Gestion des infections neuroméningées sur matériel

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UMR 1101

Déclaration de liens d'intérêt avec les industries de santé en rapport avec le thème de la présentation (loi du 04/03/2002) :

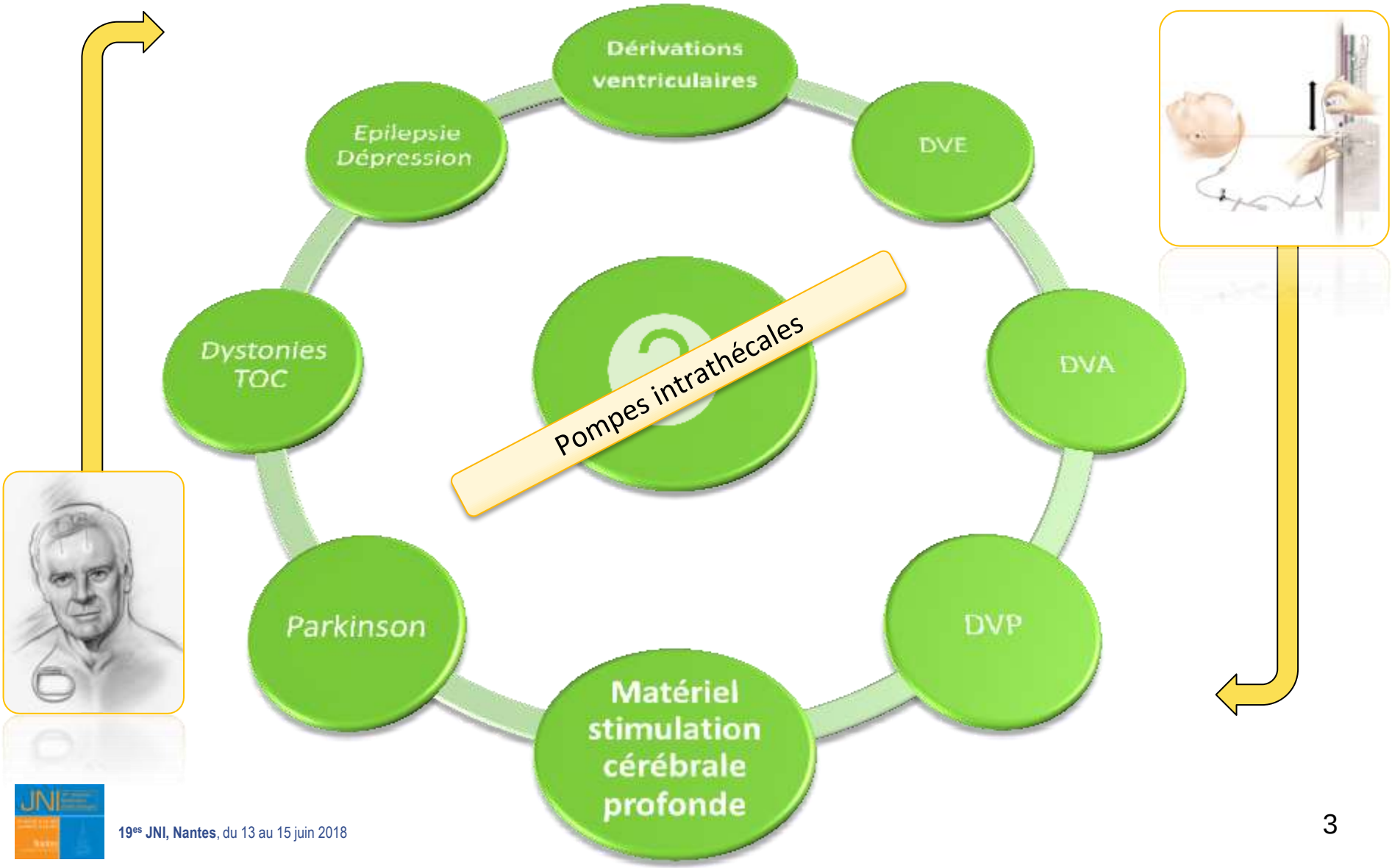
Intervenant : Nom/Prénom

Titre : Intitulé de l'intervention

- L'orateur ne souhaite pas répondre ☑

- Consultant ou membre d'un conseil scientifique — ☐ OUI ☑ NON
- Conférencier ou auteur/rédacteur rémunéré d'articles ou documents — ☐ OUI ☑ NON
- Prise en charge de frais de voyage, d'hébergement ou d'inscription à des congrès ou autres manifestations — ☑ OUI ☐ NON
  ViiVHealthcare, MSD, Gilead, Janssen, Eumedica
- Investigateur principal d'une recherche ou d'une étude clinique — ☐ OUI ☑ NON

Infections neuroméningées sur matériel



Matériel stimulation cérébrale : Incidence infections

Management of hardware infections following deep brain stimulation. Temel Y *et al.* Acta Neurochir (Wien) (2004) 146: 355–361

Abode-Iyamah K et al. J Neurosurg 2018. DOI: 10.3171/2017.9.JNS1780

Bjerknes S et al. PLoS ONE 9(8): e105288.

Tolleson C et al. Stereotact Funct Neurosurg 2014;92:227–233

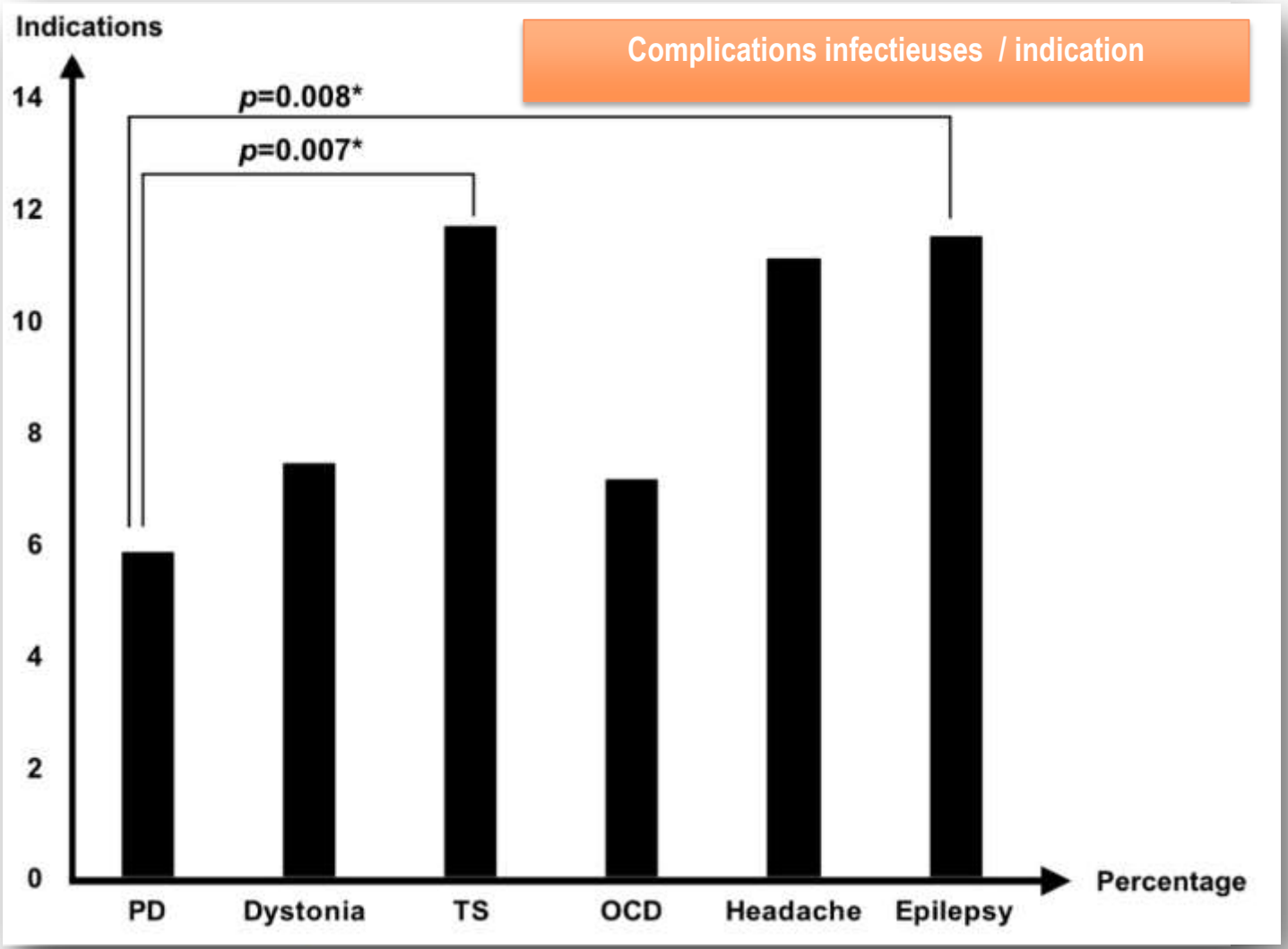
Table 3. *Overview of infection rates in publications on deep brain stimulation*

Research group*	Publication year	Number of stimulated patients	Journal	
Benabid *et al.* [3]	1998	197	Movement Disorders	1.5%
Kumar *et al.* [10]	1997	68	Neurosurgery	5.9%
Levy *et al.* [13]	1987	114	Neurosurgery	16.3%
Limousin *et al.* [14]	1999	110	J Neurology Neurosurgery Psychiatry	1.8%
Lyons *et al.* [15]	2001	206	Neurology	2.5%
Obeso *et al.* [18]	1998	36	Movement Disorders	22.2%
Oh *et al.* [19]	2002	79	Neurosurgery	8.8%
Pahwa *et al.* [20]	2001	50	Neurology	6.9%
Pollak *et al.* [21]	2002	300	Movement Disorders	3.3%
Present study	2003	106		3.8%

Bjerknes et al	2010	368	PLoS One	**8.7%**
Tolleson et al	2014	447	Stereotact Funct Neurosurg	**5.8%**
Abode-Iyamah et al	2018	242	J Neurosurg	**6.5%**

Matériel stimulation cérébrale

Systematic review of hardware-related complications of deep brain stimulation: Do new indications pose an increased risk?. Jitkritsadakul O, *et al.* Brain Stimulation 2017, doi: 10.1016/j.brs.2017.07.003

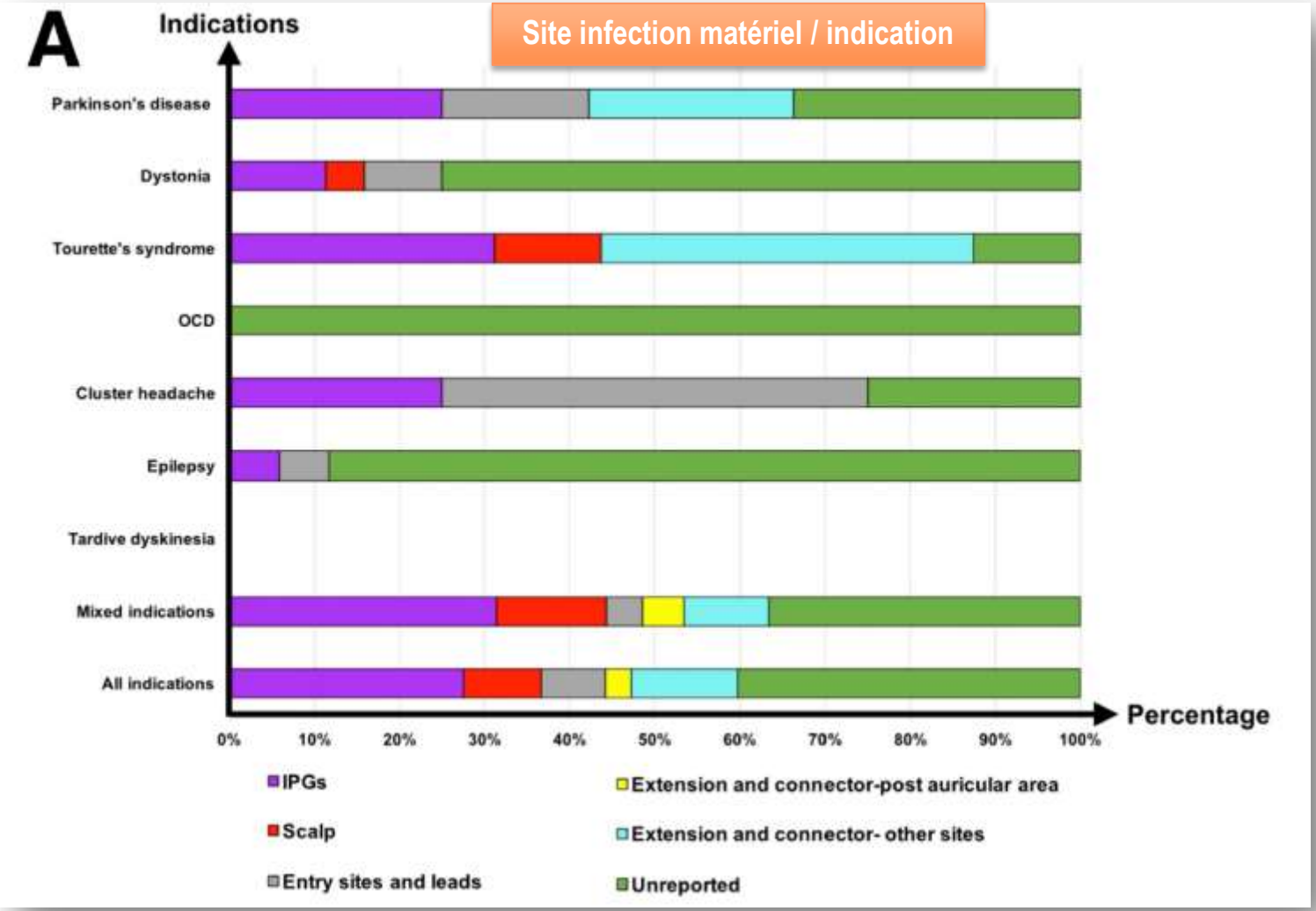


Méta-analyse

1987-2017
96 articles
8933 patients

Matériel stimulation cérébrale

Systematic review of hardware-related complications of deep brain stimulation: Do new indications pose an increased risk?. Jitkritsadakul O, *et al.* Brain Stimulation 2017, doi: 10.1016/j.brs.2017.07.003



Matériel stimulation cérébrale

Deep Brain Stimulation Hardware-Related Infections: A Report of 12 Cases and Review of the Literature. Fily F, *et al.* Clin Infect Dis 2011;52:1020-1023

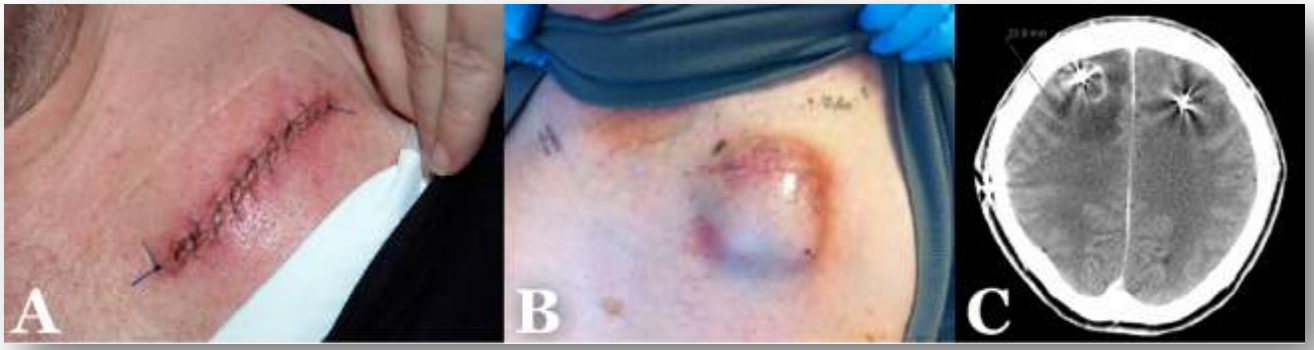
2006 -2008 – 67 patients avec stimulateurs – 12 infections associées

Case	Sex	Age, years	DBS indication	Infection delay (days after last DBS surgery)	Infection location	CT finding at admission	Serum CRP level, mg/L	Initial surgery	Culture results (c)	Evolution	Antibacterial treatment duration (weeks
1	F	42	OCD	90	Frontal (B)	Abscess	1	Total removal (B)	MSSA	Cure – no further surgery	12
2[a]	F	59	Dystonia	32	Chest, retroauricular (L)	Normal	108	Partial removal	MSSA	Cure after second surgery (total removal)	8
3[a]	F	59	Dystonia	14	Frontal, retroauricular (L)	Not done	30	No surgery	Not done	Cure – no further surgery	6
4	M	61	Parkinson	18	Chest, frontal, retroauricular (R)	Oedema	48	Total removal (B)	MSSA	Cure after second surgery (total removal)	12
5	M	46	Parkinson	28	Frontal (L)	Oedema	1.8	Total removal (L)	MSSA	Cure after second surgery (total removal)	4
6	F	54	Essential tremor	8	Frontal (L)	Normal	20	Wound debridment	PA	Hypodensity on CT scan (day 3) Cure after second surgery (total removal)	6
7	F	68	Parkinson	57	Chest (L)	Normal	130	Partial removal	MSSA	Cure – no further surgery	6
8	F	60	Parkinson	25	Chest, retroauricular (R)	Normal	3.3	Partial removal	*micrococcus*	Cure after second surgery (total removal)	NA
9	M	57	Parkinson	820	Chest, retroauricular (B)	Not done	5	Partial removal	MSSA	Cure after second surgery (total removal)	12
10	M	56	Parkinson	18	Chest (R)	Not done	31	Partial removal	MSSA	Cure – no further surgery	4
11	M	66	Parkinson	365	Chest (R)	Normal	3	Partial removal	SE	Cure – no further surgery	6
12	M	21	Dystonia	90	Chest (R)	Not done	NA	Partial removal	SE	Cure – no further surgery	3

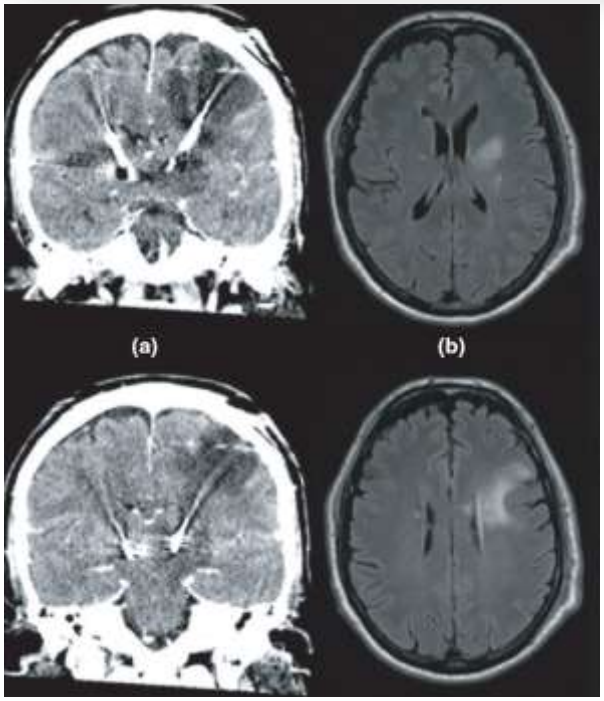
Peu de signes généraux
3 patients fébriles < 38,5C
1 seul avec signes neuro

Hémocultures stériles

Matériel stimulation cérébrale : Présentation clinique



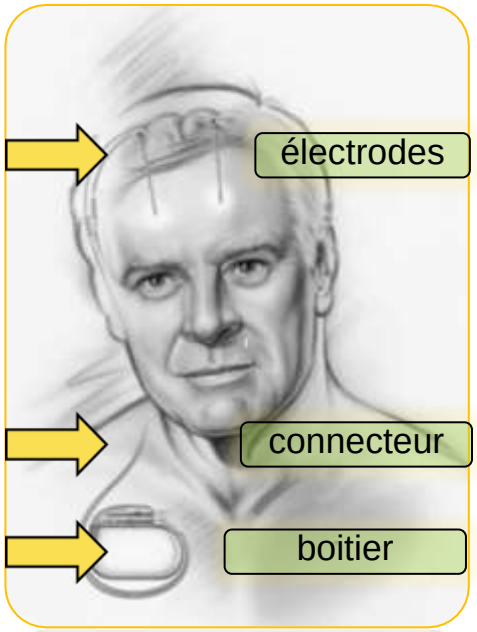
Bjerknes et al. PLoS One 2014: 9: e105288



Abcès cérébraux post DBS
6 cas rapportés dans littérature

Zsigmond et al. Neurology and Clinical Neuroscience 2014;2:161-162

Matériel stimulation cérébrale : Microbiologie



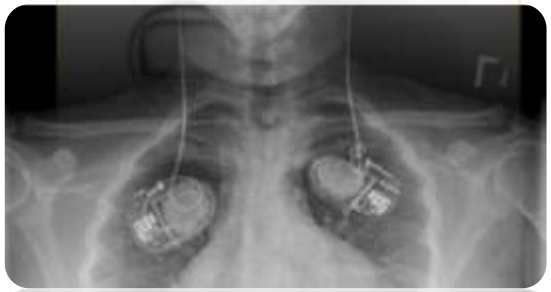


Table 1. Summary of the microbiology of implantable cardiac electronic device infection

Pathogen (number of studies reporting this pathogen)	Range in studies using patients as the denominator	Range in studies using isolates as the denominator
CoNS (17)	10%[a]–68%	42%–77%
Staphylococcus aureus (16)	24%–59%	10%–30%
Gram-negative bacilli (11)	1%–17%	6%–11%
Enterococcus spp. (6)	5%–6%[b]	0.4%–10%[b]
Streptococcus spp. (5)	4%–6%[b]	3%–10%[b]
Propionibacterium spp. (3)	—	0.8%–8%
Fungi (5)	0.5%–2%	0.4%–1.4%

Staph. et Gram + : 68% à 93% des infections
Bacilles Gram négatif : < 18% des infections
Polymicrobien : 2-24,5%
Culture négative : 15 %

Tong et al. Neurosurg Rev (2015) 38:245–252
Fily F, et al. Clin Infect Dis 2011;52:1020-1023

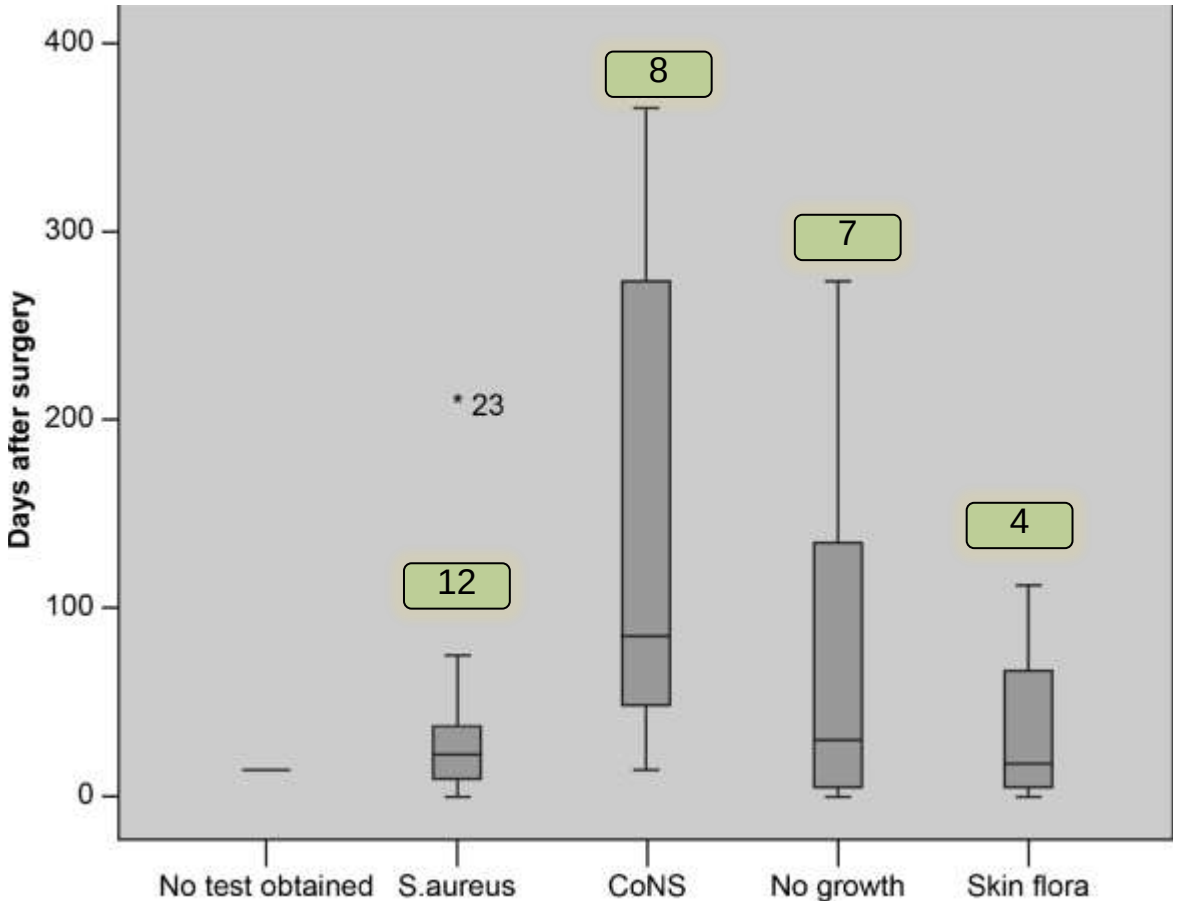
Matériel stimulation cérébrale

Fily F, *et al.* Clin Infect Dis 2011;52:1020-1023
Bjerknes S et al. PLoS One 2014: 9: e105288

67 patients
DBS Infections n= 12 (17,9%)

Case	Sex	Age, years	Culture results (c)
1	F	42	MSSA
2[a]	F	59	MSSA
3[a]	F	59	Not done
4	M	61	MSSA
5	M	46	No growth
6	F	54	PA
7	F	68	MSSA
8	F	60	*micrococcus*
9	M	57	MSSA
10	M	56	MSSA
11	M	66	SE
12	M	21	SE

368 patients
DBS Infections n= 33 (8,7%)



Matériel stimulation cérébrale : Microbiologie

Abode-Iyamah K et al. J Neurosurg 2018. DOI: 10.3171/2017.9.JNS1780

Sillay et al. Neurosurgery 62:360–367, 2008

242 adultes
DBS Infections n= 16 (6,5%)

SSI Organism	No. (%)
MSSA	6 (37.5)
MSSA alone	4 (25.0)
MSSA, *Propionibacterium acnes*	1 (6.3)
MSSA, GPR suggestive of diphtheroids	1 (6.3)
P. acnes	7 (43.8)
P. acnes alone	1 (6.3)
P. acnes, GPR suggestive of diphtheroids	1 (6.3)
P. acnes, *Pseudomonas aeruginosa*	1 (6.3)
P. acnes, methicillin-resistant CoNS, *Staphylococcus epidermidis*	1 (6.3)
P. acnes, *Enterobacter cloacae*	1 (6.3)
P. acnes, *S. lugdunensis*	1 (6.3)
Gram-positive cocci	1 (6.3)
Methicillin-resistant *S. epidermidis*	1 (6.3)
Serratia marcescens	1 (6.3)
Mixed skin flora	1 (6.3)
All infections	16 (100)

420 patients
DBS infections n=19 (4,5%)

Age (yr)/ sex	Culture results
57/F	*Staphylococcus aureus*
42/M	*Propionibacterium acnes*
76/M	No growth
4/F	*Staphylococcus epidermidis*
58/F	No growth
60/F	*S. epidermidis*
65/M	Few skin flora
74/M	*P. acnes*
73/M	*S. aureus*
77/F	*S. aureus* (nafcillin resistant)
71/M	*S. aureus*
8/M	*S. aureus*
78/M	*S. aureus*
63/F	Unavailable
53/F	*S. aureus*
69/M	*S. aureus*
73/M	*S. aureus*
71/F	*S. aureus*
78/M	*S. aureus*

Matériel stimulation cérébrale : PEC

Sandoe JAT et al. JAC 2015; 70: 325–359

ESC Guidelines. Europ Heart J 2015 36, 3075–3123

Tunkel AR et al. Clin Infect Dis 2017;64(6):e34–e65

- **Absence recommandations de prise en charge**
- **Analogie avec dispositif cardiologique (recommandations PM et EI)**

- **Recommandations méningites et ventriculites associées aux soins**

Matériel stimulation cérébrale : PEC

Clinical Characteristics and Outcome of Infective Endocarditis Involving Implantable Cardiac Devices. Athan E, et al. JAMA. 2012;307(16):1727-1735

ANALOGIE DISPOSITIF CARDIOLOGIQUE


Journal of Antimicrobial Chemotherapy

Guidelines for the diagnosis, prevention and management of implantable cardiac electronic device infection. Report of a joint Working Party project on behalf of the British Society for Antimicrobial Chemotherapy (BSAC, host organization), British Heart Rhythm Society (BHRS), British Cardiovascular Society (BCS), British Heart Valve Society (BHVS) and British Society for Echocardiography (BSE)

9.1.2 In generator pocket infection, ICED-LI and ICED-IE?

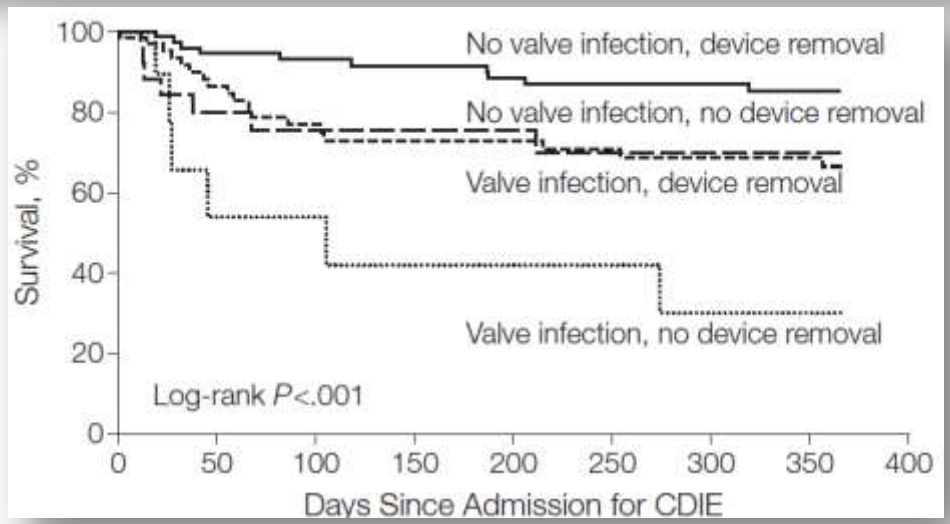
Summary:

- **Recommendation 9.1.2: Complete and early (as soon as possible, but not more than 2 weeks after diagnosis) removal of an infected ICED system (generator and all leads) combined with appropriate antimicrobial therapy is the most effective, safe and efficient treatment option. [B]**

Etude prospective multicentrique

61 centres – 28 pays – 2000-2006
Cardiac Device Infective Endocarditis (CDIE) : n= 177

Rôle atteinte valvulaire sur mortalité
Bénéfice survie à 1 an si ablation
(0.42 [95% CI 0.22- 0.82]



Matériel stimulation cérébrale : PEC

Deep brain stimulator hardware-related infections : incidence and management in a large series. Sillay et al. Neurosurgery 62:360–367, 2008

Bjerknes S et al. PLoS ONE 9(8): e105288.

368 patients - 33 infections (8,7%)
Ablation totale 12%
Ablation partielle 67%
Traitement conservateur 21%

Bjerknes *et al.* PLoS One 2014

57/F	Parkinson's disease	Chest	Partial	Succeeded	*Staphylococcus aureus*
42/M	Parkinson's disease	Chest	Partial	Succeeded	*Propionibacterium acnes*
76/M	Parkinson's disease	Chest	Partial	Succeeded	No growth
4/F	Dystonia	Parietal	Partial	Succeeded	*Staphylococcus epidermidis*
58/F	Essential tremor	Phest	Partial	Succeeded	No growth
60/F	Parkinson's disease	Chest	Partial	Succeeded	*S. epidermidis*
65/M	Parkinson's disease	Chest	Partial	Succeeded	Few skin flora
74/M	Parkinson's disease	Chest	Partial	Succeeded	*P. acnes*
73/M	Essential tremor	Parietal	Partial	Succeeded	*S. aureus*
77/F	Parkinson's disease	Chest	Partial	Failed	*S. aureus* (nafcillin resistant)
71/M	Parkinson's disease	Chest	Partial	Failed	*S. aureus*
8/M	Dystonia	Chest	Partial	Failed	*S. aureus*
78/M	Essential tremor	Chest	Partial	Failed	*S. aureus*
63/F	Parkinson's disease	Chest	Partial	Failed	Unavailable
53/F	Parkinson's disease	Frontal	Washout[b]	Failed	*S. aureus*
69/M	Parkinson's disease	Frontal	Total	N/A	*S. aureus*
73/M	Essential tremor	Parietal	Total	N/A	*S. aureus*
71/F	Parkinson's disease	Parietal, chest	Total	N/A	*S. aureus*
78/M	Essential tremor	Chest	Total	N/A	*S. aureus*

Matériel stimulation cérébrale : PEC

Deep Brain Stimulation Hardware-Related Infections: A Report of 12 Cases and Review of the Literature. Fily F, *et al.* Clin Infect Dis 2011;52:1020-1023

Case	Sex	Age, years	DBS indication	Infection location	CT finding at admission	Initial surgery	Culture results (c)	Evolution	Antibacterial treatment duration (weeks
1	F	42	OCD	Frontal (B)	Abscess	Total removal (B)	MSSA	Cure – no further surgery	12
2[a]	F	59	Dystonia	Chest, retroauricular (L)	Normal	Partial removal	MSSA	Cure after second surgery (total removal)	8
3[a]	F	59	Dystonia	Frontal, retroauricular (L)	Not done	Not done	Not done	Cure – no further surgery	6
4	M	61	Parkinson	Chest, frontal, retroauricular (R)	Pedestal	Total removal (R)	MSSA	Brain abscess appeared on treatment Cure after abscess drainage	12
5	M	46	Parkinson	Frontal	Not done	Not done	No growth	Cure – no further surgery	4
6	F	54	Essential tremor	Frontal (L)	Not done	Not done	PA	Hypodensity on CT scan (day 3) Cure after second surgery (total removal)	6
7	F	68	Parkinson	Chest (L)	Normal	Partial removal	MSSA	Cure – no further surgery	6
8	F	60	Parkinson	Chest, retroauricular (R)	Normal	Partial removal	*micrococcus*	Cure after second surgery (total removal)	NA
9	M	57	Parkinson	Chest, retroauricular (B)	Not done	Not done	MSSA	Cure after second surgery (total removal)	12
10	M	56	Parkinson	Chest (R)	Not done	Partial removal	MSSA	Cure – no further surgery	4
11	M	66	Parkinson	Chest (R)	Normal	Partial removal	SE	Cure – no further surgery	6
12	M	21	Dystonia	Chest (R)	Not done	Partial removal	SE	Cure – no further surgery	3

Ablation complète si infection intracrânienne ou le long cicatrice frontale

Probable ablation complète si infection connecteur

Ablation partielle si atteinte boitier seul

ATBT 2-6 S après ↕ (6S si INM)

Matériel stimulation cérébrale : PEC

2017 Infectious Diseases Society of America's Clinical Practice Guidelines for Healthcare-Associated Ventriculitis and Meningitis. Tunkel AR et al. Clin Infect Dis 2017;64(6):e34–e65

IDSA GUIDELINE

Table 1. Recommended Antimicrobial Therapy in Patients With Healthcare-Associated Ventriculitis and Meningitis Based on Isolated Pathogen and In Vitro Susceptibility Testing

Microorganism	Standard Therapy	Alternative Therapies
Staphylococci[a]		
Methicillin sensitive	Nafcillin or oxacillin	Vancomycin
Methicillin resistant	Vancomycin	Daptomycin, trimethoprim-sulfamethoxazole, or linezolid
Propionibacterium acnes	Penicillin G	Third-generation cephalosporin,[b] vancomycin, daptomycin, or linezolid

STAPHYLOCOQUE : RIFAMPICINE RECOMMANDEE EN ASSOCIATION EN CAS DE SOUCHE SENSIBLE

Analogie cardiologique…Prise en charge

Diagnosis/scenario	ICED management (recommendation)	Antimicrobial strategy
Early post-implantation inflammation	leave device *in situ*	case by case, consider observation or oral therapy 7–10 days (Table 3 and Figure 1)
Uncomplicated generator pocket infection AND no absolute requirement for ICED AND device removable	complete device removal without replacement ICED	10–14 days (iv and po) therapy (Tables 3 and 4)
Uncomplicated generator pocket infection AND absolute requirement for ICED AND device removable	complete device removal, temporary pacing, delayed replacement ICED until signs of infection resolved	10–14 days iv antimicrobials. (Tables 3 and 4)
Generator pocket infection when attempted lead extraction considered too risky/or declined by patient AND no absolute requirement for ICED	removal of generator leaving leads *in situ* without replacement ICED	6 weeks iv therapy (Table 5)
Generator pocket infection when attempted extraction considered too risky or declined by patient AND absolute requirement for ICED	removal of generator leaving leads *in situ* with early/ single-stage replacement ICED	6 weeks iv therapy (Table 5)
ICED-IE (with or without clinical evidence of generator pocket infection) AND no absolute requirement for ICED AND device removable	prompt and complete device removal without replacement ICED	if native valves affected: total 4 weeks iv therapy (Table 6). If prosthetic valves affected, secondary brain abscess or spinal infection: 6 weeks iv therapy (Table 6)
ICED-LI (with or without clinical evidence of generator pocket infection or IE) AND no absolute requirement for ICED AND device removable	prompt and complete device removal without replacement ICED	prolonged therapy post removal not usually required. Review therapy 1 week after removal
ICED-IE or ICED-LI (without generator pocket infection) when extraction considered too risky/or declined by patient AND absolute requirement for ICED	leave entire device *in situ*	6 weeks iv therapy (Table 5)

Matériel stimulation cérébrale : Prévention

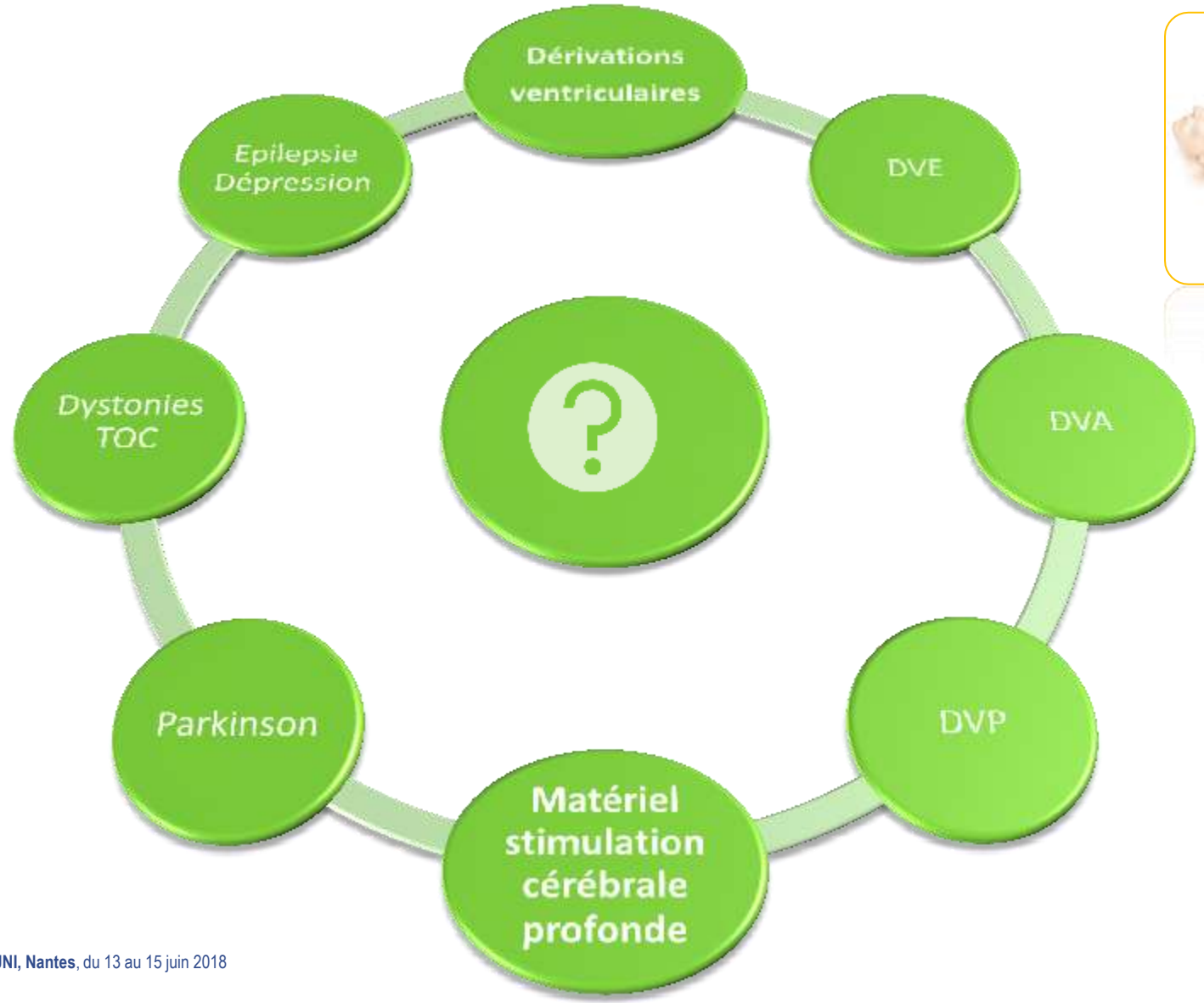
Acte chirurgical	Produit	Dose initiale	Ré-injection et durée
Dérivation interne du LCR	Céfazoline	2 g IV lente	Dose unique (si durée > 4 h, réinjecter 1g)
	Allergie : vancomycine*	30 mg/kg/60 min	Dose unique
Dérivation externe du LCR	Pas d'ABP		
Crâniotomie	Céfazoline	2 g IV lente	Dose unique (si durée > 4 h, réinjecter 1g)
	Allergie : vancomycine*	30 mg/kg/60 min	Dose unique
Neurochirurgie par voies trans-sphénoïdale et trans-labyrinthique	Céfazoline	2 g IV lente	Dose unique (si durée > 4 h, réinjecter 1g)
	Allergie : vancomycine*	30 mg/kg/60 min	Dose unique
Chirurgie du rachis avec mise en place de matériel prothétique	Céfazoline	2 g IV lente	Dose unique (si durée > 4 h, réinjecter 1g)
	Allergie : vancomycine*	30 mg/kg/60 min	Dose unique
Plaies crânio-cérébrales	Péni A + IB**	2 g IV lente	2 g toutes les 8h 48h maximum
	Allergie : vancomycine*	30 mg/kg/60 min	30 mg/kg/jour 48h maximum
Fracture de la base du crâne avec rhinorrhée	Pas d'ABP		

SFAR

Antibioprophylaxie en chirurgie et médecine interventionnelle. (patients adultes)

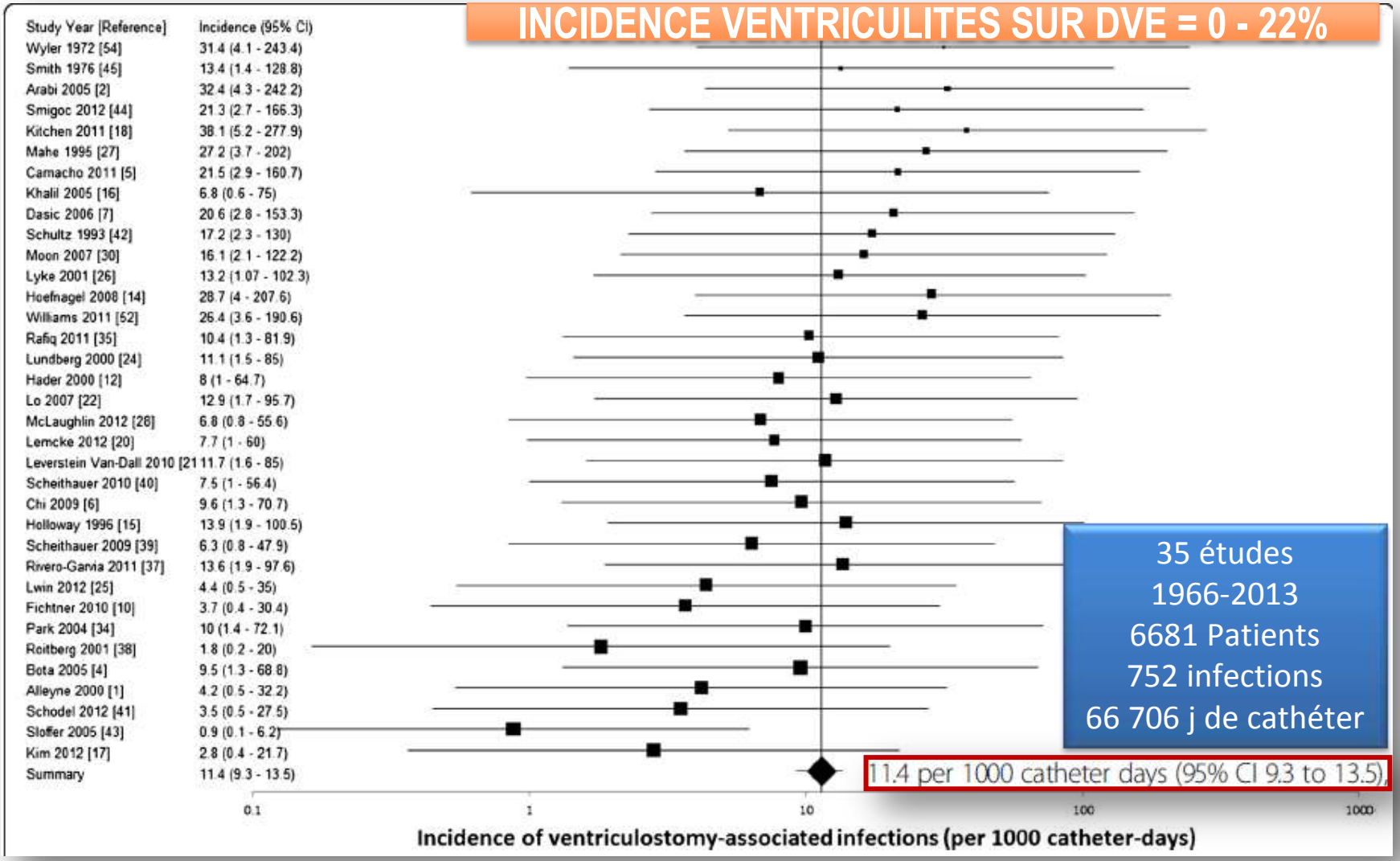
Acte chirurgical	Produit	Dose initiale	Ré-injection et durée
Chirurgie cardiaque	Céfazoline	2 g IV lente +1g au priming	1 g à la 4ème heure per-opératoire.
	Céfamandole ou céfuroxime	1,5 g IV lente +0,75g au priming	1 réinjection de 0,75g toutes les 2h en per-opératoire
	Allergie : vancomycine*	30 mg/kg/60 min	Dose unique
Mise en place d'un stimulateur cardiaque	Voir ci-dessus chirurgie cardiaque	voir ci-dessus chirurgie cardiaque	Dose unique
Geste endocavitaire	Voir ci-dessus chirurgie cardiaque	voir ci-dessus chirurgie cardiaque	Dose unique
Drainage péricardique	Pas d'ABP		
Dilatation coronaire +/- stent	Pas d'ABP		
ECMO …	Pas d'ABP		

Infections neuroméningées sur matériel



DVE : Incidence INM

Ramanan et al BMC Infectious Diseases 2015; 2-12



Dérivations : Facteurs favorisants

Lozier et al Neurosurgery 2002; 51:170-182

Factors associated with CSF infection
Intraventricular hemorrhage
Subarachnoid hemorrhage
Operative depressed cranial fracture
Basilar cranial fracture with CSF leak
Neurosurgical operation
Ventriculostomy irrigation
Systemic infection
Duration of catheterisation : **7 J**
Factors possibly associated with CSF infection
Venue of ventriculostomy insertion
Corticosteroids
CSF pleocytosis
Catheter manipulations and leak
Factors not associated xith CSF infection
Multiple catheters
Concomitant ICP monitors
CSF drainage
Closed head trauma
Tumor
Intracerebral hemorrhage

Revue littérature
5261 patients -5733 DVE
INM 8,8%

Dérivations : Signes cliniques

2017 Infectious Diseases Society of America's Clinical Practice Guidelines for Healthcare-Associated Ventriculitis and Meningitis. Tunkel AR et al. Clin Infect Dis 2017;64(6):e34–e65

IDSA GUIDELINE

- Céphalées, nausées, confusion (shunt, DVE)
- Signes inflammatoires locaux (shunt)
- Hyperthermie en absence autre cause (shunt 14-92%; DVE)

- DVP : douleurs abdominales, signes d'irritation péritonéale (absent dans 60% des cas)
- DVA : Bactériémie (en absence autre PE)
- DVA : Glomérulonéphrite +++(4-14% - +++ staphylocoques)

Infections difficiles à identifier…

Lozier et al Neurosurgery 2002; 51:170-182
Tunkel AR et al. Clin Infect Dis 2017;64(6):e34–e65

Term	
Contamination	Isolated positive CSF cultures
Ventriculostomy colonization	Multiple positive CSF cultures
Suspected ventriculostomy-related infection	Declining CSF glucose Increasing CSF protein Pleiocytosis Absence of positive CSF
Ventriculostomy-related infection	One or more positif CSF Fever
Ventriculitis	Clinical signs of meningitis

Revue littérature
5261 patients -5733 DVE
INM 8,8%

IDSA GUIDELINE

- Anomalies (cellularité, glycorrachie, protéïnorrachie) non discriminantes pour le diagnostic (faible, modéré)

- Cultures LCR essentielles pour le diagnostic de méningites/ventriculites associées aux soins (10 J)

Infections difficiles à diagnostiquer…

2017 Infectious Diseases Society of America's Clinical Practice Guidelines for Healthcare-Associated Ventriculitis and Meningitis. Tunkel AR et al. Clin Infect Dis 2017;64(6):e34–e65

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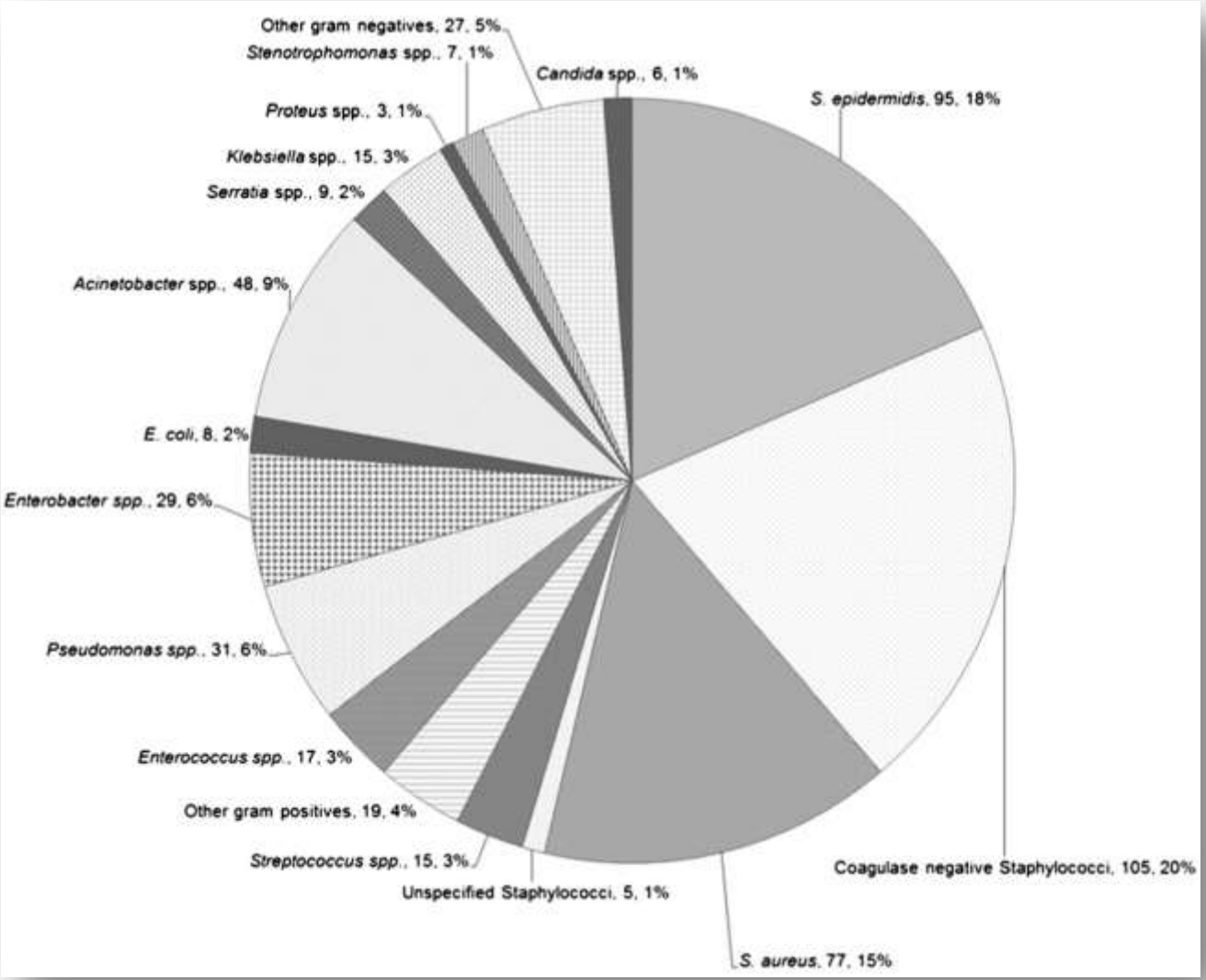
- Intérêt élévation lactate et / ou PCT dans LCR (faible, modéré)
  - Lactates > 4 mmol/l : sensibilité de 93% et une spécificité de 96% pour dg méningite (Sakushima et al . J Infect 2011;62:255-262)
  - PCT > 0,5 ng/ml (LCR) ? (sensibilité 100%; spécificité 68%) (Schwartz et al. Crit Care 2000)
  - PCT > 0,075 et lactates > 3,45 : sensibilité 96%; VPN 97,6% (Li et al. Clin Biochem 2015)

- Utilité PCT sérique si anomalies LCR (infection? Chirurgie? Hémorragie?) : > 1 ng/ml?
- ARN 16 S (faible, modéré)

- Imagerie : IRM recommandée; échographie ou TDM abdo si DVP

Dérivations ventriculaires : Microbiologie

A meta-analysis of ventriculostomy-associated cerebrospinal fluid infections. Ramanan et al . BMC Infectious Diseases 2015; 2-12



25 études
523 cultures +

SCN 40%
S. aureus 15%
BGN 30%
Pseudomonas 6%

Dérivations : Prise en charge en pratique

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62. Complete removal of an infected CSF shunt and replacement with an external ventricular drain combined with intravenous antimicrobial therapy is recommended in patients with infected CSF shunts (strong, moderate).
63. Removal of an infected CSF drain is recommended (strong,

DV: Antibiothérapie probabiliste

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V. What is the Empiric Antimicrobial Approach for Patients with Suspected Healthcare-Associated Ventriculitis and Meningitis?

Recommendations

37. Vancomycin plus an anti-pseudomonal beta-lactam (such as cefepime, ceftazidime, or meropenem) is recommended as empiric therapy for healthcare-associated ventriculitis and meningitis; the choice of empiric beta-lactam agent

38. In seriously ill adult patients with healthcare-associated ventriculitis and meningitis, the vancomycin trough concentration should be maintained at 15–20 μg/mL in those who receive intermittent bolus administration (strong, low).

39. For patients with healthcare-associated ventriculitis and meningitis who have experienced anaphylaxis to beta-lactam antimicrobial agents and in whom meropenem is contraindicated, aztreonam or ciprofloxacin is recommended for gram-negative coverage (strong, low).

DV: Antibiothérapie documentée

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Microorganism	Standard Therapy	Alternative Therapies
Staphylococci[a]		
Methicillin sensitive	Nafcillin or oxacillin	Vancomycin
Methicillin resistant	Vancomycin	Daptomycin, trimethoprim-sulfamethoxazole, or linezolid
Propionibacterium acnes	Penicillin G	Third-generation cephalosporin,[b] vancomycin, daptomycin, or linezolid
Streptococcus pneumoniae		
Penicillin MIC ≤0.06 µg/mL		
Penicillin MIC ≥0.12 µg/mL		
Cefotaxime or ceftriaxone MIC <1.0 µg/mL	Third-generation cephalosporin[b]	Cefepime or meropenem
Cefotaxime or ceftriaxone MIC ≥1.0 µg/mL	Vancomycin plus a third-generation cephalosporin[b,c]	Moxifloxacin[d]
Pseudomonas aeruginosa	Cefepime, ceftazidime, or meropenem	Aztreonam or ciprofloxacin
Haemophilus influenzae		
β-lactamase negative	Ampicillin	Third-generation cephalosporin,[b] cefepime, or a fluoroquinolone
β-lactamase positive	Third-generation cephalosporin[b]	Cefepime, aztreonam, or a fluoroquinolone
Extended spectrum β-lactamase-producing gram-negative bacilli	Meropenem	Cefepime or a fluoroquinolone
Acinetobacter baumannii	Meropenem	Colistin (usually formulated as colistimethate sodium)[e] or polymyxin B[e]
Other Enterobacteriaceae[f]	Third-generation cephalosporin[b]	Meropenem, aztreonam, trimethoprim-sulfamethoxazole, or ciprofloxacin
Candida species[g]	Lipid formulation of amphotericin B ± flucytosine	Fluconazole or voriconazole
Aspergillus species	Voriconazole	Lipid formulation of amphotericin B or posaconazole

CMI≥1 µg/ml

Staph : Adjonction RIFAMPICINE SI SOUCHE SENSIBLE

DV: Antibiothérapie intrathécale

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IDSA GUIDELINE

Table 3. Recommended Dosages of Antimicrobial Agents Administered by the Intraventricular Route

Antimicrobial Agent	Daily Intraventricular Dose
Amikacin	5–50 mg[a]
Amphotericin B deoxycholate[b]	0.01–0.5 mg in 2 mL of 5% dextrose in water
Colistin (formulated as colistimethate sodium)	10 mg
Daptomycin	2–5 mg[c]
Gentamicin	1–8 mg[d,e,f]
Polymyxin B	5 mg[g]
Quinupristin/dalfopristin	2–5 mg
Tobramycin	5–20 mg
Vancomycin	5–20 mg[e,f,h]

Durée traitement / Délai repose

Management of hardware infections following deep brain stimulation. Temel Y *et al.* Acta Neurochir (Wien) (2004) 146: 355–361

IDSA GUIDELINE

Recommendations

58. Infections caused by a coagulase-negative staphylococcus or *P. acnes* with no or minimal CSF pleocytosis, normal CSF glucose, and few clinical symptoms or systemic features should be treated for 10 days (strong, low).
59. Infections caused by a coagulase-negative staphylococcus or *P. acnes* with significant CSF pleocytosis, CSF hypoglycorrhachia, or clinical symptoms or systemic features should be treated for 10–14 days (strong, low).
60. Infections caused by *S. aureus* or gram-negative bacilli with or without significant CSF pleocytosis, CSF hypoglycorrhachia, or clinical symptoms or systemic features should be treated for 10–14 days (strong, low); some experts suggest treatment of infection caused by gram-negative bacilli for 21 days (weak, low).
61. In patients with repeatedly positive CSF cultures on appropriate antimicrobial therapy, treatment should be continued for 10–14 after the last positive culture (strong, low).

Si négativation des cultures 48H après externalisation, repose à J3 de l'ablation

Si culture - , repose à J7 /ATBT
Si culture répétées +, maintien ABTBT 7-10 j après négativation, avant repose

Repose shunt possible J10 après négativation des cultures

Dérivations : Prévention

2017 Infectious Diseases Society of America's Clinical Practice Guidelines for Healthcare-Associated Ventriculitis and Meningitis. Tunkel AR et al. Clin Infect Dis 2017;64(6):e34–e65

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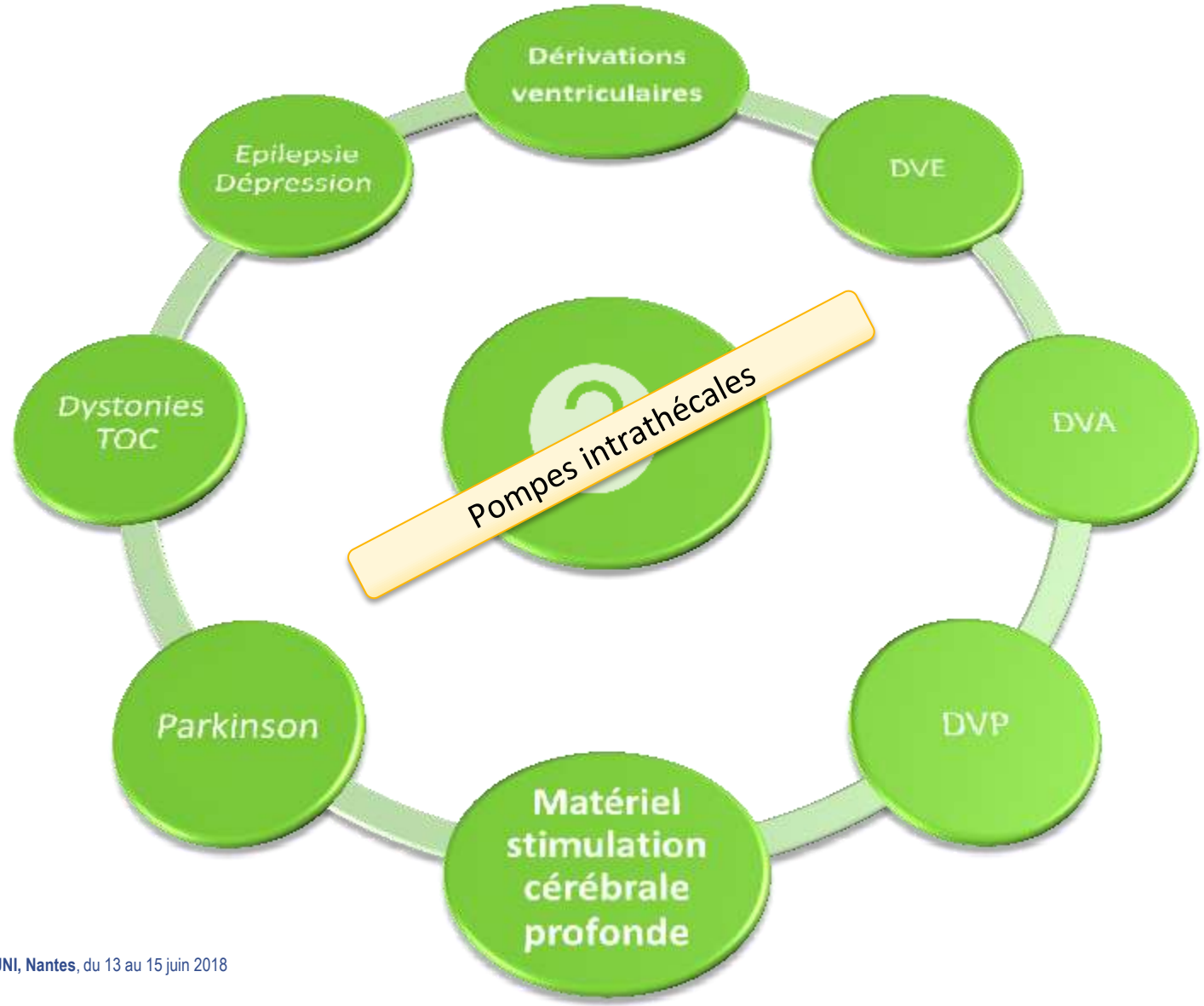
- Periprocedural prophylactic antimicrobial administration is recommended for patients undergoing CSF shunt or drain insertion (or placement of external ventricular drains)
- Use of antimicrobial-impregnated CSF shunts and CSF drains is recommended

  (clindamycine + RMP : 6% vs 16,6% ; minocycline + RMP : 1,3% vs 9,4% ; Ratilal B, et al. Cochrane Database Syst Rev 2006;3:CD005365)
- In patients with external ventricular drains, fixed interval exchange **is not recommended**
- Use of a standardized protocol for insertion of CSF shunts and drains is recommended

  (protocole aspesie, système clos, diminution durée : 4, 6% vs 9,9%; Korinek AM et al Acta Neurochir (Wien) 2005; 47: 39-46)

Acte chirurgical	Produit	Dose initiale	Ré-injection et durée
Dérivation interne du LCR	Céfazoline	2 g IV lente	Dose unique (si durée > 4 h, réinjecter 1g)
	Allergie : vancomycine*	30 mg/kg/60 min	Dose unique
Dérivation externe du LCR	Pas d'ABP		

Infections neuroméningées sur matériel



Pompes intrathécales

Analysis of complications in 430 consecutive pediatric patients treated with intrathecal baclofen therapy: 14-year experience. Motta F et al. J Neurosurg Pediatrics 13:301–306, 2014

- Administration intrathécale baclofène (contenu dans pompe) dans LCR par biais cathéter
- Indications: SEP, lésions médullaires, spasticité
- Peu d'études évaluant incidence INM (méningites) compliquant pompes intrathécales

430 patients consécutifs (<18 ans) – sur 14 ans

Taux d'infection global 9,3%

TABLE 4: Infections occurring in the overall population and in the 2 groups classified according to pump placement

Variable	Overall	Subcutaneous Implant (Group A)	Subfascial Implant (Group B)	p Value
no. of patients	430	149	281	
patients affected by infections	40 (9.3%)	30 (20.1%)	10 (3.6%)	<0.001

Pompes intrathécales

Complications of Intrathecal Baclofen Pumps in Children: Experience from a Tertiary Care Center. Ghosh D et al. Pediatr Neurosurg 2013;49:138–144

Etude rétrospective 1996 - 2011 - 119 patients (< 21 ans)

49 complications – 7 méningites (14,3%; 5,9%)

Total complications	Number of patients (n = 49)
Infection of incision site	19
Meningitis without infection at incision site	4
Meningitis with infection at incision site	3
Catheter displacement/disconnection	10
Skin erosion over pump	8
Catheter fracture	4
Cerebrospinal fluid leak	1

Pompes intrathécales

Evaluation of salvage techniques for infected baclofen pumps in pediatric patients with cerebral palsy. Hester SM et al. J Neurosurg Pediatrics 10:548–554, 2012

38 (18,4%) complic. infectieuses chez 207 patients (<18 ans) avec dispositif – 13 profondes

TABLE 1: Characteristics in 13 patients with cerebral palsy who experienced deep wound infection, meningitis, or empyema*

Case No	Age (yrs), Sex	Weight (kg)	Type of Infection	Isolate	Therapy	Outcome
1	3, F	12	pocket empyema	group B streptococci	washout, vancomycin ip & iv (7 days), iv ampicillin (7 days), discharged home on Keflex po (10 days)	salvage
2	9, F	16	pocket empyema	MSSA	washout, vancomycin ip & iv (10 days)	
3	16, M	29	pocket empyema	MSSA	washout, vancomycin ip, nafcillin iv (4 days)	explant
4	11, F	28	pocket infection complicated by meningitis	*P. aeruginosa*	ceftazidime iv, gentamicin iv (5 days)	explant
5	15, M	22	pocket empyema	MSSA	ceftazidime iv (30 min prior to incision)	explant
6	10, F	22	pocket empyema	MRSA, *Acinetobacter*	vancomycin iv (2 days)	explant
7	9, M	13	pocket empyema	MSSA	vancomycin iv, ceftriaxone iv (7 days)	explant
8	14, M	42	pocket empyema	*P. aeruginosa*	ceftazidime iv (7 days)	explant
9	15, M	51	pocket empyema	no growth†	cefazolin iv (10 days)	explant
10	10, M	26	pocket infection complicated by meningitis	*P. aeruginosa*	tobramycin iv, ciprofloxacin po (3 wks)	explant
11	6, F	15.5	deep wound infection	MSSA	vancomycin iv (2 days)	explant
12	4, M	12	pocket empyema	*P. aeruginosa*	ceftazidime iv, tobramycin iv (3 days)	explant
13	3, M	13.6	pocket empyema	*S. epidermidis*	vancomycin iv (8 days)	explant

Pompes intrathécales

Infection as a Complication of Intrathecal Baclofen Treatment in Children With Cerebral Palsy. Bayhan IA et al. J Pediatr Orthop 2016;36:305–309

Etude rétrospective 1997 - 2013 - 294 patients (< 18 ans)

28 complications infectieuses (9,5%)

Microorganisms	Acute	Chronic	Grand Total [n (%)]
Escherichia coli	1	1	2 (7.1)
MRSA	3	1	4 (14.2)
MSSA	8	6	14 (50)
Proteus mirabilis	—	1	1 (3.5)
Pseudomonas	2	2	4 (14.2)
Streptococcus agalactiae	—	2	2 (7.1)
Serratia marcescens	—	1	1 (3.5)
Grand total	14	14	28

Pompes : diagnostic et PEC

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IDSA GUIDELINE

- **Signes cliniques d'appel** : Hyperthermie récente; collection liquidienne péri-implant

IX. What is the Role of Catheter Removal in Patients with Cerebrospinal Fluid Shunts or Drains?

Recommendations

64. Removal of an infected intrathecal infusion pump is recommended (strong, moderate).
65. Removal of infected hardware in patients with deep brain stimulation infections is recommended (strong, moderate).

- ATBT / microbiologie : Absence recommandations
- Durée : Absence recommandations (analogie matériel de stimulation cérébrale profonde)

Infections NM sur matériel : Conclusions

- Entités cliniques avec présentation variée
- Point commun : Importance ablation du matériel dans les INM sur matériel
- Choix et durée antibiothérapie probabiliste puis documentée:
  - MSP : anti staphylococcique (2S si boitier ; 6 S si INM)
  - Dérivations ventriculaires : anti staphylococcique et anti *Pseudomonas ; (10; 14 ; 21 J selon bactérie)*
  - Pompes intrathécales : idem DV; (2S si boitier ; 6 S si INM)