Mean Difference (IV, Fixed, 95% CI)	0.94 [-0.13, 2.01]

Prélèvements respiratoires

Quantitative versus qualitative cultures of respiratory secretions for clinical outcomes in patients with ventilator-associated pneumonia (Review)

Plan

- Quand suspectez une PAVM ?
- Quels prélèvements effectuer ?
- **Quel délai pour débuter l'antibiothérapie ?**
- Quelle antibiothérapie ? Donc quelle microbiologie ?
- Réévaluation ?
- Quelle durée d'antibiothérapie ?
- Quels moyens de prévention ?

Vous suspectez une PAVM…

- Vous venez de prélevez le patient.
- Il est 21h et vous êtes seul pour décider…

Réponse A : on attend la visite de demain et le rendu de la microbiologie

Réponse B : c'est une urgence, j'initie de suite (malgré mes doutes diagnostiques)

Diminution de la consommation antibiotique

Meilleure adaptation de la molécule antibiotique si PAVM

Evite le retard thérapeutique si PAVM confirmée

Risque d'inadéquation plus important

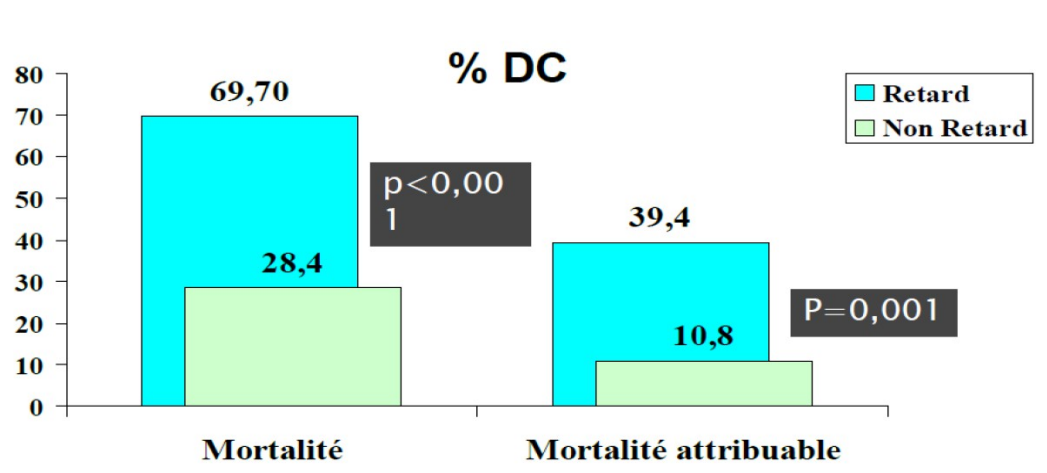
Risque de prescription inutile (surconsommation d'ATB)

Conséquence d'une PAVM ?

Clinical Importance of Delays in the Initiation of Appropriate Antibiotic Treatment for Ventilator-Associated Pneumonia*

CHEST 2002; 122:262–268

Manuel Iregui, MD; Suzanne Ward, RN; Glenda Sherman, RN; Victoria J. Fraser, MD; and Marin H. Kollef, MD, FCCP



- Néanmoins :
  - **Pas de certitude sur un lien Mortalité et PAVM**
  - Certitudes sur
    - Augmentation de la durée de ventilation mécanique
    - Augmentation de la durée de séjour en réanimation
    - Augmentation du coût de prise en charge

Vous suspectez une PAVM…

- Vous venez de prélevez le patient.
- Il est 21h et vous êtes seul pour décider…

Réponse A : on attend la visite de demain et le rendu de la microbiologie

Réponse B : c'est une urgence, j'initie de suite (malgré mes doutes diagnostiques)

Au cas par cas selon :

- Gravité du patient
- Terrain
- Disponibilité d'un résultat microbiologique 24/24
- Expérience

Plan

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- **Quelle antibiothérapie ? Donc quelle microbiologie ?**
- Réévaluation ?
- Quelle durée d’antibiothérapie ?
- Quels moyens de prévention ?

Epidémiologie

ANTIMICROBIAL AGENTS AND CHEMOTHERAPY, July 2009, p. 2714–2718

Early- and Late-Onset Pneumonia: Is This Still a Useful Classification?[▽]

Petra Gastmeier,[1,2]* Dorit Sohr,[2] Christine Geffers,[2] Henning Rüden,[2]
Ralf-Peter Vonberg,[1] and Tobias Welte[3]

TABLE 3. Isolates per 100 pneumonia cases for the most frequent microorganisms, together with the order of frequency of the four most frequent pathogens[a]

Pathogen	No. of isolates per 100 pneumonia cases (order of frequency)					
	"Early-onset" pneumonia			"Late-onset" pneumonia		
	1–4 days	1–5 days	1–7 days	>4th day	>5th day	>7th day
S. aureus	25.7 (1st)	26.8 (1st)	26.9 (1st)	23.7 (1st)	23.0 (1st)	21.0 (1st)
MSSA	21.4	22.9	22.7	16.8	13.8	14.5
MRSA	4.3	4.0	4.3	6.9	6.5	6.5
P. aeruginosa	11.6 (2nd)	11.6 (2nd)	11.9 (2nd)	17.4 (2nd)	16.1 (2nd)	19.9 (2nd)
K. pneumoniae	10.8 (3rd)	10.7 (4th)	11.1 (3rd)	11.8 (3rd)	10.6 (3rd)	12.6 (3rd)
E. coli	10.0 (4th)	10.8 (3rd)	10.6 (4th)	10.1 (4th)	8.7 (4th)	10.1 (4th)
S. pneumoniae	9.3	8.9	8.3	5.1	4.2	4.3
Enterobacter spp.	6.4	6.7	7.5	8.8	7.9	9.4
Haemophilus spp.	6.9	6.9	6.7	3.9	3.1	2.9
Acinetobacter spp.	2.6	2.6	3.2	4.8	4.5	5.5
S. maltophilia	1.3	1.3	1.4	3.1	3.0	3.8

Epidémiologie

Table 2 Etiologic agents causing VAP

Core pathogens	MDR pathogens
S. pneumoniae	*P. aeruginosa*
H. influenzae	*Acinetobacter* sp.
Enterobacter spp.	*Stenotrophomonas maltophilia*
Escherichia coli	*Klebsiella pneumoniae* (ESBL+)
Klebsiella spp.	Methicillin-resistant *S. aureus* (MRSA)
Proteus spp.	
Serratia marcescens	
Methicillin-sensitive *S. aureus*	

MDR risk Factors

1. Current hospitalization of ≥5 days
2. Antibiotic treatment in the prior 90 days
3. High frequency (>25%) of antibiotic resistance in the specific ICU
4. Immunosuppressive disease/therapy
5. Presence of multiple risk factors for healthcare associated pneumonia
   - Hospitalization for 2 days or more in the preceding 90 days
   - Residence in a nursing home or extended care facility
   - Home infusion therapy (including antibiotics)
   - Chronic dialysis within 30 days

Quelle antibiothérapie ?

No MDR risk factors

Monotherapy with any of the following agents (normal renal function) :

- Ampicillin/Sulbactam : 1.5 to 3 g intravenously every 6 hours
- Ceftriaxone : 1-2 g intravenously every 24 hours
- Ertapenem : 1 g intravenously every 24 hours
- Levofloxacin : 750 mg intravenously every 24 hours
- Moxifloxacin : 400 mg hours

If MRSA is suspected, add one of the following -

- Linezolid : 600 mg intravenously every 12 hours
- Vancomycin HCl : 15 mg/kg intravenously every 12 hours

MDR risk factors present

Combination therapy with:

Any one of the following (normal renal function) –

- Cefepime : 1-2 g intravenously every 8 to 12 hours
- Ceftazidime sodium : 2 g intravenously every 8 hours
- Imipenem/cilastatin : 500 mg intravenously every 6 hours; or 1000 mg intravenously every 8 hours
- Meropenem : 1 g intravenously every 8 hours
- Piperacillin/Tazobactam : 4.5 g intravenously every 6 hours

Plus any one of the following -

- Ciprofloxacin : 400 mg intravenously every 8-12 hours
- Levofloxacin : 750 mg intravenously every 24 hours
- Amikacin : 2 [redacted] 4 hours
- Gentamicin : 7 mg/kg intravenously every 24 hours
- Tobramycin : 7 mg/kg intravenously every 24 hours

25-30 mg/kg poids mesuré

Questions persistantes en 2018

Table 6 Other issues with VAP treatment

1. Linezolid versus glycopeptides in treatment of MRSA VAP
2. Role of tigecycline in treatment of *Acinetobacter* sp.
3. Use of adjunctive aerosolized antibiotics in VAP treatment
4. Role of non-bacterial pathogens in VAP—viruses and fungi
5. VAP in trauma patients
6. Role of low pathogenicity organisms such as *Staphylococcus epidermidis* and anaerobic bacteria in VAP
7. Continuous or prolonged infusion of antibiotics versus standard intermittent dosing
8. Role of therapeutic drug monitoring to decrease mortality

Plan

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- Quelle antibiothérapie ? Donc quelle microbiologie ?
- **Réévaluation ?**
- Quelle durée d’antibiothérapie ?
- Quels moyens de prévention ?

Culture positive + Improving biomarker profile and Clinical status

-Narrow antibiotic regimen to the isolated pathogen.

Culture negative + Improving biomarker profile and Clinical Status

-Consider stopping therapy

Non responders or Worsening Clinical status

-Check for improper dosage of antibiotics

- Rule out complications

- Cover for resistant pathogens

-Use of adjunctive aerosolized medications

Objectif de réduire l'antibiothérapie (spectre + ++)

Après 72h

Plan

- Quand suspectez une PAVM ?
- Quels prélèvements effectuer ?
- Quel délai pour débuter l’antibiothérapie ?
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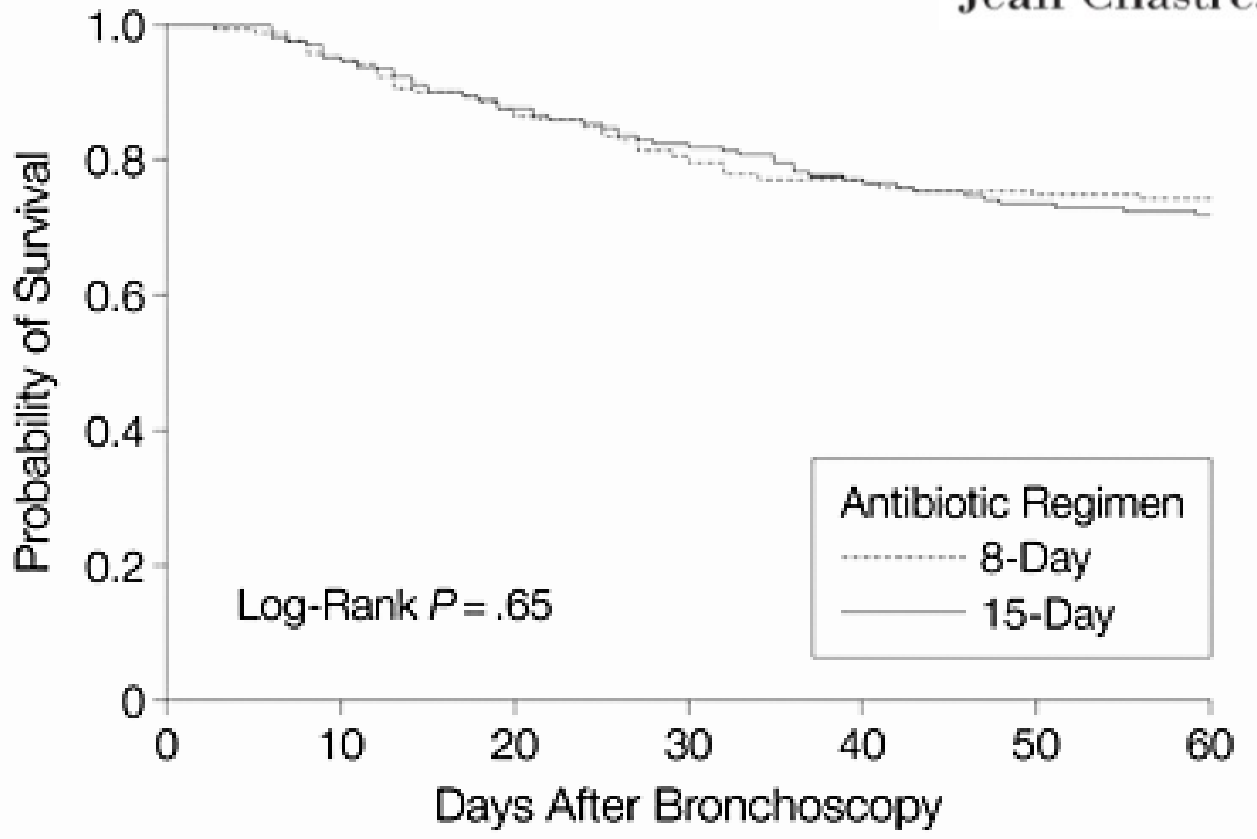
- Réévaluation ?
- **Quelle durée d’antibiothérapie ?**
- Quels moyens de prévention ?

Comparison of 8 vs 15 Days of Antibiotic Therapy for Ventilator-Associated Pneumonia in Adults

Jean Chastre, MD

JAMA. 2003 Nov 19;290(19):2588-98

Durée de l'antibiothérapie



). at Risk							
Regimen	197	187	172	158	151	148	147
Regimen	204	194	179	167	157	151	147

Plan

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- Quelle antibiothérapie ? Donc quelle microbiologie ?
- Réévaluation ?
- Quelle durée d’antibiothérapie ?
- **Quels moyens de prévention ?**

Pneumonia Prevention to Decrease Mortality in Intensive Care Unit: A Systematic Review and Meta-analysis

Antoine Roquilly,[1] Emmanuel Marret,[3] Edward Abra

Intervention	No. of RCTs; No. of Patients (N); I^2, %	Relative Risk (95% CI)	*P* Value
Acidified enteral feeding	1; 120; NA	2.07 (.90–4.49)	**.09**
Tracheal cuff monitoring	2; 264; 0	1.22 (.70–2.11)	.49
PEEP	1; 127; NA	1.17 (.66–2.06)	.59
Silver-coated ET	1; 1509; NA	1.14 (.97–1.34)	.11
Physiotherapy	2; 204; 81	1.14 (.20–6.59)	.88
Patient position	5; 785; 0	1.06 (.82–1.38))	.65
Decreased gastric content	3; 810; 0	1.06 (.83–1.35)	.65
Tracheal saline instillation	1; 262; NA	1.05 (.82–1.33)	.71
Ulcer prophylaxis	16; 3365; 0	1.00 (.89–1.13)	.97
SOD	23; 9666; 0	0.99 (.92–1.08)	.89
Subglottic secretion drainage	9; 2241; 0	0.98 (.84–1.15)	.85
Heat moisture exchanger	13; 2431; 0	0.98 (.86–1.12)	.78
Closed suctioning system	5; 909; 0	0.98 (.83–1.17)	.85
Aerosolized antibiotic	5; 450; 23	0.95 (.66–1.38)	.80
Post pyloric feeding	6; 582; 0	0.93 (.67–1.28)	.64
Probiotic/symbiotic	13; 1569; 23	0.89 (.66–1.18)	.41
Early tracheotomy	6; 1050; 45	0.85 (.64–1.12)	.24
SDD	**30; 10 227; 16**	**0.84 (.76–0.92)**	**.001**
Sinusitis prophylaxis	1; 399; NA	0.80 (.63–1.01)	.06
Early enteral feeding	1; 150; NA	0.75 (.42–1.35)	.34
Phytotherapy	1; 36; NA	0.67 (.13–3.53)	.65
Overall	**145; N=37156; 4**	**0.95 (.92–.99)**	**.02**

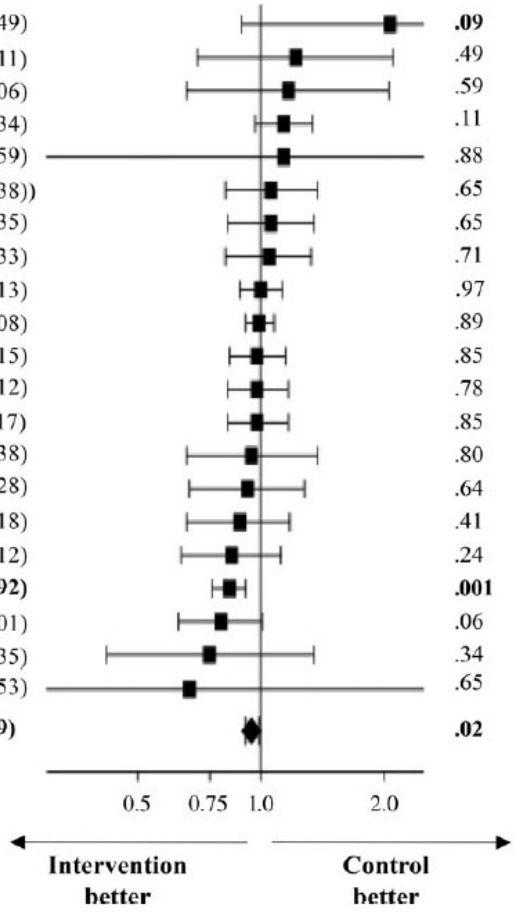


Figure 2. Hospital mortality rates in critically ill patients receiving a strategy for preventing hospital-acquired pneumonia. All pooled estimates used the random effects model. Boldface *P* values indicate significant differences ($P < .05$). Abbreviations: CI, confidence interval; ET, endotracheal tube; NA, not applicable; PEEP, positive end-expiratory pressure; RCT, randomized controlled trial; SDD, selective digestive decontamination; SOD, selective oropharyngeal decontamination.

Long-Term Impact of a Multifaceted Prevention Program on Ventilator-Associated Pneumonia in a Medical Intensive Care Unit

Lila Bouadma,[1] Emmanuelle Deslandes,[2] Isabelle Lolom,[3] Bertrand Le Corre,[1] Bruno Mourvillier,[1] Bernard Regnier,[1] Raphael Porcher,[2] Michel Wolff,[1,4] and Jean-Christophe Lucet[3]

Clinical Infectious Diseases 2010;51(10):1115–1122

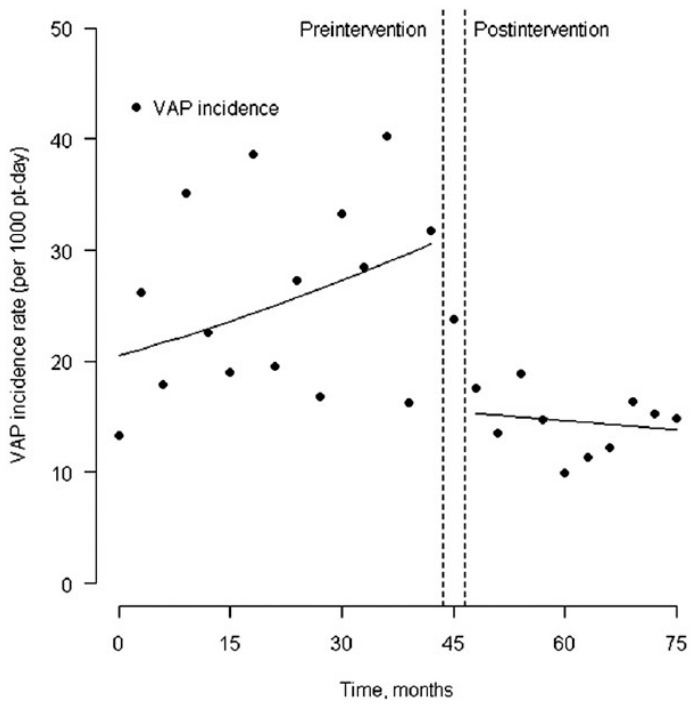


Figure 1. Segmented Poisson regression analysis, comparing incidence rates of ventilator-associated pneumonia (VAP) in the intensive care unit before and after a preventive intervention.

Process Indicators (References)	Preventive Measures Applied Herein (References)
Bedside observations	
Hand-hygiene adherence	According to published Centers for Disease Control guidelines (25, 26)
Glove-and-gown adherence	
Measurements made	
Correct backrest-elevation maintenance	Place the patient in a semirecumbent position with head of the bed elevated
Orogastric tube use	Use of an orogastric rather than a nasogastric tube
Gastric overdistention avoidance	Monitor gastric residual volume ≥4 times/day and take adequate action if it exceeds 150 mL
Good oral hygiene (7, 10)	After oropharyngeal aspiration, apply a 0.12% chlorexidine solution on each side of the buccal cavity with a foam applicator swab ≥4 times/day
Elimination of nonessential tracheal suction	Aspirate only productive tracheal secretions

In conclusion, our program for preventing VAP in the ICU was successful, with sustained improvements during 3 years. However, the VAP rates remained substantial despite high compliance with most of the preventive measures, suggesting that some VAP episodes may not be preventable in the ICU setting.

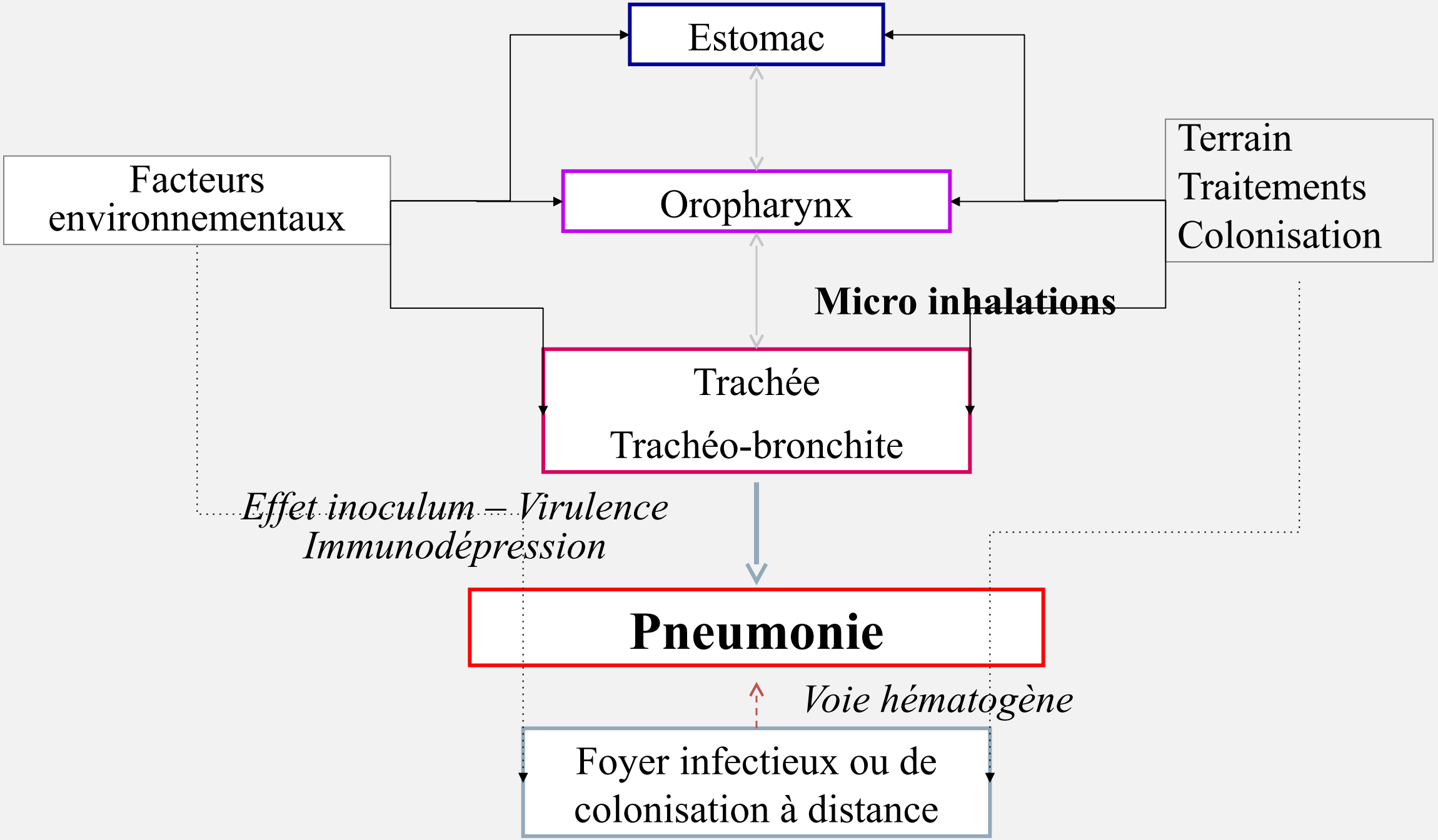
Conclusion

Step 1. Clinical suspicion for Ventilator associated pneumonia
1. Fever
2. Purulent tracheobronchial secretions
3. Worsening oxygenation status
4. Leukocytosis or leukopenia
5. Infectious Ventilator Associated Complications
Step 2. Confirmation and assess risk factors
1. Radiographic Confirmation
2. Culture - Lower respiratory tract
3. Clinical Pulmonary Infection score
4. Local antiobiograms
5. Risks for Multi-drug resistant pathogens
6. Check Biomarkers - Procalcitonin, CRP
Step 3. Initiate antibiotic therapy as soon as possible
Step 4. Re-evaluate in 72 hours, antibiotic de-escalation
Culture positive + Improving biomarker profile and Clinical status
-Narrow antibiotic regimen to the isolated pathogen.
Culture negative + Improving biomarker profile and Clinical Status
-Consider stopping therapy
Non responders or Worsening Clinical status
-Check for improper dosage of antibiotics
- Rule out complications
- Cover for resistant pathogens
-Use of adjunctive aerosolized medications

Physiopathologie des PAVM

- PAVM précoce
- <4-5 jours de ventilation mécanique

- PAVM tardive
- >5 jours de VM


Estomac
Facteurs environnementaux
Oropharynx
Terrain
Traitements
Colonisation
Micro inhalations
Trachée
Trachéo-bronchite
Effet inoculum – Virulence
Immunodépression
Pneumonie
Voie hématogène
Foyer infectieux ou de colonisation à distance