6th Infectivology Today®

L'infettivologia del 3° millennio: AIDS ed altro

VI Convegno Nazionale

15- 16 -17 maggio 2014

Centro Congressi Hotel Ariston

Paestum (SA)

6th Infectivology Today®

Le infezioni in neurochirurgia

Franco Faella

Centro Congressi Hotel Ariston
Paestum (SA)

venerdì 16 maggio

Postoperative intracranial neurosurgery infection rates in North America versus Europe: A systematic analysis

Shearwood McClelland III, MD
Minneapolis, Minnesota

Table 1. European intracranial neurosurgery series included in the analysis

Author	Study Design	Number of Intracranial Cases	PWIs	PWI Incidence
Blomstedt et al, 1985[13]	Retrospective	1324	74	5.6%
Maurice-Williams et al, 1999[14]	Retrospective	652	12	1.8%
Korinek et al, 2006[10]	Prospective	6243	381	6.1%
Total		8219	467	5.7%

Table 2. North American intracranial neurosurgery series included in the analysis

Author	Study Design	Number of Intracranial Cases	PWIs	PWI Incidence
Tenney et al, 1985[15]	Retrospective	599	37	6.2%
Savitz et al, 1986[16]	Retrospective	1007	0	0.0%
NNIS report, 2003[17]	Retrospective	8059	195	2.4%
McClelland et al, 2007[11]	Retrospective	1587	14	0.8%
Total		11252	246	2.2%

The relative risk of postoperative intracranial neurosurgery infections *for cases in the European studies compared with those in the North American studies* ***was 2.60*** *(95% confidence interval 2.23 to 3.02)* . *Seven studies (4 North American, 3 European)*

Postoperative Central Nervous System Infection: Incidence and Associated Factors in 2111 Neurosurgical Procedures

Clinical Infectious Diseases 2007;45:55–9

Shearwood McClelland III and Walter A. Hall

Conclusions. In one of the largest neurosurgical studies to have investigated PCNSI, the incidence of infection after neurosurgical procedures was <1%—more than 6 times lower than that reported in recent series of comparable numerical size.

*The medical records and postoperative courses for patients involved in **2111 neurosurgical procedures** at our institution during **1991–2005** were reviewed retrospectively to determine the **incidence of** **postoperative central nervous system infection** (PCNSI), the identity of offending organisms, and the factors associated with infection*.

A maggior rischio

Table 1. Distribution of neurosurgical case load.

Surgery description	No. of operations	No. of PCNSI cases	Infection rate, %
Cranial procedures			
Craniotomy for tumor, mass, and/or lesion	448	5	1.1
Brain biopsy	407	2	0.5
CSF shunting	312	5	1.6
Transphenoidal and/or transnasal	184	1	0.5
Nontumor or nonmass craniotomy	114	0	0
Ommaya reservoir placement	69	1	1.4
Burr hole, aspiration, and/or drainage	46	0	0
Miscellaneous	7	0	0
Subtotal	1587	14	0.8
Spinal procedures			
Laminectomy, discectomy, foraminotomy, instrumentation, and/or lumbar drain placement	432	0	0
Biopsy of tumor and/or mass	38	2	5.3
Cyst resection	9	0	0
Chiari I decompression	9	0	0
Myelomeningocele repair	4	0	0
Subtotal	492	2	0.4
Peripheral nerve procedures			
Nerve release, transposition, lysis, exploration, and/or graft repair	25	0	0
Tumor resection	5	0	0
Neuroma resection	2	0	0
Subtotal	32	0	0

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Shearwood M… fectious Diseases 2007

Meni… ebrali

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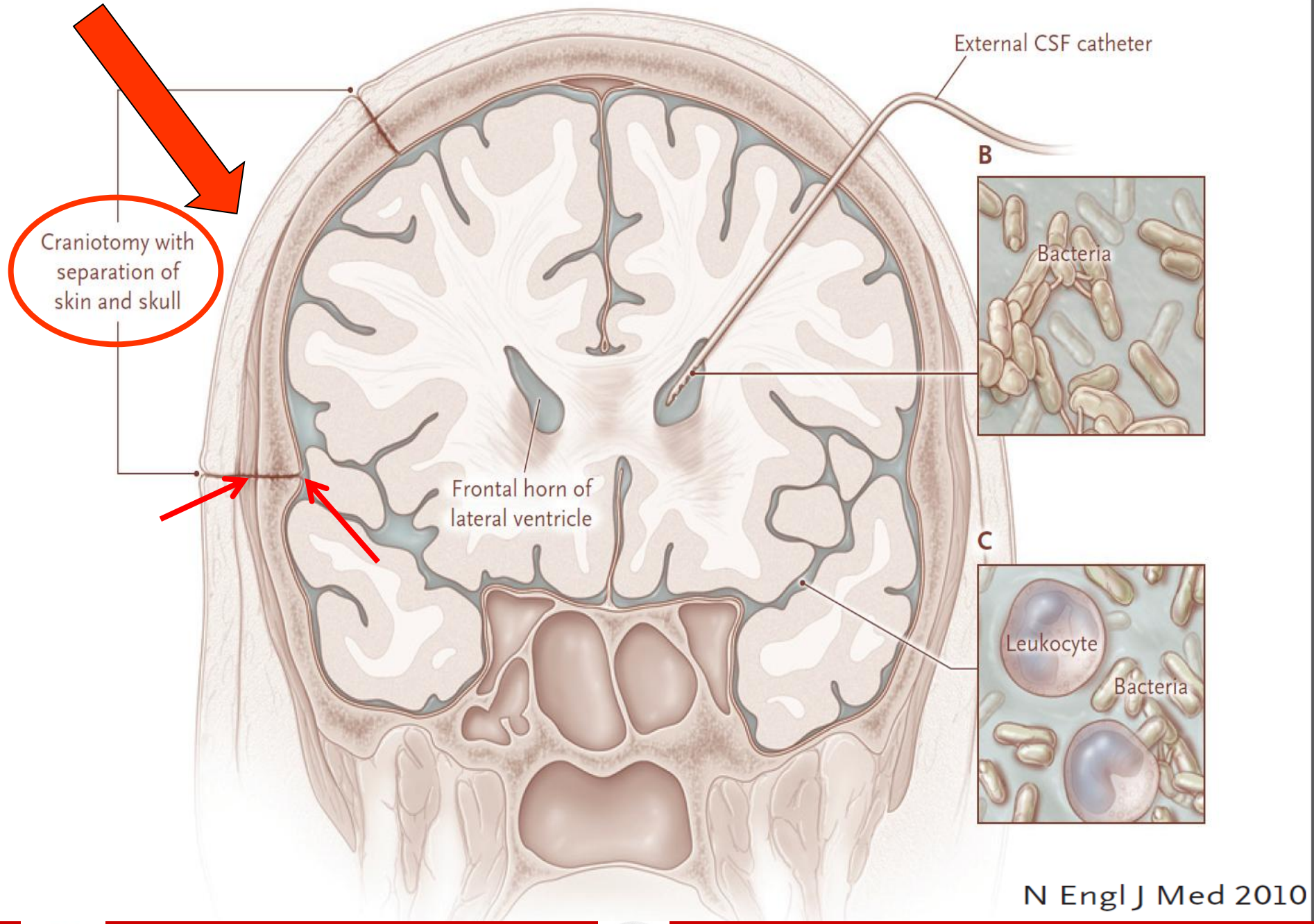
Table 2. Classification of infectious organisms involved in cases of postoperative CNS infection.

Pathogen	No. of cases	Type(s) of surgery after which infection developed (no. of cases)	Percentage of total infections (percentage of cranial infections)
Staphylococcus aureus	8 (6 cranial, 2 spinal)	Craniotomy for tumor (3), craniotomy for open brain biopsy (1), stereotactic brain biopsy with no craniotomy (1), VP shunt placement (1), sacral mass resection (1), thoracic tumor resection (1)	50.0 (42.9)[a]
Propionibacterium acnes	4	VP shunt placement (2), Ommaya reservoir placement (1), VP shunt removal (1)	25.0 (28.6)
Multiorganism	2	VP shunt placement (1), craniotomy for tumor (1)	12.5 (14.3)
Pseudomonas aeruginosa	1	Craniotomy for tumor	6.3 (7.1)
Culture-negative	1	Transnasal hypophysectomy	6.3 (7.1)
Total	16 (14 cranial and 2 spinal)		



N Engl J Med 2010

Risk factors for neurosurgical site infections after craniotomy

NEUROSURGERY
THE REGISTER OF THE NEUROSURGICAL MEME

Neurosurgery. ***1997*** *Nov;41(5):1073-9;* ***Risk factors for neurosurgical site infections after craniotomy: a prospective multicenter study of 2944 patients. The French Study Group of Neurosurgical Infections, the SEHP, and the C-CLIN Paris-Nord. Service Epidémiologie Hygiène et Prévention.***
Korinek AM.

British Journal of Neurosurgery

Br J Neurosurg. ***2005*** *Apr;19(2):155-62.*
Risk factors for neurosurgical site infections after craniotomy: a critical reappraisal of antibiotic prophylaxis on 4,578 patients.
Korinek AM, Golmard JL, Elcheick A, Bismuth R, van Effenterre R, Coriat P, Puybasset L.

NEUROSURGERY
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Neurosurgery. ***2006*** *Jul;59(1):126-33*
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Neurosurgery. ***2008*** *Feb;62 Suppl 2:532-9.*
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Korinek AM, Baugnon T, Golmard JL, van Effenterre R, Coriat P, Puybasset L

Neurosurgery. ***2011*** *Apr;68(4):985-94*
Morbidity of ventricular cerebrospinal fluid shunt surgery in adults: an 8-year study.
Korinek AM, Fulla-Oller L, Boch AL, Golmard JL, Hadiji B, Puybasset L.

Korinek AM, Baugnon T, Golmard JL, van Effenterre R, Coriat P, Puybasset L.
Neuro-anesthesia Unit, Department of Anesthesiology, Pitié-Salpêtrière Hospital, University of Paris VI, Paris, France. anne-marie.korinek@psl.aphop-paris.fr

Fattori indipendenti di rischio di infezione del sito neurochirurgico, in 6243 consecutive craniotomie:

- ❑ Perdita liquorale
- ❑ Infezione della ferita
- ❑ Durata dell'intervento >4 ore
- ❑ Sesso maschile

Antibioticoprofilassi

- ✓ L'antibioticoprofilassi riduce le infezioni della ferita chirurgica [8.8% vs 4.6% (P < 0.0001)]
- ✓ L'antibioticoprofilassi non previene la meningite (1.63 vs 1.50%), specie da *germi non cutanei*
- ✓ La mortalità è più alta per le meningiti da *batteri non cutanei*
- ✓ L'antibioticoprofilassi tende a selezionare microrganismi resistenti

INFEZIONI POST-CRANIOTOMIA

Operative intracranial infection following craniotomy

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Division of Neurological Surgery, Barrow Neurological Institute, St. Joseph's Hospital and Medical Center, Phoenix, Arizona

Neurosurg Focus 24 (6):E10, 2008

Meningite
Infezione del lembo osseo
Empiema subdurale
Empiema epidurale
Ascesso cerebrale

►**Postoperative meningitis**, the patient can be treated with antibiotics only.

Evaluation of the Management of Postoperative Aseptic Meningitis

Virginie Zarrouk,[1] Isabelle Vassor,[1] Frederic Bert,[2] Didier Bouccara,[3] Michel Kalamarides,[4] Noelle Bendersky,[5] Aimée Redondo,[4] Olivier Sterkers,[3] and Bruno Fantin[1]

Clinical Infectious Diseases 2007

Harvey Williams Cushing

Meningite asettica postneurochirurgica (1925)

- **<u>Rappresenta il 60-75% di tutti i casi di meningite postNCH</u>**
- Forse causata da reazione infiammatoria locale ai prodotti ematici
- Forse causata da reazione infiammatoria locale ad antigeni tumorali
- E' più frequente in età pediatrica
- E' più frequente a seguito di interventi in fossa cranica posteriore
- **<u>La coltura liquorale è evidentemente negativa</u>**
- *Outcome* in genere favorevole (steroidi)
- Clinica e alterazioni liquorali simili a quelli di meningite batterica

Meningite batterica e Meningite asettica postneurochirurgica

Table 1. Initial presentation of patients with postoperative meningitis.

Clinical feature	All patients (n = 75)	Patients with bacterial meningitis (n = 21)	Patients with aseptic meningitis (n = 54)	P[a]
Age, mean years ± SD	48 ± 16	47 ± 17	49 ± 15	.7
Sex				.4
Male	45	11	34	
Female	30	10	20	
Previous neurosurgical procedure	13 (17)	7 (33)	6 (11)	.024
Duration of surgery, mean h (range)	4.1 (1–11)	3.3 (1–6)	4.2 (1–11)	.015
CSF leakage	41 (55)	13 (62)	28 (52)	.68
Time between surgery and meningitis, mean days (range)	10 (1–120)	12 (2–120)	9 (1–25)	.53
Symptom				
Headache	64 (85)	19 (90)	45 (83)	.12
Vomiting	33 (44)	8 (38)	25 (46)	.73
Meningeal stiffness	23 (31)	5 (24)	18 (33)	.26
Fever				
Temperature, >38°C	50 (67)	16 (76)	34 (63)	.28
Temperature, >39°C	21 (28)	6 (29)	15 (28)	.59
Focal neurologic defect	2	2	0	.15

NOTE. Data are no. or no. (%) of patients, unless otherwise indicated.

[a] Comparison between bacterial and aseptic meningitis.

Precedenti interventi NCH più frequenti nel gruppo delle meningiti batteriche

Table 2. Biological findings in CSF samples from patients with bacterial or aseptic postoperative meningitis.

Biological variable	Patients with bacterial meningitis (n = 21)	Patients with aseptic meningitis (n = 54)
Leukocyte count, mean leukocytes/mm^3 (range)	1560 (200–4500)	1511 (180–4200)
Erythrocyte count, mean erythrocytes/mm^3 (range)	2430 (20–8500)	2100 (15–6050)
Glycorrachia, mean mmol/L (range)	1.1 (0–3.8)	1.8 (0–7.3)
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Zarrouk CID 2007; 44, 1555-9

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*Le **meningiti asettiche** seguono più frequentemente interventi neurochirurgici di durata maggiore.*

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Minime differenze nella composizione citochimica del LCR tra la meningite batterica e la meningite asettica

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Clinical Infectious Diseases 2007

British Society of Antimicrobial Chemotherapy recommended empirical antibiotic therapy (based on the local bacterial ecology) for all patients with signs of postoperative meningitis and treatment withdrawal after 48 or 72 h if CSF culture results are negative. However, this approach is not universally accepted and has not been assessed in clinical trials.

Nel 2000, la consensus conference organizzata dalla *British Society of Antimicrobial therapy* consigliava:

- ►Terapia antibiotica empirica per tutti i pazienti con segni di meningite postNCH
- ►Vancomicina + ceftazidime o meropenem
- ►Terapia interrotta dopo 48 o 72 ore se colture LCR negative

e ciò perchè la

meningite batterica postneurochirurgica

- è complicanza rara, ma ***complicanza della chirurgia intracranica minacciante la vita.***
- la meningite batterica postNCH è gravata da una mortalità che supera il 20% se la terapia non è rapidamente iniziata
- la diagnosi di meningite batterica postNCH può essere difficile per segni clinici modesti e spesso non specifici, per la composizione liquorale modificata dallo stesso trauma chirurgico, per la batterioscopia spesso negativa.

Operative intracranial infection following craniotomy

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Division of Neurological Surgery, Barrow Neurological Institute, St. Joseph's Hospital and Medical Center, Phoenix, Arizona

16.540 interventi di craniotomia dal Gennaio 1997 al Dicembre 2007 eseguiti da 25 neurochirurghi

- **82 (0,5%)** furono le infezioni intracraniche postchirurgiche in 50 pazienti

Postoperative infections

Type of Infection	No. of Patients (%)
wound infection	26 (52)
subdural empyema	7 (14)
epidural empyema	27 (54)
cerebral abscess	8 (16)
posterior fossa abscess	2 (4)
bone flap infection	22 (44)

Types of organisms causing infection

Organism	No. of Patients (%)
Staphylococcus spp.	
methicillin-resistant	2 (4)
methicillin-sensitive	10 (20)
coagulase-negative	6 (12)
gram-negative	
Enterobacter	3 (6)
Pseudomonas	4 (8)
Serratia	2 (4)
other	6 (12)
Streptococcus spp.	2 (4)
Propionibacterium spp.	2 (4)
multiple organisms	5 (10)
Candida spp.	2 (4)
culture-negative	6 (12)
total	50 (100)

La mediana dell'intervallo tra l'intervento e la presentazione dell'infezione fu di 1,5 mesi (range 4 giorni-5 anni)

Neurosurg Focus 24 (6):E10, 2008

Operative intracranial infection following craniotomy

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16.540 interventi di craniotomia dal Gennaio 1997 al Dicembre 2007 eseguiti da 25 neurochirurghi

- **82 (0,5%)** furono le infezioni intracraniche postchirurgiche in 50 pazienti

Postoperative infections

Type of Infection	No. of Patients (%)
wound infection	26 (52)
subdural empyema	7 (14)
epidural empyema	27 (54)
cerebral abscess	8 (16)
posterior fossa abscess	2 (4)
bone flap infection	22 (44)

Types of organisms causing infection

Organism	No. of Patients (%)
Staphylococcus spp.	
methicillin-resistant	2 (4)
methicillin-sensitive	10 (20)
coagulase-negative	6 (12)
gram-negative	
Enterobacter	3 (6)
Pseudomonas	4 (8)
Serratia	2 (4)
other	6 (12)
Streptococcus spp.	2 (4)
Propionibacterium spp.	2 (4)
multiple organisms	5 (10)
Candida spp.	2 (4)
culture-negative	6 (12)
total	50 (100)

La mediana dell'intervallo tra l'intervento e la presentazione dell'infezione fu di 1,5 mesi (range 4 giorni-5 anni)

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Neurosurg Focus 24 (6):E10, 2008

Propionibacterium acnes Osteomyelitis Occurring 23 Years After Craniotomy: Case Report and Review of Literature

Michael R. Levitt, MD*

Patrik Gabikian, MD§

Paul S. Pottinger, MD‡

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Michael R. Levitt, MD,
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BACKGROUND AND IMPORTANCE: *Propionibacterium acnes* is an uncommon pathogen in delayed surgical site infection, and its indolent course can complicate diagnosis and treatment. We report the longest delay between neurosurgery and *P acnes* infection reported.

CLINICAL PRESENTATION: Asymptomatic postoperative *P acnes* osteomyelitis and tumor recurrence occurring 23 years after initial craniotomy. Initial presentation was of tumor recurrence only, without signs or symptoms of infection. Calvarial osteomyelitis was unexpectedly discovered intraoperatively. Craniectomy and débridement were performed, and there was prolonged antibiotic therapy.

CONCLUSION: The longest delay between neurosurgery and asymptomatic *P acnes* infection is reported. We review the literature for *P acnes* infection and discuss biofilm formation and its role in delayed surgical infection.

KEY WORDS: Biofilms, Central nervous system infection, Osteomyelitis, *Propionibacterium*

Neurosurgery. 2011 Sep;69(3):E773-9

INFEZIONI POST-CRANIOTOMIA

Operative intracranial infection following craniotomy

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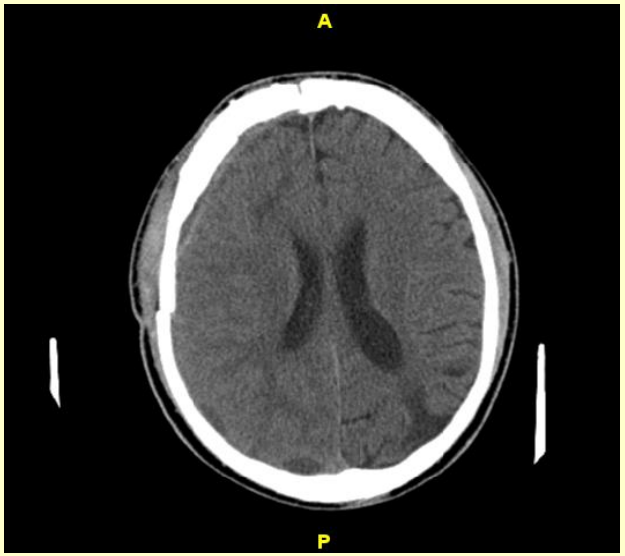
Neurosurg Focus 24 (6):E10, 2008

Meningite
Infezione del lembo osseo
Empiema subdurale
Empiema epidurale
Ascesso cerebrale



►Postoperative meningitis, the patient can be treated with antibiotics only.

►**Bone flap infection, subdural empyema, or cerebral abscess** usually require a repeated operation.

Segni e sintomi

Presenting symptoms in 50 patients with intracranial infections

Symptoms	No. of Patients (%)
fever	11 (22)
purulent drainage	17 (34) ←
mental status change	18 (36) ←
headache	10 (20)
swelling	7 (14)
seizure	2 (4)

- ✓ *L'alterazione dello stato mentale è stato il sintomo più frequente, seguito da*
- ✓ *Fuoriuscita di materiale purulento dalla ferita, poi da*
- ✓ *Febbre e*
- ✓ *Cefalea*

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Meningite
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Empiema subdurale
Empiema epidurale
Ascesso cerebrale

►Postoperative meningitis, the patient can be treated with antibiotics only.

►Bone flap infection, subdural empyema, or cerebral abscess usually require a repeated operation.

►**The goal of the surgery** is then to evacuate pus and infected debris as much as possible to allow the intravenous antibiotics to work effectively.

Pus and free bone flaps

Clinical article

Lars Widdel, M.D., and Ken R. Winston, M.D.

Department of Neurosurgery, University of Colorado Denver School of Medicine, University Hospital and The Children's Hospital, Denver, Colorado

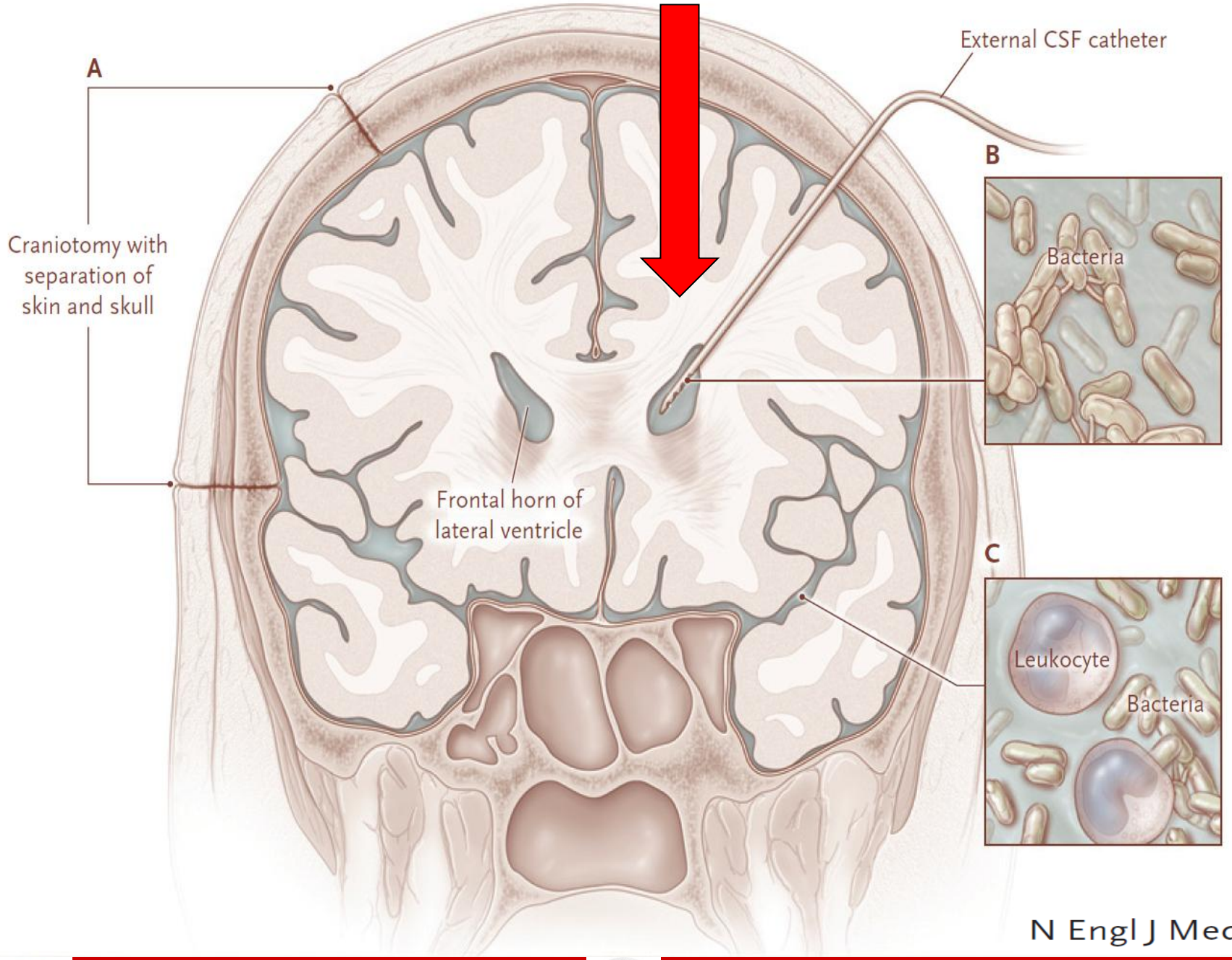
Bone Flap Preservation Technique

The contaminated bone flap is removed from the surgical field and any soft tissue that remains attached to the bone is removed. The free bone flap is then scrubbed vigorously with a brush for 3 to 5 minutes in an iodophor or bacitracin solution and the flap is then immersed in either a solution of either povidone iodine or bacitracin (1000 u/ml) until reimplantation. The operative bed is repeatedly irrigated with bacitracin solution and the entire surgical bed is scrubbed abrasively with gauze sponges. Bone edges surrounding the craniotomy are scraped with various instruments and scrubbed with a brush.

TABLE 3: Published reports on preservation of contaminated avascular bone flaps

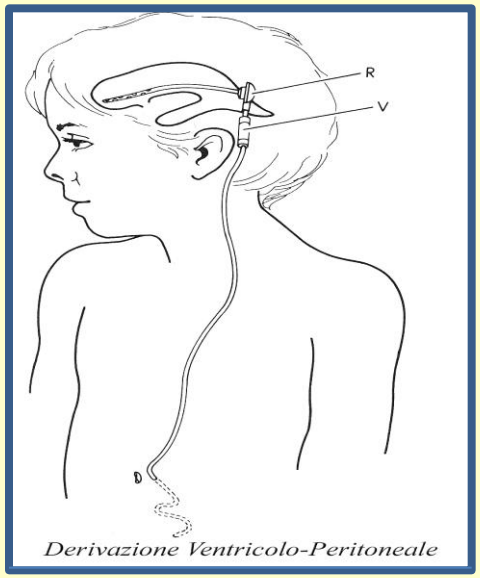
Authors & Year	No. of Attempts at Flap Preservation	No. of Successes (%)
Erickson et al., 1974	8	6 (75)
Chou & Erickson, 1976	25	15 (60)
Blomstedt, 1985	5	2 (40)
Bruce & Bruce, 2003	13	11 (85)
Josan et al., 2005	3	2 (67)
Auguste & McDermott, 2006	12	11 (92)
Dashti et al., 2008	28	unknown
current study	14	14 (100)

J Neurosurg Pediatrics 4:378–382, 2009



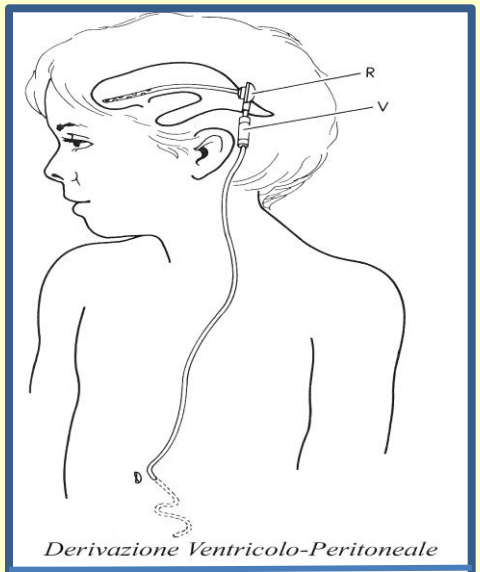
N Engl J Med 2010

Gli Shunt ventricolari, utilizzati dal 1952, vengono utilizzati per ridurre o monitorare la pressione intracranica e talora per introdurre farmaci



Derivazione Ventricolo-Peritoneale

Gli Shunt ventricolari, utilizzati dal 1952, vengono impiegati per ridurre o monitorare la pressione intracranica e talora per introdurre farmaci



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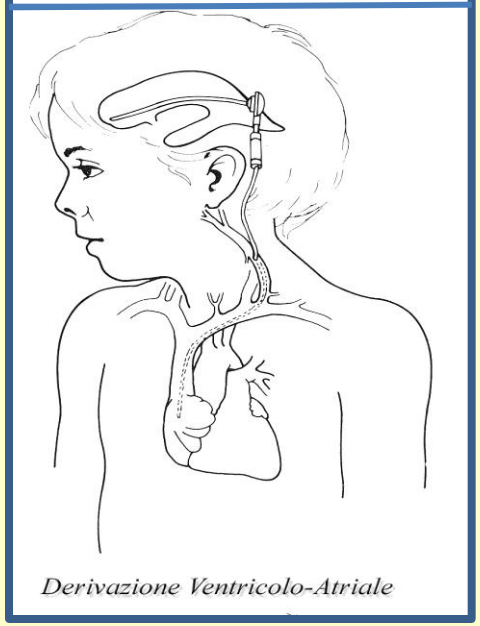
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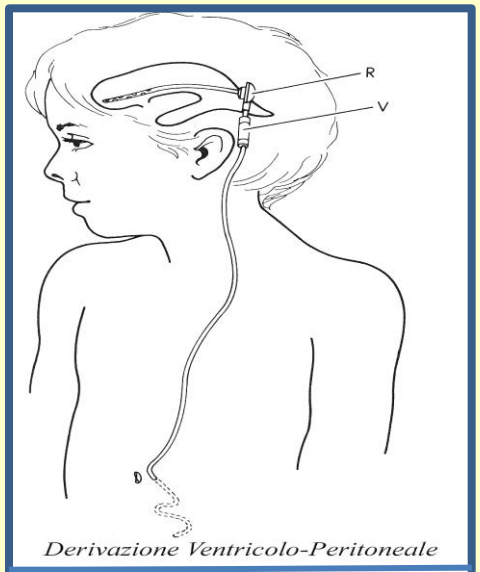
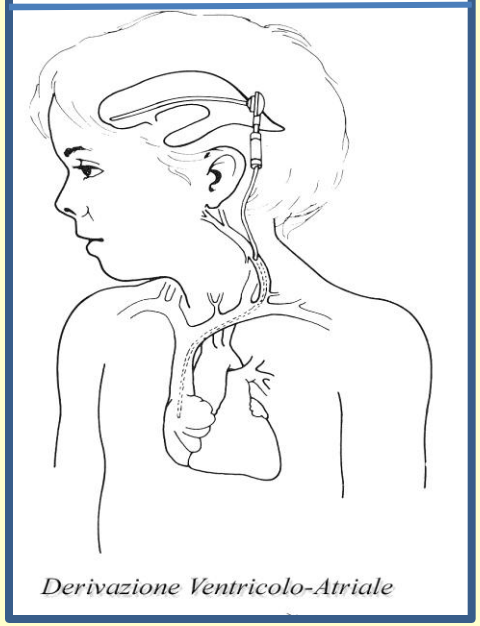


Derivazione Ventricolo-Peritoneale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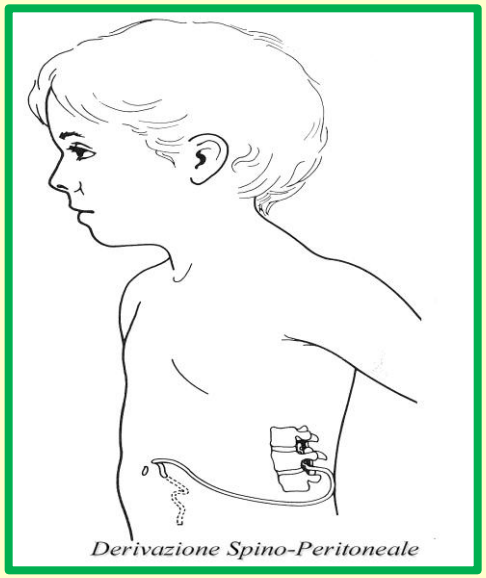
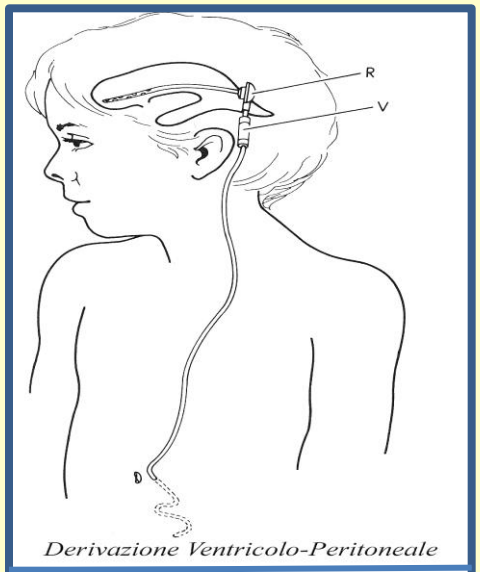
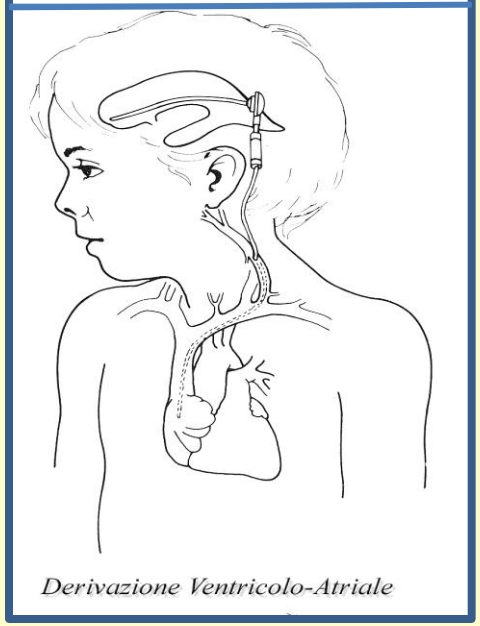
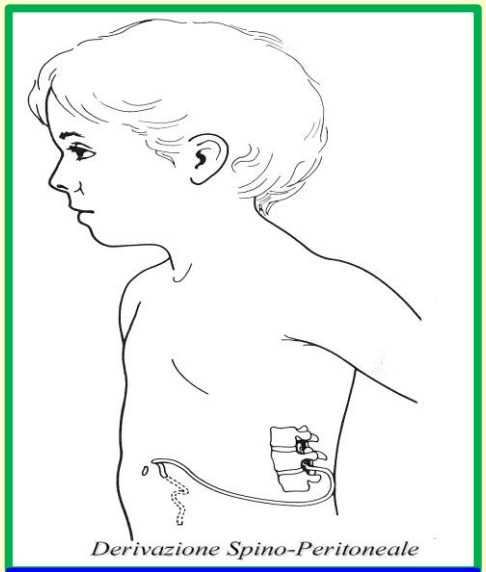

Derivazione Spino-Peritoneale

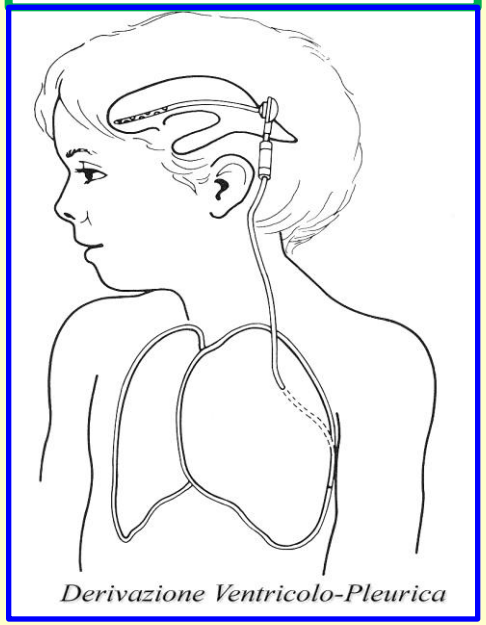
Gli Shunt ventricolari, utilizzati dal 1952, vengono utilizzati per ridurre o monitorare la pressione intracranica e talora per introdurre farmaci



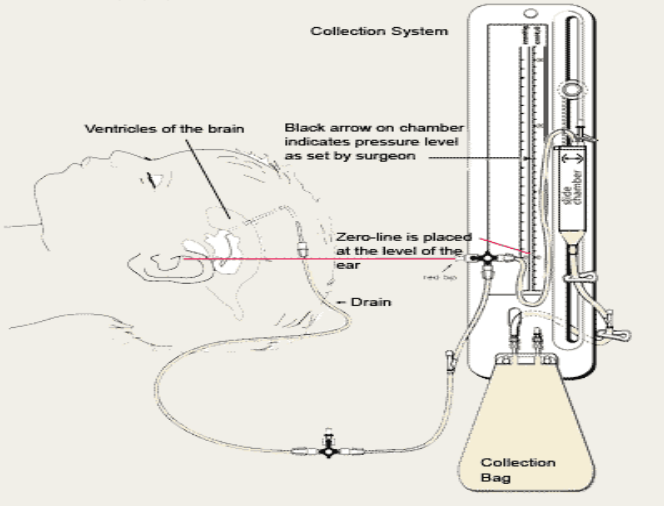
Derivazione Ventricolo-Peritoneale


Derivazione Ventricolo-Atriale

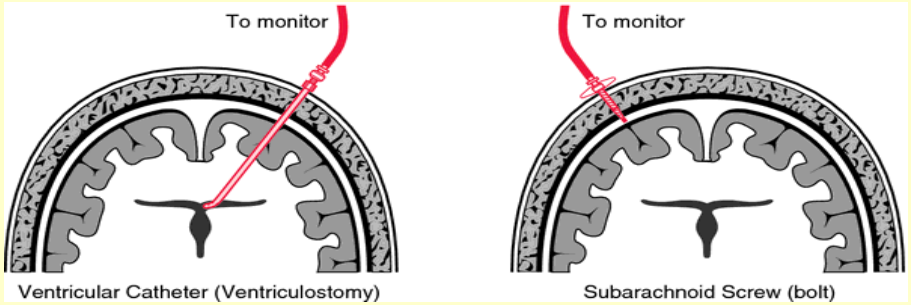

Derivazione Spino-Peritoneale


Derivazione Ventricolo-Pleurica

INDICAZIONI AL DRENAGGIO VENTRICOLARE ESTERNO

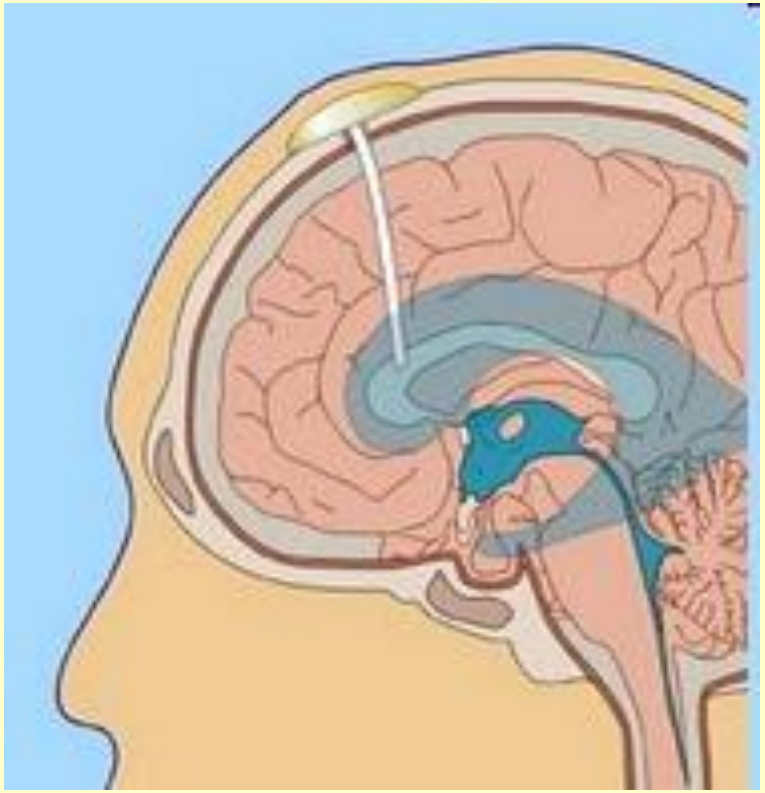


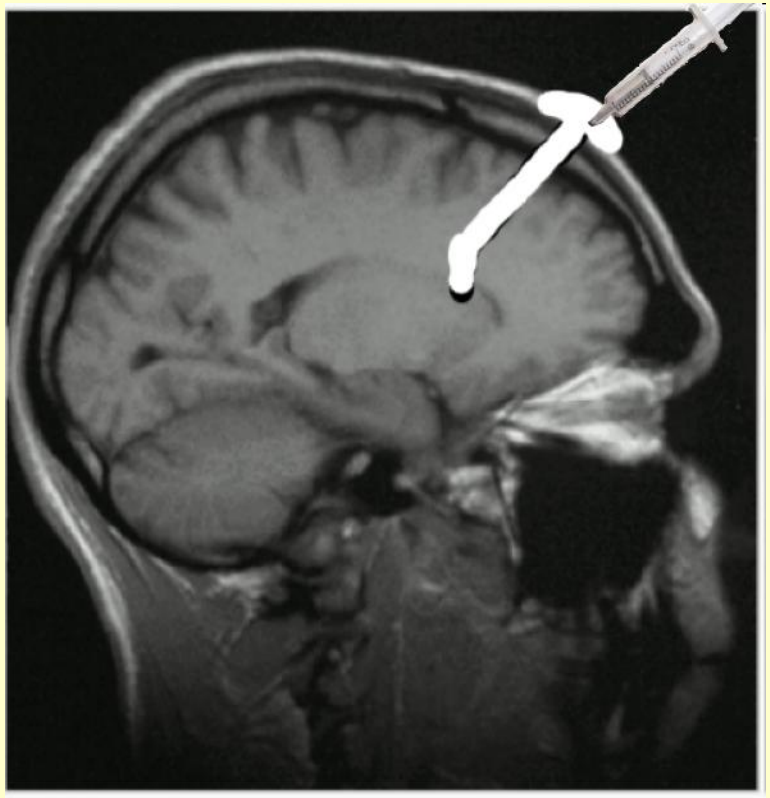
Drenaggio ventricolare esterno (per es. idrocefalo acuto)



***Monitoring* pressione intracranica**

Ommaya reservoir





Infezioni associate a shunt liquorali

*"Shunt infection remains the foremost problem of shunt implantation
after mechanical malfunctions."*

Shunt implantation: reducing the incidence of shunt infection.
Choux M, Genitori L, Lang D, Lena G

JNS JOURNAL OF NEUROSURGERY
OFFICIAL JOURNALS OF THE AANS SINCE 1944

1992 Dec;77(6):875-80.

Table 1. Clinical and Economic Consequences of Infections Associated with Surgical Implants.*

Implant	Implants Inserted in the U.S. Annually	Projected Infections of Implants Annually	Average Rate of Infection†	Preferred Practice of Surgical Replacement	Estimated Average Cost of Combined Medical and Surgical Treatment
	no.		%	*no. of stages*	*U.S. $*
Cardiovascular					
Mechanical heart valve	85,000	3,400	4	1	50,000
Vascular graft‡	450,000	16,000	4	1 or 2	40,000
Pacemaker–defibrillator	300,000	12,000	4	2	35,000§
Ventricular assist device	700	280	40	1	50,000
Orthopedic					
Joint prosthesis	600,000	12,000	2	2	30,000
Fracture-fixation device¶	2,000,000	100,000	5	1 or 2	15,000
Neurosurgical — ventricular shunt	40,000	2,400	6	2	50,000
Plastic — mammary implant (pair)	130,000	2,600	2	2	20,000
Urologic — inflatable penile implant	15,000	450	3	2	35,000

N Engl J Med 2004

Infezioni degli shunt liquorali

- *Incidenza dell'infezione 2-13% (in media 20% EVD)*

  Solo pochi centri riferiscono infezioni ~1%

Guitierrez-Gonzales R. et al.; *Eur J Clin Microbiol Infect Dis* (2012)

J Neurosurg Pediatr. 2011 July ; 8(1): 22–29. doi:10.3171/2011.4.PEDS10551.

A standardized protocol to reduce cerebrospinal fluid shunt infection: The Hydrocephalus Clinical Research Network Quality Improvement Initiative

John R. W. Kestle, M.D.[1], Jay Riva-Cambrin, M.D.[1], John C. Wellons III, M.D.[2], Abhaya V. Kulkarni, M.D.[3], William E. Whitehead, M.D.[4], Marion L. Walker, M.D.[1], W. Jerry Oakes, M.D.[2], James M. Drake, M.B.Ch.B.[3], Thomas G. Luerssen, M.D.[4], Tamara D. Simon, M.D., M.S.P.H.[5], and Richard Holubkov, Ph.D.[6] for the Hydrocephalus Clinical Research Network

[1]Primary Children's Medical Center, University of Utah, Salt Lake City, Utah

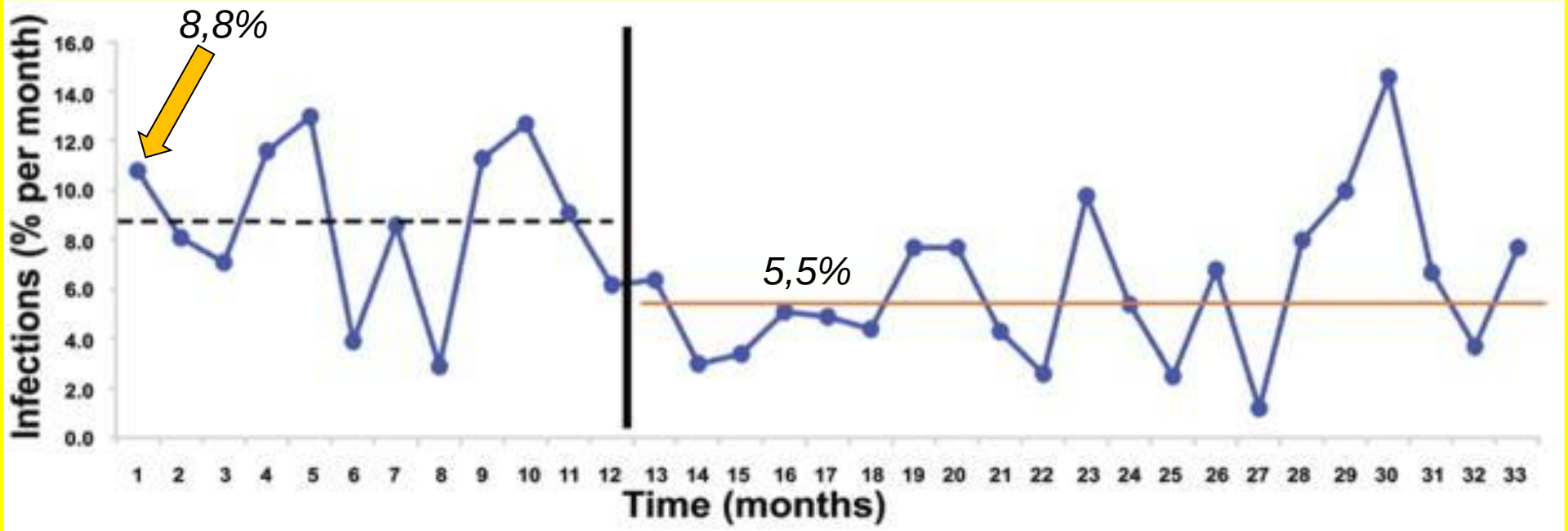
[2]Birmingham Children's Hospital, University of Alabama, Birmingham, Alabama

[3]Hospital for Sick Children, University of Toronto, Ontario, Canada

[4]Texas Children's Hospital, Baylor College of Medicine, Houston, Texas

[5]Seattle Children's Research Institute, University of Washington, Seattle, Washington

[6]Hydrocephalus Clinical Research Network Data Coordinating Center, Department of Pediatrics, University of Utah, Salt Lake City, Utah



Infezioni degli shunt liquorali

- ***Incidenza dell'infezione*** *2-13% (in media 20% EVD)*

  Solo pochi centri riferiscono infezioni ~1%

- ***Sorgente dell'infezione***
  - *Più frequentemente (75% dei casi) la contaminazione batterica avviene al momento dell'intervento chirurgico*

Guitierrez-Gonzales R. et al.; *Eur J Clin Microbiol Infect Dis* (2012)

Table 2. Clinical characteristics of patients with episodes of CSF shunt–associated infection.

Variable	Episodes (n = 78)
Duration of symptoms before diagnosis of infection, median days (range)	5 (0–21)
Time between implantation or last surgery and manifestation of infection	%
<1 month	48 (62)
1–12 months	22 (28)
>12 months	8 (10)

Delay

- **Il 62 % delle infezioni viene diagnosticato entro i primi 30 giorni**
- **Il 90% delle infezioni diventa evidente durante i primi sei mesi**.
- La probabilità di infezione è più alta nelle prime 8 settimane dopo l'intervento

Anna Conen; CID, 2008

Common Pathogens Associated With Ventriculoperitoneal Shunt Infections[a]

Early Infection (≈85% of Shunt Infection) (Within Weeks of Shunt Placement or Revision)	Late Infection (≈15% of Shunt Infection) (Several Months After Shunt Placement or Revision)
Coagulase-negative *Staphylococci* (ie, *S. epidermidis*)—50%	*Pseudomonas aeruginosa*
Staphylococcus aureus—33%	*Serratia marcescens*
Corynebacterium	*Stenotrophomonas*
Propionibacterium acnes	*Candida albicans*

AACN Advanced Critical Care
Volume 24, Number 1, pp.6-12

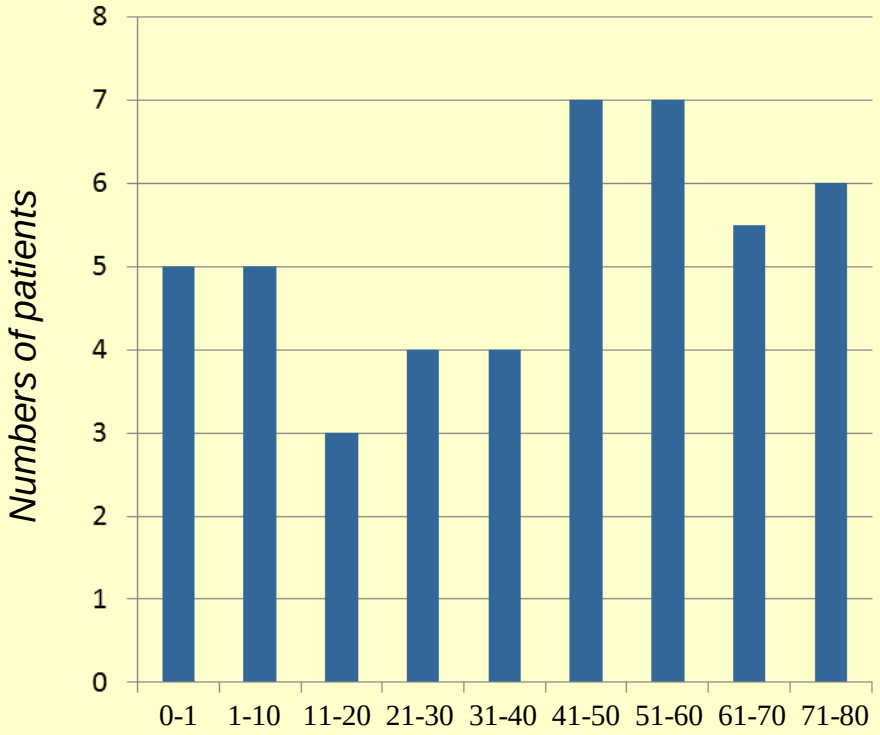
Chiou CC, et al. Fungal infection of ventriculoperitoneal shunts in children *Clin Infect Dis* . 1994 ; 19 : 1049 – 1053

Davis SE, et al. .; Does age or other factors influence the incidence of ventriculoperitoneal shunt infections ? *Pediatr Neurosurg.* 1999 ; 30 : 253 – 257

Distribuzione per età di pazienti con infezione di shunt liquorali

infezione dello shunt più frequente in età pediatrica

La percentuale di infezione complessiva fu del 2,1%, compresa tra 1,7 ed **il 9,3%** per il gruppo degli adulti e **dei bambini**, rispettivamente.



Wang Kwo-Wei et al.: *Jpn J Infect Dis; 2004*

2220 Shunt V/P: 2112 adulti, 108 bambini: 46 infezioni

In età pediatrica la percentuale di infezione dei cateteri è più alta tra i bambini con meno di 1 anno di età, nei quali <u>l'alta densità batterica</u> della pelle risulta correlata con l'incidenza della infezione.

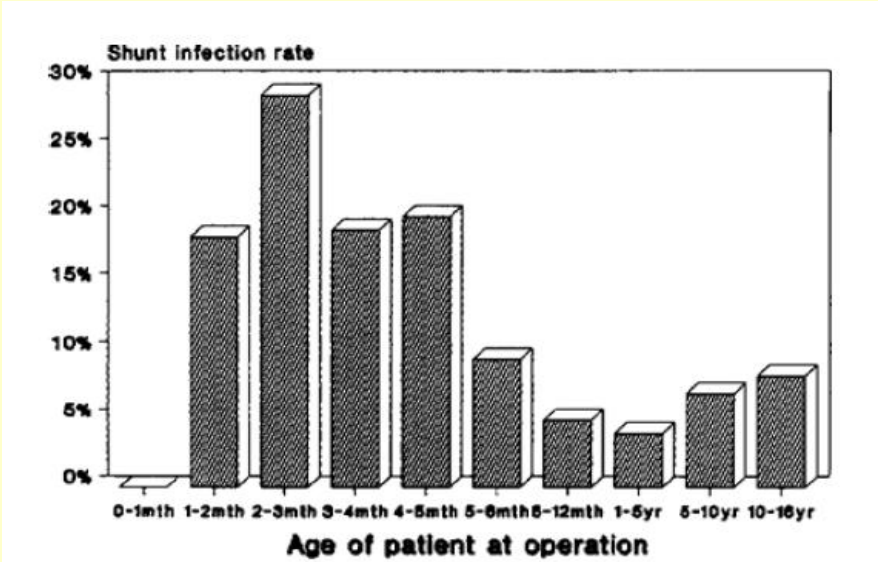


FIG. 1. Graph illustrating relationship between incidence of shunt infection and age at operation found in 466 operations on 294 children.

IAN K. POPLE, J Neurosurg 77:29–36, 1992

Infezioni degli shunt liquorali

- *Incidenza dell'infezione 2-13% (in media 20% EVD)*

  Solo pochi centri riferiscono infezioni ~1%

- *Sorgente dell'infezione*
  - *Più frequentemente (75% dei casi) la contaminazione batterica avviene al momento dell'intervento chirurgico*
  - *Attraverso la pelle: per soluzione di continuità della cute che copre il dispositivo*
    - *Incisione mal suturata*
    - *Grattamento della ferita (specie da parte di bambini)*
    - *Ulcera da decubito*
    - *Infezione cutanea adiacente alla ferita*

Guitierrez-Gonzales R. et al.; *Eur J Clin Microbiol Infect Dis* (2012)

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    - *Grattamento della ferita (specie da parte di bambini)*
    - *Ulcera da decubito*
    - *Infezione cutanea adiacente alla ferita*
  - *Per diffusione ematogena (rara, di solito solo nelle derivazioni V-A)*
  - *Per infezione retrograda dall'estremo distale dello shunt*

Guitierrez-Gonzales R. et al.; *Eur J Clin Microbiol Infect Dis* (2012)

INFEZIONE DEL DRENAGGIO VENTRICOLARE ESTERNO

- Incidenza tra il 10-17% **fino al 20%**
- Rischio
  - Minimo tra il 1°-4° giorno di posizionamente in sito
  - Aumenta nei successivi dieci giorni
  - Decresce successivamente
  - ***Il tempo di drenaggio non è un significativo fattore di rischio per infezioni***
- L'incidenza non si riduce con cambi ad intervalli regolari del EVD
- Eziologia
  - Predominanti CNS

Pfisterer W. et al.; *J Neurol Neurosurg Psychiatry* 2003, 74, 929-932

DRENAGGIO VENTRICOLARE ESTERNO

Table 1 Causative organisms and diagnosis of infection according to the Centers for Disease Control definition

Causative organism	EVD	LD	Σ (%)	Criterion 1 only (%)	Criterion 1+2 (%)
Σ (CoNS)	13	16	29 (73)	25 (86)	4 (14)
Σ (*S aureus*), divided into	3	4	7 (18)	3 (43)	4 (57)
S aureus, MSSA	2	1	3 (8)	2 (67)	1 (33)
S aureus, MRSA	1	3	4 (10)	1 (25)	3 (75)
Enterococcus faecalis	1	0	1 (2.5)	0 (0)	1 (100)
Acinetobacter baumannii	1	0	1 (2.5)	0 (0)	1 (100)
Pseudomonas aeruginosa	1	0	1 (2.5)	0 (0)	1 (100)
Candida albicans	1	0	1 (2.5)	0 (0)	1 (100)
Σ (all microorganism)	20	20	40	28 (70)	12 (30)

Meningitis occurred more often in patients with LD than EVD

However, the difference was not statistically significant.

Detection of intraventricular blood by cranial CT was significantly correlated with meningitis

Table 4 Risk factors analysis for meningitis

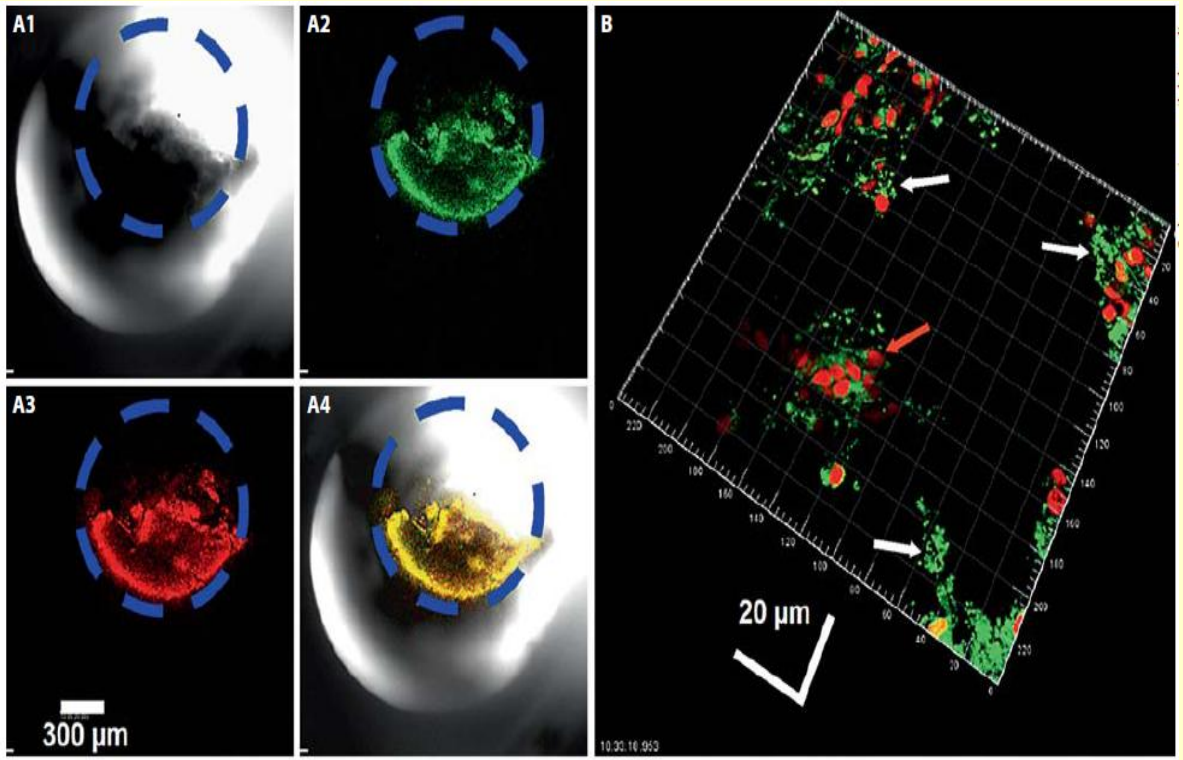
Meningitis	OR (CI 95%)	p (<0.05)
LD versus EVD	1.39 (0.58–3.30)	0.46
Previous trauma	3.21 (1.00–10.33)	0.04
Intraventricular blood (cranial CT; NSICU)	4.93 (1.57–15.45)	0.003
LD placement >9 days	1.38 (0.29–6.48)	0.68
EVD placement >9 days	0.61 (0.25–1.48)	0.27

Scheithauer S.,*J Neurol Neurosurg Psychiatry* 2009; 80, 1381-1385

Colonizzazione dei device e formazione di Biofilm

I microrganismi causa di infezioni di shunt tipicamente sono in grado di aderire alla superficie dei *device* e di formare *biofilm* , che rende difficile la diagnosi clinica e di laboratorio, ma soprattutto rende veramente difficile la terapia.

Il materiale occludente il catetere consiste di un biofilm formato da gruppi di cocchi vitali (freccia bianca) frammisti con cellule dell'ospite (freccia rossa).



Biofilm in Confocal microscopy

Stoodley P. et al.; *Pediatr Neurosurg*, 2010

Characteristics of infections associated with external ventricular drains of cerebrospinal fluid

Laura N. Walti et al.

Journal of Infection (2013) **66**, 424—431

Table 3 Clinical findings at EVD insertion and at diagnosis of EVD-associated infection.

Parameter	At EVD insertion	At diagnosis of EVD-associated infection	*p* Value
Fever ≥38 °C	7 (15)	38 (79)	<0.0001
Neurological signs and symptoms[a]	3 (6)	15 (31)	0.003
GCS, median (range) – points	3 (3–15)	8 (3–15)	0.004
Decrease in GCS score[b]			
No decrease	13 (27)	34 (71)	<0.0001
1–3 points	4 (8)	8 (17)	NS
4–6 points	3 (6)	4 (8)	NS
≥7 points	28 (58)[c]	2 (4)	<0.0001

About one-fifth of EVDassociated infections occurred up to 10 days after removal of the EVD. Since about half of patients need a subsequent internalization of the shunt, the accurate diagnosis and treatment of EVD-associated infection is crucial.

The clinical presentation of infection in VA shunts differs from that in VP shunts

-- Clinical features of ventriculoatrial and ventriculoperitoneal shunt infections of surgical origin.

CLINICAL FEATURES OF VA AND VP SHUNT INFECTIONS OF SURGICAL ORIGIN		
	VA shunts	**VP shunts**
Time from surgery to presentation	Weeks, months, several years	<9 months
Intermittent fever	75%	<50%
Anorexia, lassitude, poor sleep pattern	>80%	>50%
Shunt obstruction	<1%	>75%
Other features	Chills, rigors: 20%	Abdominal pain, bloating: >75%
	Arthralgia: 50% (late onset cases (1–15 years))	Swelling, erythema over shunt tubing: >60%
	Rash: 70% (late onset cases (1–15 years))	Headache, vomiting, etc. (i.e. recurrence of hydrocephalus): 75%
	Nephritis: 30% (late onset cases (1–15 years))	
Percentages indicate the approximate proportion of cases in which features are present. It is important to realize that each case is different and that many of these features may be absent or modified		

Cohen J.: Infectious diseases ; Third ed. 2010

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Cohen J.: Infectious diseases ; Third ed. 2010

Clinical Infectious Diseases 2008

MAJOR ARTICLE

Characteristics and Treatment Outcome of Cerebrospinal Fluid Shunt–Associated Infections in Adults: A Retrospective Analysis over an 11-Year Period

Anna Conen,[1] Laura Naemi Walti,[1] Adrian Merlo,[2] Ursula Fluckiger,[1] Manuel Battegay,[1] and Andrej Trampuz[1,3]

[1]Division of Infectious Diseases and Hospital Epidemiology, Department of Internal Medicine, [2]Department of Neurosurgery, and [3]Infectious Diseases Research Laboratory, Department of Biomedicine, University Hospital Basel, Basel, Switzerland

Table 4. Microbiological findings for episodes of CSF shunt–associated infection.

Pathogen	Overall (*n* = 78)	Infection onset: Early[a] (*n* = 48)	Delayed[b] (*n* = 22)	Late[c] (*n* = 8)
Coagulase-negative staphylococci[d]	29 (37)	19	9	1
Staphylococcus aureus[d]	14 (18)	9	5	…
Propionibacterium acnes	7 (9)	5	2	…
Viridans group streptococci	3 (4)	2	1	…
Enterobacteriaceae[e]	3 (4)	3	…	…
Nonfermenters[f]	2 (3)	…	1	1
Enterococcus species	1 (1)	…	1	…
Polymicrobial[g]	12 (15)	4	2	6
Culture negative	7 (9)	6	1	…

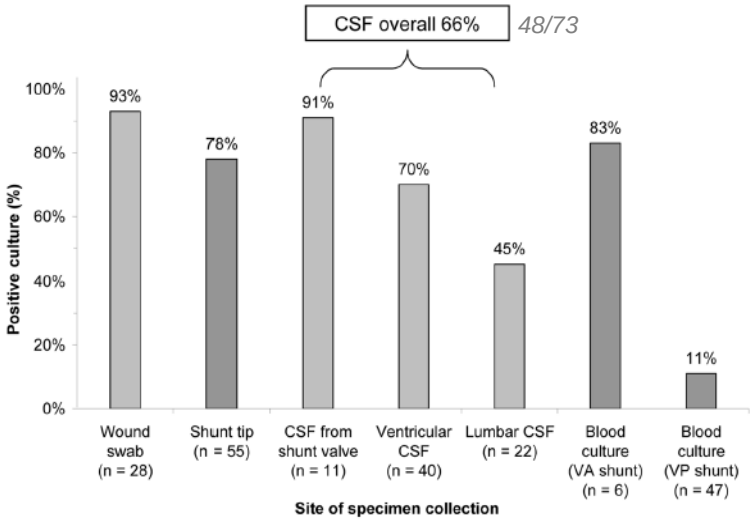
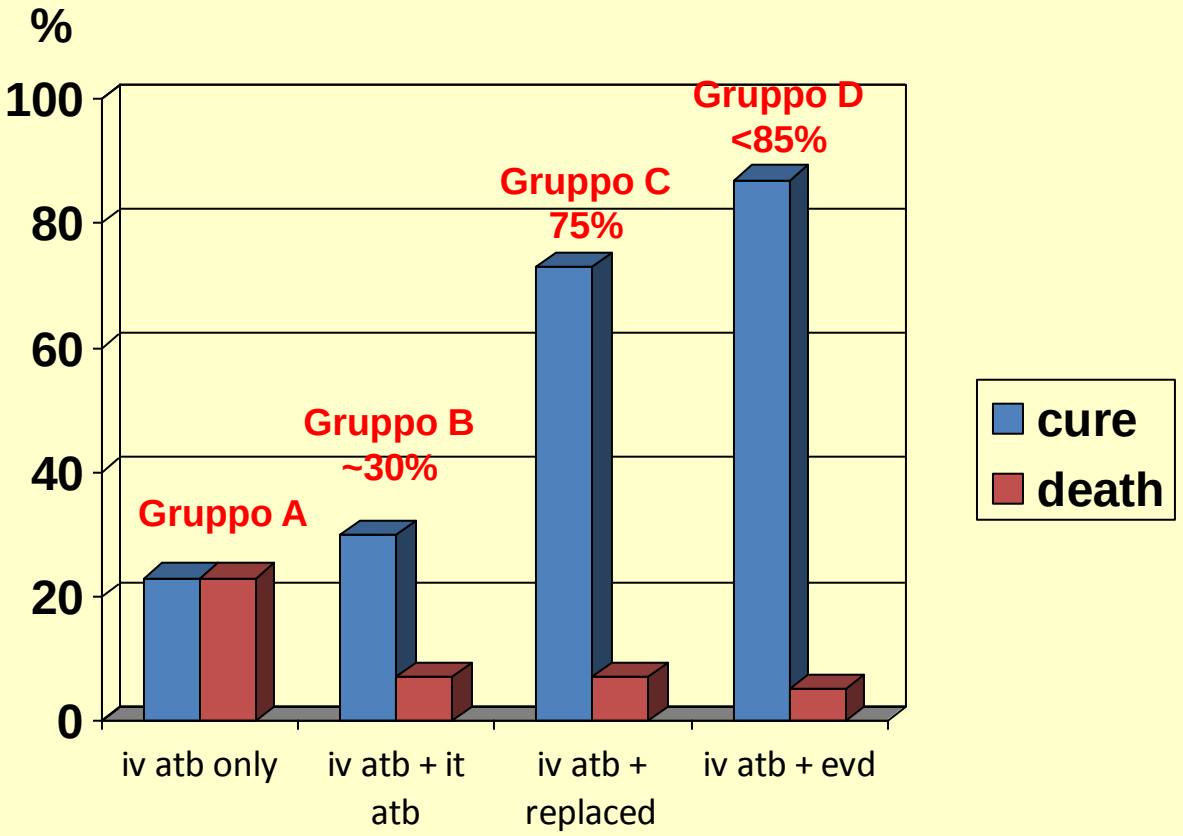


Figure 2. Rate of positive culture results by specimen collection site. VA, ventriculoatrial; VP, ventriculoperitoneal.

INFEZIONE DELLO SHUNT

Morbilità e mortalità per trattamenti diversi



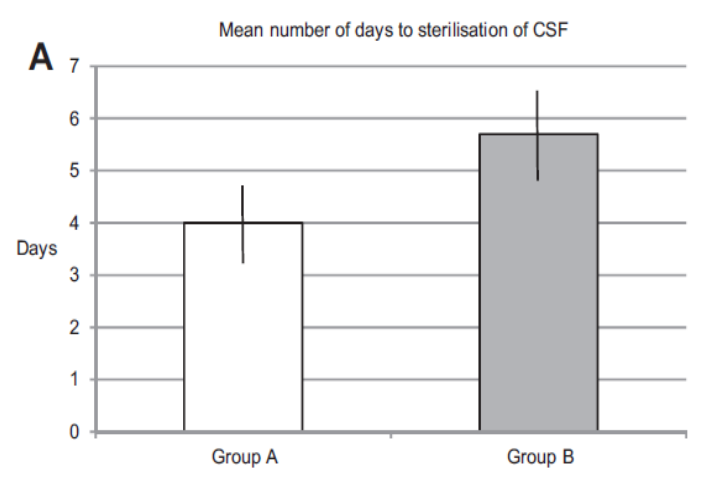
Il gruppo trattato con esternalizzazione non solo ha presentato il più basso tasso di mortalità ma ha anche dimostrato la più elevata percentuale di successo.

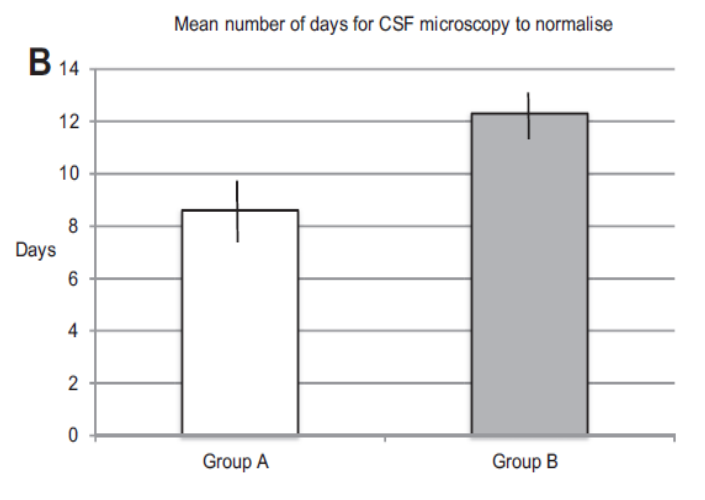
James HE, et al. *Neurosurgery*.; 1980

Infections of cerebrospinal fluid diversion devices in adults: The role of intraventricular antimicrobial therapy

M.D. Wilkie [a,*], M.F. Hanson [b], P.F. Statham [a], P.M. Brennan [a]

[a] Department of Clinical Neurosciences, Western General Hospital Crewe Road South Edinburgh EH4 2XU, UK
[b] Department of Microbiology, Western General Hospital, Crewe Road South, Edinburgh EH4 2XU, UK



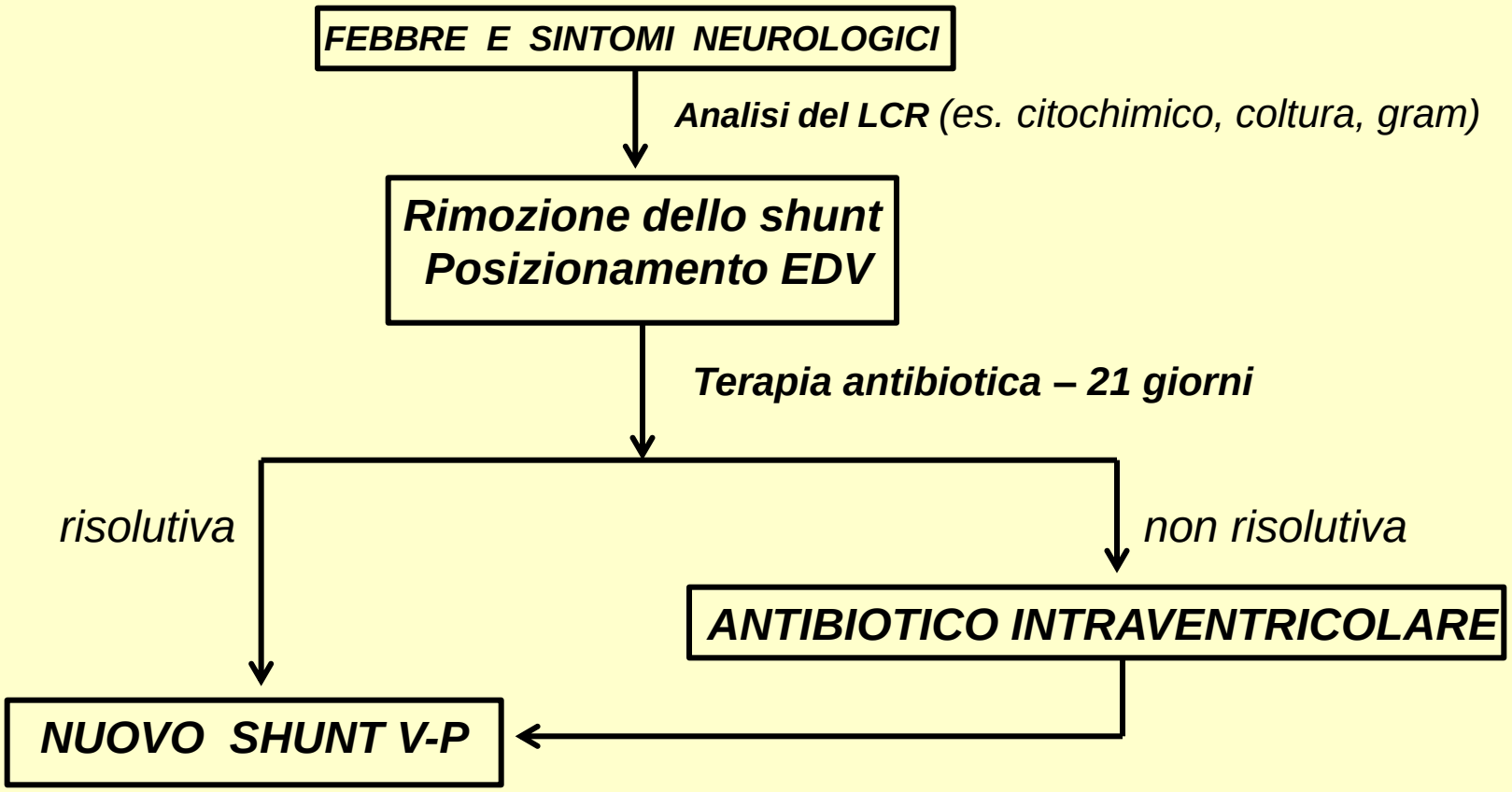


Group A received systemic and intraventricular antimicrobials

Group B received systemic therapy alone

Journal of Infection (2013) 66, 239–246

Protocollo per diagnosi e trattamento delle infezioni di shunt ventricolo-peritoneali



- ***Inutile tentare una terapia con soli antibiotici***

Paiva WS, et al. 2010

Durata della terapia antibiotica prima del '*reshunting*'

- ***Microrganismo isolato***

- *Ottenuta la negativizzazione della liquorcoltura*

  - Per gli stafilococchi CN
  - Per il *P. acnes*

    Con esame citochimico LCR normale: 3 giorni
    Con esame citochimico LCR anormale: 10 giorni

  - Per lo *S. aureus : 10 giorni*

  - Per batteri Gram negativi : 10-20 giorni

James HE, Bradley JS; *Pediatr Neurosurg*. 2008;44(2):104-11.

Practice Guidelines for the Management of Bacterial Meningitis

May 2004.

The principles of antimicrobial therapy for CSF shunt infections are generally the same as those for the treatment of acute bacterial meningitis. However, direct instillation of antimicrobial agents into the ventricles through either an external ventriculostomy or shunt reservoir is occasionally necessary in patients who have shunt infections that are difficult to eradicate or who cannot undergo the surgical components of therapy (A-III). No antimicrobial agent has been approved by the US Food and Drug Administration for intraventricular use, and the specific indications are not well-defined.

The optimal duration of antibiotic administration after the shunt has been replaced also is unknown, and practice is variable.

Table 7. Recommended dosages of antimicrobial agents administered by the intraventricular route (A-III).

Antimicrobial agent	Daily intraventricular dose, mg
Vancomycin	5–20[a]
Gentamicin	1–8[b]
Tobramycin	5–20
Amikacin	5–50[c]
Polymyxin B	5[d]
Colistin	10
Quinupristin/dalfopristin	2–5
Teicoplanin	5–40[e]

IDSA GUIDELINES

Practice Guidelines for the Management of Bacterial Meningitis

May 2004.

Common Intravenous Antimicrobial Treatment Regimens for Ventriculoperitoneal Shunt Infections Based on Causative Pathogen[a]

Microorganism	Treatment of Choice	Common Intravenous Dosing Requirements (Normal Renal Function)	Treatment Duration, d
Coagulase-negative *Staphylococci* (eg, *S epidermis*)	Vancomycin	15 mg/kg every 8-12 h	7
Staphylococcus aureus	MRSA: Vancomycin	15 mg/kg every 8-12 h	10
	MSSA: Nafcillin	2 g every 4 h	
Gram-negative bacilli (eg, *P aeruginosa*)	Ceftazidime	2 g every 8 h	10-14; depending on clinical response
	Cefepime	2 g every 8 h	
	Meropenem	2 g every 8 h	

Abbreviations: MRSA, methicillin-resistant *Staphylococcus aureus*; MSSA, methicillin-sensitive *Staphylococcus aureus*.

[a]Based on information from meningitis guidelines and Tunkel et al.[23,24]

Practice Guidelines for the Management of Bacterial Meningitis

May 2004.

have ever been performed. The principles of antimicrobial therapy for CSF shunt infections are generally the same as those for the treatment of acute bacterial meningitis. However, direct instillation of antimicrobial agents into the ventricles through either an external ventriculostomy or shunt reservoir is occasionally necessary in patients who have shunt infections that are difficult to eradicate or who cannot undergo the surgical components of therapy (A-III). No antimicrobial agent has been approved by the US Food and Drug Administration for intraventricular use, and the specific indications are not well-defined.

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The optimal duration of antibiotic administration after the shunt has been replaced also is unknown, and practice is variable.

IDSA GUIDELINES

Conservative Management of Patients with Cerebrospinal Fluid Shunt Infections

OBJECTIVE: In patients with cerebrospinal fluid (CSF) shunt infection, removal of the shunt and antibiotic administration is the current standard of care. In 1986, we developed a protocol for the conservative management of patients with infected but functioning shunts. Treatment was based on the administration of a combination of intraventricular and systemic antibiotics.

Brown E.M et coll. *Neurosurgery 58:657-665, 2006*

Trattamento conservativo:

- **in pazienti selezionati con infezione di shunt da microrganismi meno virulenti (non *S. aureus*)**
- **Con somministrazione di antibiotici per via sistemica ed intraventricolare (attraverso un *device* ventricolare separato)**

TABLE 3. Infecting organisms treated with conservative therapy[a]

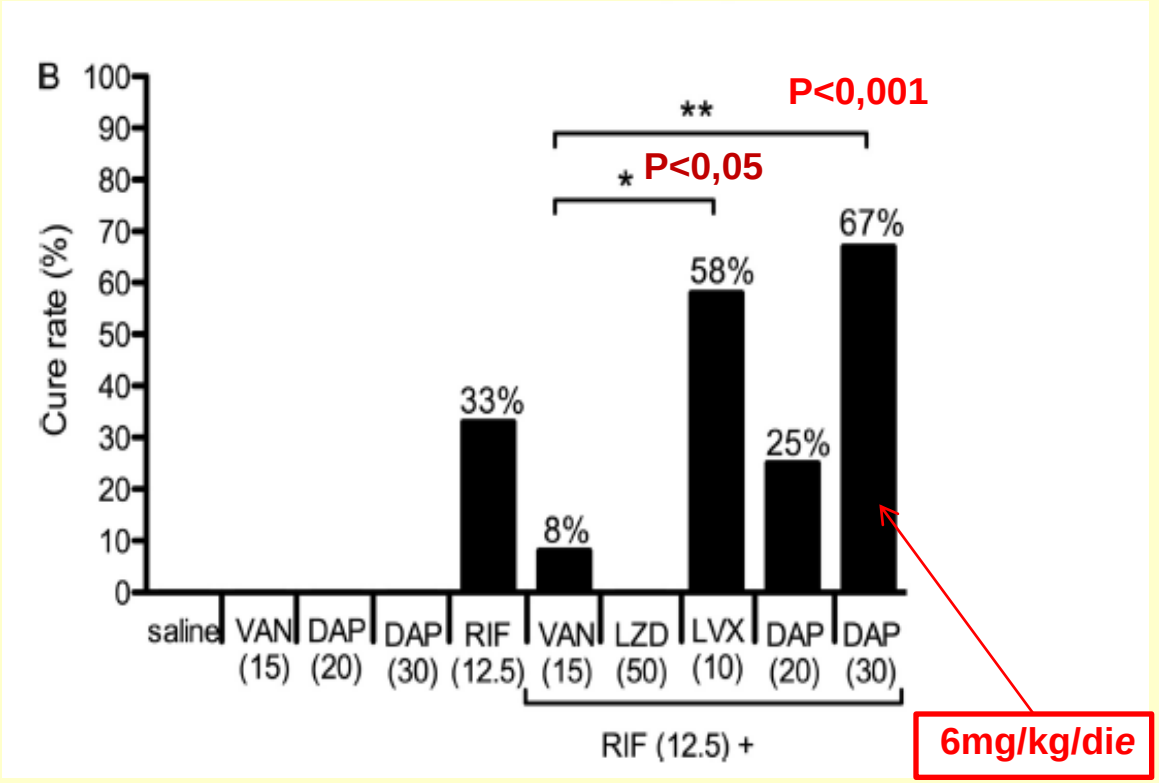
Organism	No. of infections	Successful eradication (%)
CoNS	30	28 (93)[d]
S. aureus	7	3 (43)
Enterococcus spp.	3[c]	3
Klebsiella oxytoca	1	1
Propionibacterium spp.	2[b]	2
Streptococcus sanguis	1	1
P. aeruginosa	1	0

[a] CoNS, coagulase-negative staphylococci.
[b] One combined with CoNS infection
[c] One combined with CoNS infection
[d] One *S. lugdunensis* and one *S. epidermidis* infection.

ANTIMICROBIAL AGENTS AND CHEMOTHERAPY, July 2009, p. 2719–2724 Vol. 53, No. 7
0066-4804/09/$08.00+0 doi:10.1128/AAC.00047-09

Efficacy of Daptomycin in Implant-Associated Infection Due to Methicillin-Resistant *Staphylococcus aureus*: Importance of Combination with Rifampin[▽]

Anne-Kathrin John,[1] Daniela Baldoni,[1] Manuel Haschke,[2] Katharina Rentsch,[3] Patrick Schaerli,[4] Werner Zimmerli,[5] and Andrej Trampuz[1,6]*



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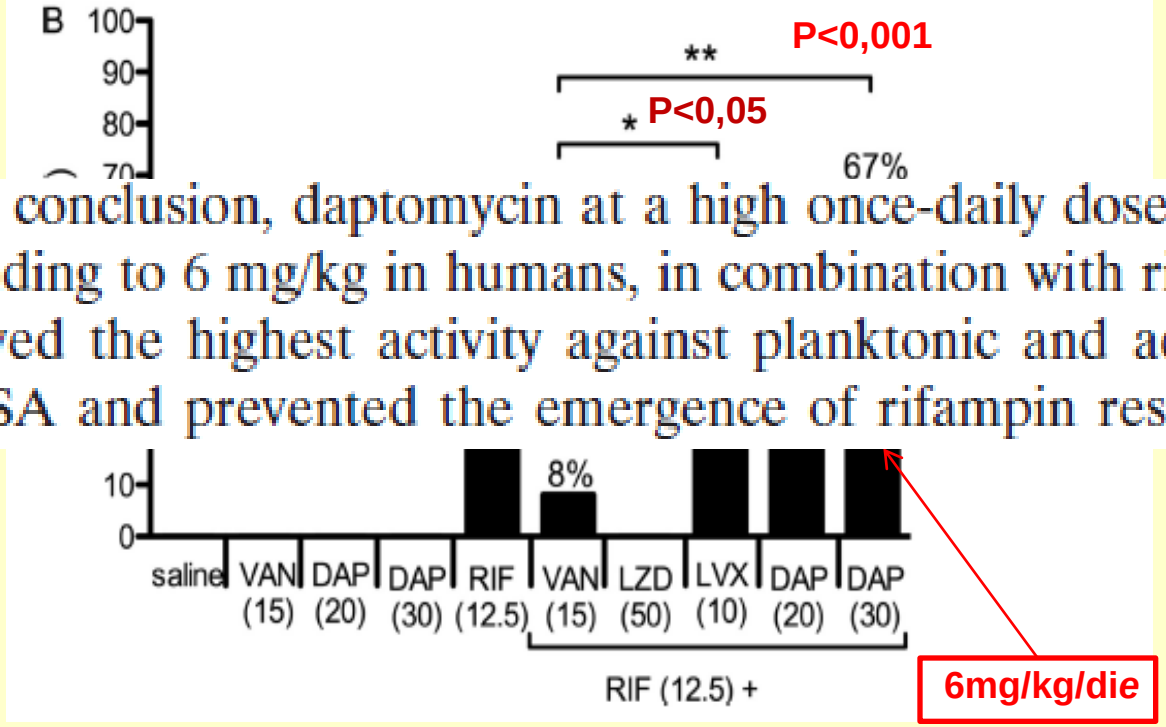


In conclusion, daptomycin at a high once-daily dose, corresponding to 6 mg/kg in humans, in combination with rifampin showed the highest activity against planktonic and adherent MRSA and prevented the emergence of rifampin resistance.

Successful Use of Intrathecal Daptomycin to Treat Meningitis Due to Vancomycin-Resistant *Enterococcus faecium*

Ralph C. Kahler, MD and Katherine Holloway, PharmD, BCPS†*

Infectious Diseases in Clinical Practice • Volume 20, Number 6, November 2012

Use of Daptomycin as Salvage Therapy in the Treatment of Central Nervous System Infections Including Meningitis and Shunt Infections

Suresh J. Antony, MD, Holly Lynn Hoffman-Roberts, PharmD,† and Bryce S. Foote, PharmD†*

Infectious Diseases in Clinical Practice • Volume 20, Number 2, March 2012

AAC
Journals.ASM.org

Action of Linezolid or Vancomycin on Biofilms in Ventriculoperitoneal Shunts *In Vitro*

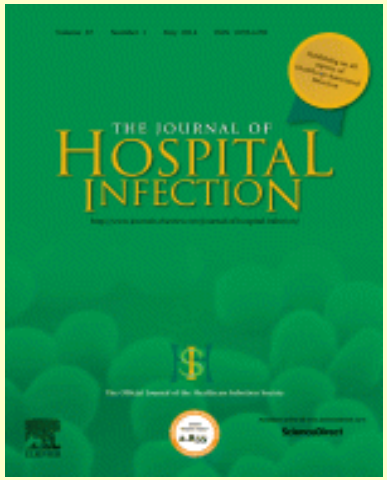
Roger Bayston, Gautham Ullas, and Waheed Ashraf

Antimicrobial Agents and Chemotherapy June 2012

Antibioticoprofilassi perioperatoria SNLG 2011

Per un reparto di Neurochirurgia (I)

Tipo di intervento	Antibiotico e modalità di somministrazione	Nei pazienti allergici ai betalattamici
DERIVAZIONE DEL LIQUIDO CEREBROSPINALE • *Shunt* ventricolo-atriale • *Shunt* ventricolo-peritoneale • *Shunt* esterno	**Somministrare**[§]: • una cefalosporina di 1° generazione (cefazolina 2 g) *oppure* • una cefalosporina di 2° generazione (cefuroxima 2 g) **come 2° scelta** • aminopenicillina associata ad un inibitore delle betalattamasi [1° dose amoxicillina/ac. clavulanico 2,2 g (1,2 g se peso <50 Kg) da infondere in 30 minuti]° **Valutazioni locali:** • dose intraoperatoria per interventi con **durata superiore a 3 ore*** • somministrazione di ulteriori dosi di antibiotico entro le **24 ore**** Vedi: Dosi addizionali nel corso dell'intervento pag. 57, Durata della profilassi pag. 59	**Somministrare** un antibiotico non appartenente alla classe dei betalattamici e con spettro adeguato, ad esempio: • un glicopeptide [vancomicina^ 15 mg/Kg (dose massima 1 g) alla concentrazione massima di 5 mg/ml da infondere in 1 ora e terminare prima dell'inizio dell'intervento] *oppure se si vuole estendere lo spettro agli anaerobi:* • associare clindamicina^ 600 mg o metronidazolo 500 mg Vedi: Presenza di eventuali allergie ai betalattamici pag. 51



J Hosp Infect. *2008 Aug;69(4):337-44..*

Vancomycin versus cefazolin prophylaxis for cerebrospinal shunt placement in a hospital with a high prevalence of meticillin-resistant *Staphylococcus aureus.*

Tacconelli E[1], Cataldo MA, Albanese A, Tumbarello M, Arduini E, Spanu T, Fadda G, Anile C, Maira G, Federico G, Cauda R.

Patients were randomly allocated to receive either vancomycin or cefazolin before surgery and followed-up for four weeks for the development of infections.
Of the 176 patients included in the study, 88 received vancomycin and 88 cefazolin.

Shunt infections were significantly less likely to be observed in patients who were on vancomycin prophylaxis (4% vs 14%; P=0.03).

All isolated staphylococci were resistant to meticillin.

Mortality of patients with post-surgical infections was higher in the cefazolin group (P=0.02).

JNS JOURNAL OF NEUROSURGERY
OFFICIAL JOURNALS OF THE AANS SINCE 1944

Neurosurg. 2006 Aug;105(2):242-7.

Surgical shunt infection: significant reduction when using intraventricular and systemic antibiotic agents.

Ragel BT, Browd SR, Schmidt RH.

A total of 802 shunt procedures were performed in 534 patients*.*
All patients underwent intraoperative systemic antistaphylococcal antibiotic therapy.

Group I: *4 mg of gentamicin intraventricularly at surgery: infection rates were* ***5.4%***

Group II*: 4 mg of gentamicin intraventricularly +10 mg of vancomycin :*
infection rate: **0.41%**

Group III e Group IV, control groups, who did not receive intraventricular antibiotic prophylaxis: infection rate: 6.21%, and 6.74%, respectively

The authors concluded that the combination of intraventricular gentamicin and vancomycin was an effective method to prevent CNS shunt infection.

Protective effect of rifampicin and clindamycin impregnated devices against *Staphylococcus* spp. infection after cerebrospinal fluid diversion procedures

Raquel Gutiérrez-González[1*], Gregorio R Boto[1], Cristina Fernández-Pérez[2], Náyade del Prado[2]

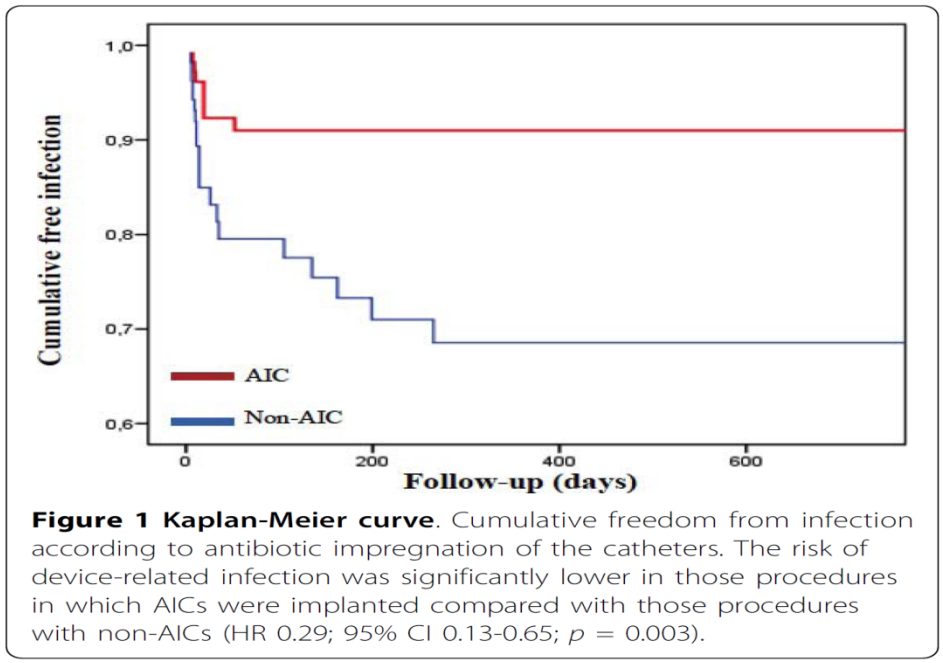


Figure 1 Kaplan-Meier curve. Cumulative freedom from infection according to antibiotic impregnation of the catheters. The risk of device-related infection was significantly lower in those procedures in which AICs were implanted compared with those procedures with non-AICs (HR 0.29; 95% CI 0.13-0.65; $p = 0.003$).

Antibiotic-impregnated catheters are a safe and helpful tool to reduce CSF shunting device-related infections.

The results obtained in this retrospective study suggest that AICs are a protective and safe tool against infection and, specifically, against *Staphylococcus* spp. infection.

However, furtherprospective, randomized, controlled trials are required to confirm these results.

Gutiérrez-González et al. BMC Neurology 2010, 10:93

Cerebrospinal shunt infection in patients receiving antibiotic-impregnated versus standard shunts

Scott L. Parker, M.D.,[1] William N. Anderson, Ph.D.,[2] Sean Lilienfeld, M.B.B.C.H., M.Med.,[3] J. Thomas Megerian, M.D., Ph.D.,[3] and Matthew J. McGirt, M.D.[4]

J Neurosurg Pediatrics 8:259–265, 2011

TABLE 1: A comparison of the number of infections between AIS catheters and non-AIS catheters reported in the literature*

Authors & Year	AISs		Non-AISs	
	No. of Shunt Procedures	No. of Infections (%)	No. of Shunt Procedures	No. of Infections (%)
adult				
Albanese et al., 2009	6	0 (0.0)	12	7 (58.3)
Eymann et al., 2008	171	1 (0.6)	98	4 (4.1)
Farber et al., 2011[14]	250	3 (1.2)	250	10 (4.0)
pediatric				
Aryan et al., 2005	32	1 (3.1)	46	7 (15.2)
Eymann et al., 2008	26	1 (3.8)	22	3 (13.6)
Hayhurst et al., 2008	214	21 (9.8)	77	8 (10.4)
Kan & Kestle, 2007	80	4 (5.0)	80	7 (8.8)
Parker et al., 2009	502	16 (3.2)	570	64 (11.2)
mixed population				
Govender et al., 2003	60	3 (5.0)	77	10 (13.0)
Pattavilakom et al., 2007	243	3 (1.2)	551	36 (6.5)
Richards et al., 2009	994	30 (3.0)	994	47 (4.7)
Ritz et al., 2007	86	5 (5.8)	172	10 (5.8)
total (%)	2664	88 (3.3)	2949	213 (7.2)

* Of the 5613 shunting procedures identified, shunt infection was noted in 301 cases. Overall, AIS catheters were associated with a reduction in the number of shunt infections over non-AIS catheters ($p < 0.0001$). There was a significant reduction in shunt infection associated with AISs compared with non-AISs in all but 2 studies.

Cost Analysis of Antibiotic-Impregnated Catheters in the Treatment of Hydrocephalus in Adult Patients

S. Harrison Farber[1], Scott L. Parker[1], Owoicho Adogwa[2], Daniele Rigamonti[1], Matthew J. McGirt[2]

WORLD NEUROSURGERY, 2010

Table 1. Resource Allocation and Health Care Costs Associated with the Treatment of Shunt Infection over the Review Period

	AIS (n = 250)	Non-AIS (n = 250)
No. infections	3 (1.2%)	10 (4.0%)
Mean months to infection	2 ± 2	2 ± 2
Resource Allocation		
Mean length of stay (days)	20.3	11.5
Total hospital days	61	115
Mean shunt surgeries per infection	2.3	1.9
Total surgeries	7	19
Mean no. CT scans per infection	6.3	2.7
Total CT scans	19	27
Mean no. x-rays per infection	2	1.8
Total x-rays	6	18
Mean no. MRI scans per infection	3	1
Total MRI scans	9	9
Hospital Costs		
Mean hospital cost per infection	$67,808	$32,141
Range	$42,577–$86,091	$14,234–$62,481
Total infection-related cost	$203,424	$321,407
Total infection-related cost per 100 patients receiving shunt	$81,370	$128,563

Grazie per l’attenzione !

Analisi retrospettiva condotta su pazienti adulti con infezione di shunt osservati in consulenza presso U.U.O.O. di NCH o ricoverati presso la Divisione di Malattie Infettive ad Indirizzo Neurologico fra il gennaio 2000 ed il dicembre 2012

Meningiti e/o ventricoliti per infezioni di shunt Ventricolo-Peritoneali e Ventricolo-Atriali

- **Numero di casi totali: 29**
- **Infezioni di shunt ventricolo-peritoneali: 20 (69%)**
- **Infezioni di shunt ventricolo-atriali: 9 (31%)**
- ***S. aureus:* 8 (27%)**
- ***Staph.* CN*: 7* (24%)**
- ***Acinetobacter baumannii:* 4 (14%)**
- ***Pseudomonas aeruginosa:* 2 (6%)**
- **Eziologia non specificata: 8 (27%)**
- **Outcome favorevole 26 (89%) ----- Reinfezioni ???**
- **Exitus: 3 (10%)** *(P. aeruginosa 1, Acinetobacter baumannii 2)*

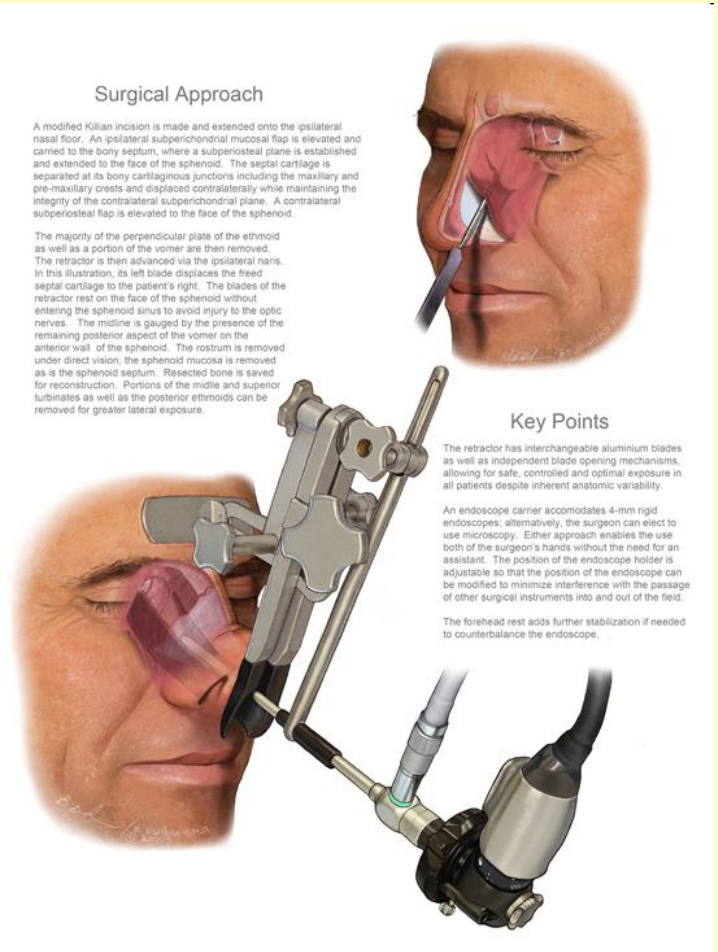
Procedura terapeutica adottata

- **Rimozione dello shunt**
- **Terapia antibiotica basandosi sulla colorazione di Gram o meglio sulla liquorcoltura**
- **Riposizionamento dello shunt ritardato quanto più possibile**
- **In un solo caso no rimozione dello shunt, solo terapia sistemica (vsCNS) con Daptomicina + Rifampicina per 14 gg. con esito favorevole (fino ad oggi ?!).**

Terapia antibiotica della infezione postneurochirurgica ottenuto l'esame colturale

Microrganismo	*t. antibiotica 1° scelta*	*t. antibiotica 2° scelta*
P. aeruginosa	**Ceftazidime/Meropenem/Cefepime + aminoglucoside (sec. Atb)**	**Aztreonam ± ± aminoglucoside ± fluorchinolone**
S. aureus		
MS	**Oxacillina + Rifampicina o Cotrimoxaz**	
MR	**Linezolid/Vancomicina + Rifampicina o Cotrimossaz**	**Linezolid/Vancomicina ± Rifampicina**
S. epidermidis	**Linezolid/Vancomicina ± Rifampicina**	**Linezolid/Vancomicina ± Rifampicina**
A. baumannii	**Meropenem/Colistina**	**Colistina/Tigeciclina?**
***Enterococcus* spp.**		
Ampicillino-sensibile	**Ampicillina + Gentamicina**	**Vancomicina/Linezolid + Gentamicina**
Ampicillino-resistente	**Linezolid/Vancomicina + Gentamicina**	
Vancomicino-resistente	**Linezolid o Ampicillina + Imipenem/Ceftriaxone**	

Meningiti ed ascessi cerebrali della fossa cranica anteriore post neurochirurgia trans-sfenoidale o trans-nasale



Trans-sphenoidal endoscopic system for pituitary surgery

Meningiti: 4

Piccoli ascessi cerebrali: 2

Per tutti eziologia non nota, ma completamente guariti in terapia empirica

Meningiti batteriche dopo anestesie spinali *intrapartum*

N° quattro casi da *Streptococcus salivarius !!!*