Child's Nerv Syst (1998) 14:378–380

ORIGINAL PAPER

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Proprionibacterium acnes infections of cerebrospinal fluid shunts

Received: 17 November 1997

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Abstract Ventricular cerebrospinal fluid shunt infections with *Proprionibacterium acnes* are generally low-grade, indolent infections. Typical presentations include gradual shunt malfunction, nausea, headache, malaise, and infrequently, fever. In all, 489 shunt procedures performed between January 1992 and December 1995, and in 15 of these cases *P. acnes* was subsequently cultured from reservoir taps or an intraoperative culture which was obtained when the existing shunt components were revised. Six of these, representing 14.6% of shunt infections, were considered to be true *P. acnes* shunt infections, as they were associated with either CSF leukocytosis or the identification of gram-positive rods by gram stain. The others were considered to be probable contaminants. Detailed analysis of all 15 of these cases revealed that no patient had positive CSF cultures after removal of the infected shunt and the initiation of antibiotics. Given the benign characteristics of *P. acnes* shunt infections, the broad sensitivity to antibiotics, and the rapid sterilization of the cerebrospinal fluid, it may be possible to treat such cases with short-term perioperative antibiotics and replacement of the shunt components, in place of prolonged external ventricular drainage and antibiotics. This would have eliminated 8 operative procedures and reduced the estimated length of stay by 77 patient-days in these 15 children.

Key words Hydrocephalus · Ventriculoperitoneal shunt · *Proprionibacterium acnes*

Introduction

Infection of ventriculoperitoneal shunts remains a serious neurosurgical complication, often requiring prolonged hospitalization for external ventricular drainage, intravenous antibiotics and multiple procedures [5]. Although we believe that this is the appropriate management for the majority of ventriculoperitoneal shunt infections, it may not always be necessary. It has been our observation that infections with *Proprionibacterium acnes* are more benign that those with the more common pathogens. *P. acnes* shunt infections may present as shunt malfunction with obstruction, hydrocephalus, nausea and emesis, or abdominal pain [6].

Cerebrospinal fluid from shunt taps or intraoperative replacement of hardware typically reveals mild or absent leukocytosis with relatively normal CSF glucose and protein values.

We reviewed all cases with CSF cultures growing *P. acnes* from shunts at Children's Hospital of Pittsburgh over a 3-year interval to determine whether or not the management of these infections might be safely altered to minimize the use of external ventricular drainage and intravenous antibiotics and reduce the length of hospitalization and the associated complications.

Materials and methods

With the assistance of the microbiology staff, a culture database identified all patients with cultures of CSF growing *P. acnes* between

Table 1 CSF Parameters for positive cultures with *Proprionibacterium acnes* (*FP* false positive, *LOS* length of stay, *N/L/M/E* differential of neutrophils, lymphocytes, monocytes and eosinophils)

Patients (n = 15)	Age	LOS	Fever >38.5 °C	Glucose	Protein	WBC	RBC	N/L/M/E	Gram staining	Diagnosis
1	17	17	Afebrile	59	<10	22	85	70/14/7/0	Positive	Infection
2	16	17	38.6	93	<10	1	23	0/100/0	Negative	FP
3	17	19	Afebrile	74	19	19	1110	14/62/17/0	Positive	Infection
4	15	21	Afebrile	67	10	49	143	11/51/24/0	Positive	Infection
5	30	1	Afebrile	67	<10	0	862	–	Negative	FP
6	13	17	Afebrile	66	12	0	0	–	Negative	FP
7	11	4	Afebrile	54	11	0	79	–	Negative	FP
8	1	2	Afebrile	30	65	0	284	–	Positive	Infection
9	17	21	Afebrile	68	22	0	1	–	Positive	FP
10	17	8	Afebrile	68	<10	1	365	100/0/0/0	Negative	Infection
11	17	12	Afebrile	62	31	3	0	0/0/100/0	Negative	Infection
12	17	21	Afebrile	65	26	2	10067	50/50/0/0	Negative	FP
13	16	3	Afebrile	62	<10	0	54	–	Negative	FP
14	1.5	6	Afebrile	73	28	1	2	22/64/10/0	Negative	FP
15	4	30	Afebrile	52	21	0	0	–	Negative	FP

1 January 1992 and 31 December 1995 and also any subsequent CSF cultures for these patients. Of the 29 patients initially identified, 13 had ventriculoperitoneal shunts. The charts of these 13 patients were examined in detail to determine each patient's age, length of hospitalization, clinical presentation, source of the culture, the CSF parameters, gram stain results and follow-up.

Results

As detailed in Table 1, 13 patients with ventriculoperitoneal shunts were identified, with 15 CSF cultures growing *P. acnes*. Six of these, representing 14.6% of shunt infections (number of infections/number of procedures), were considered to be true *P. acnes* shunt infections, as they were associated with either CSF leukocytosis or the identification of gram-positive rods by gram stain [3]. The others were considered to be contaminants or false positives based upon the clinical and laboratory data [1]. They were followed up clinically and never developed any evidence of shunt malfunction or infection. Other authors have identified all patients with positive cultures as infected [6]. Detailed analysis of all 15 of these cases revealed that no patient had positive CSF cultures after the initiation of antibiotics and removal of the infected shunt.

Discussion

Proprionibacterium acnes is a ubiquitous skin bacterium found predominantly near sebaceous glands of the scalp. *P. acnes* outnumbers *Staphylococcus epidermidis* 10- to 100-fold, with a peak during adolescence [3, 8]. Although *P. acnes* has been historically mistaken for a contaminant of cultures, it is accepted as a well-established pathogen of shunt infections [3, 6, 8]. Complications of *P. acnes* shunt infections include membranproliferative glomerulonephritis, peritonitis, encephalitis, and shunt malfunction [1, 2, 6, 7]. Infections with *P. acnes* may not correlate well with fever [8]. *P. acnes* shunt infections may be underdiagnosed, as it has been shown to be more difficult to culture. When *P. acnes* is suspected, a CSF gram stain should be obtained along with aerobic, anaerobic and thioglycolate broth cultures, which must be observed for 14 days [3].

Of the patients studied here, all cultures were susceptible to most antibiotics tested, including penicillin, ampicillin, cefamandol, cefotaxime, chloramphenicol, clindamycin, and erythromycin. Resistance was detected routinely with metronidazole and twice with cefoxitin. The broad sensitivity of *P. acnes* has been reported previously [3, 8]. At the Children's Hospital of Pittsburgh, patients with a suspected shunt infection are treated with shunt removal, external ventricular drainage and broad-spectrum antibiotics until culture results are available. Antibiotics are then tailored according to the gram stain results and culture sensitivities. Patients undergoing shunt replacement for malfunction are treated prophylactically with parenteral cefazolin and intrathecal vancomycin. Patients found to have an abdominal pseudocyst are treated with external ventricular drainage and antibiotics until all signs and symptoms of their infection have resolved and ultrasound imaging shows resolution of the cyst.

The patients in this retrospective chart review were divided into two treatment groups. The first includes those with presumed infections, who were treated with external ventricular drainage, intravenous antibiotics, and subsequent replacement of the shunt approximately 1 week later (patients 1–4, 6, 9, 11, 12). This has been and remains the basic clinical approach to treatment of ventriculoperitoneal shunt infections at our institution. While it was successful for each of these children, perhaps the same result could have been achieved with perioperative antibiotics

and immediate shunt replacement. If all 15 children had been treated with shunt replacement without EVD and had an average hospitalization of 5 days, we would have reduced inpatient hospitalization by 77 days and eliminated eight operative procedures.

The second group was made up patients who were thought to have a malfunctioning shunt without infection. They underwent complete shunt replacement, and subsequently *P. acnes* grew from CSF obtained intraoperatively (patients 5, 7, 8). Retrospectively, only 1 of these patients was thought to have had a true shunt infection according to our criteria. All 3 achieved an excellent result with only perioperative antibiotics (intraoperatively and 0–48 h after surgery).

From this small group, several unique circumstances provided supporting evidence for the efficacy of intravenous antibiotics and shunt replacement. Patient 1 had bilateral ventriculoperitoneal shunts. An infection of the right shunt was treated with intravenous antibiotics, external ventricular drainage and subsequent replacement. The left shunt was evaluated pre- and postoperatively by reservoir taps, with no antibiotics, and all cultures remained negative. It is likely that the anatomical barrier that dictated the need for bilateral shunts also prevented the spread of this benign infection. Patient 4 underwent a distal shunt revision and subsequently developed positive cultures from intraoperative CSF. He was treated with intravenous antibiotics for 1 week, but developed persistent fevers. Only when the infected instrumentation was removed did the patient become afebrile. Forward et al. reviewed 32 patients with shunt infections in 1983 and found a significantly higher rate of treatment failure for those treated with intravenous antibiotics and incomplete shunt removal compared with complete replacement [4]. Despite the benign nature of *P. acnes* infections, we believe that our case supports the well-documented importance of removing the complete shunt rather then giving medical therapy alone [9]. Patients 10 and 13–15 had positive cultures from the time of their shunt revision, but had no leukocytosis, gram stain or clinical evidence of infection. Patient 15 was observed clinically, patient 13 underwent a shunt tap 2 months after surgery and patient 14 underwent a tap 5 months later. Patient 10 had persistent headaches and underwent a shunt valve revision 1 month after surgery. All cultures remained negative.

The important observations among all of these patients are that all had *P. acnes* isolated from CSF cultures and that all were "cured" of their infection with complete removal of the shunt system and intravenous antibiotics. All patients were seen more than 3 months postoperatively without further evidence of shunt malfunction or CSF obtained by subsequent shunt taps or revisions was sterile. This is not proof that *P. acnes* can consistently be treated effectively without external ventricular drainage, but it merits further consideration. This may also provide some reassurance in treating patients whose intraoperative cultures grow *P. acnes* when the shunt has been thought to be malfunctioning without infection.

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