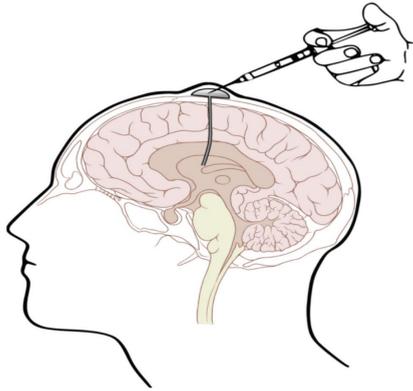


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Objective

Infection is a severe complication of Ommaya reservoirs. However, data on the clinical presentation and therapeutic approach for such infections are limited. Herein we describe the largest study of the clinical manifestations and treatment outcomes of Ommaya reservoir-related infections.



Methods:

■ We retrospectively reviewed the hospital records of all patients at MD Anderson Cancer Center who had an Ommaya reservoir placement between 2001 and 2011.

■ We included in our analysis only those patients who developed a definite device-related infectious process:

1) Local and/or systemic clinical manifestations,

and

2) Microbiological growth from at least one of the following sources: CSF, removed device material, surgical wounds, or a purulent collection in close proximity to the reservoir.

Results

■ Among 501 Ommaya reservoir placements, 40 patients (8%) had developed an active device-related infectious process (table 1).

■ Of these 40 patients, 28 patients (60%) presented with a meningeal syndrome, 5 patients (12%) presented with only local skin and soft tissue inflammatory signs, while the remaining 7 patients (28%) had developed an overlap of both clinical syndromes (table 2).

Table 1. Characteristics of Patients with Ommaya Reservoir-related Infections.

Variable	Episodes (n = 40)
Age in years, mean±SD	45±17.9
Male	25 (63)
Ethnicity	
White	32 (80)
Hispanic	6 (15)
Black	2 (5)
Comorbidities	
Hematologic malignancy	25 (62)
Non-primary CNS lymphoma	12 (30)
Acute leukemia	6 (15)
Chronic leukemia	4 (10)
Waldenstrom's macroglobulinemia	2 (5)
Primary CNS lymphoma	1 (3)
Solid malignancy	15 (38)
Non-primary CNS tumor	10 (25)
Primary CNS tumor	5 (13)
Tobacco	4 (10)
Diabetes	2 (5)
HIV	1 (3)
Other	0
Reason for Ommaya reservoir placement	
Intrathecal chemotherapy	40 (100)

Table 2. Clinical Manifestations in Patients with Ommaya Reservoir-related Infections

Variable	Value
Median temperature in °C, (range)	38.3 (35.5-39.7)
Systemic manifestations	
Headaches	33 (83)
Temperature >38°C	27 (68)
Neck rigidity	16 (40)
Nausea/vomiting	13 (33)
Altered mental status	10 (25)
Hypotension	0
Local manifestations	
Discharge	9 (23)
Purulent	4 (10)
Serohemorrhagic	3 (8)
CSF	2 (5)
Exposure/dehiscence	8 (20)
Erythema	8 (20)
Warmth	5 (13)
Tenderness	2 (5)
Concomitant infection at time of admission	
Bacteremia	4 (10)
Pneumonia	4 (10)
Urinary tract infection	2 (5)
Subgaleal collection	1 (3)
Findings of Imaging Studies	
Computed axial tomography	12 (30)
Meningeal enhancement	1
Epidural abscess	1
No abnormal findings	10
Magnetic resonance imaging	6 (15)
Meningeal enhancement	2
No abnormal findings	4

■ The majority of these infections occurred soon after the reservoir placement or the last time the device was last accessed (table 3).

Table 3. Device placement and access in relation to infection

Variable	Median (Q1–Q3)	No. of patients (%)
Days to infection after device placement	41 (15.5–142.5)	
<30		15 (38)
31–90		12 (30)
>90		13 (32)
Days to infection after device was last accessed	7 (4–30)	
<10 ^b		17 (59)
11–30		5 (17)
>30		7 (24)
Number of Ommaya taps prior to infection onset	5 (2-17)	
<10		20 (69)
10–20		5 (17)
>20		4 (14)

■ Twenty-one percent of the patients had all cerebrospinal fluid parameters within normal limits - leukocytes, glucose, and protein levels (table 4).

Table 4. Laboratory analysis of patients with Ommaya reservoir infection.

Variable	Median (Q1–Q3)	No. of patients (%)
Peripheral WBC/μL	6100 (3800–8950)	
Leukocytes >10000 cells/μL		8 (20)
CSF values		
Glucose, mg/dL	59 (47–74)	
Protein, mg/dL	41 (24–114)	
Leukocytes, cells/μL	45 (3.5–241)	
Neutrophils, %	65 (12.5–92)	
Lymphocytes, %	21 (4–67.5)	
Red blood cells/μL	9 (0.5–66)	
Normal CSF values		
Leukocytes		10/36 (28)
Protein		8/35 (51)
Glucose		28/35 (80)
Leukocytes, protein, and glucose		7/34 (21)
Cytology		34 (85)
Benign		26 (65)
Malignant		8 (20)
Gram stain		37 (93)
Gram-positive cocci		18 (45)
Gram-negative rods		5 (13)
Gram-positive rods		1 (2)
Negative smear		13 (33)
Positive cultures		
CSF from Ommaya reservoir		37/37 (100)
Ommaya tip		10/17 (59)
Intraoperative wound culture		5/5 (100)

■ Gram-positive skin flora accounted for ≈ 80% of the pathogens. The frequency of Gram-negatives begin to increase after 30 days of device placement (table 5).

■ The median hospital stay and antibiotic therapy duration were 13 and 24 days, respectively, while the overall mortality rate was 10% (table 6).

Table 5. Pathogens isolated in Ommaya reservoir-related infections, stratified by time of placement.

Pathogen	Overall (n = 52)	<30 days (n = 19)	31–90 days (n = 18)	>90 days (n = 15)
Gram-positive bacteria	42 (81%)	17	13	12
CoNS	28	11	7	10
<i>Propionibacterium acnes</i>	4	3	1	-
MSSA	4	1	3	-
α-Hemolytic streptococci	3	1	1	1
<i>Corynebacterium</i> spp.	1	1	-	-
<i>Enterococcus faecalis</i>	1	-	1	-
MRSA	1	-	-	1
Gram-negative bacteria	9 (17%)	1	5	3
<i>Pseudomonas</i> spp.	4	-	3	1
<i>Enterobacter aerogenes</i>	1	1	-	-
<i>Escherichia coli</i>	1	-	1	-
<i>Bacteroides fragilis</i>	1	-	1	-
Non-typeable haemophilii	1	-	-	1
<i>Klebsiella pneumoniae</i>	1	-	-	1
Fungi				
<i>Candida albicans</i>	1 (2%)	1	-	-

Table 6. Treatment and outcomes of Ommaya reservoir-related infections.

Outcomes	Overall (n=40)	Early removal (n=22)	Device retained (n=9)	Late removal (n=9)	p-value	Pairwise comparison
Median days between infection diagnosis and device removal (Q1-Q3)	N/A	3 (1-5)	N/A	14 (10-20)	<0.0001	-
Median days of hospitalization (Q1-Q3)	13 (10-22)	10 (7-15)	15 (10-24)	18 (15-31)	0.05	0.035
Median days of antibiotic use (Q1-Q3)	24 (15-34)	16 (14-28)	24 (23-35)	26 (24-38)	0.06	0.038
Death due to infection, n (%)	4 (10%)	2° (9%)	1 (11%)	1 (11%)	> .99	-

Conclusion

■ Most Ommaya reservoir-related infections develop soon after device placement or last access.

■ As clinical symptoms are usually mild and nonspecific and because CSF parameters may be within normal limits, a high suspicion for infection is required.

■ Although mortality rates were similar among all groups (p>0.99), the most cost-effective therapeutic approach was early versus late removal of the reservoir (p<0.038).

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