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A Study on Bacteriological Profile of Chronic Suppurative Otitis Media and Their Anti-Microbial Susceptibility Pattern

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ABSTRACT

Introduction: Chronic Suppurative Otitis Media is one of the most notorious infective conditions, which can lead to many complications if not treated properly. It is known for its recurrence and is linked to significant morbidity.
Aims: To find out the common bacterial agents causing Chronic Suppurative Otitis Media and to determine the Antibiotic Susceptibility pattern of the isolates.
Materials & Methods: The present study was an Institutional based observational, cross-sectional study, conducted at Dept. of Microbiology in collaboration with Dept. of ENT at ICARE Institute of Medical Sciences and Research, Haldia. Total 106 patients were included in this study. Patients clinically diagnosed with CSOM are selected from the ENT Department. Pus samples from discharging ear was collected from each patients using sterile swabs which were then cultured for the bacterial flora following the standard procedures. The Antibiotic Sensitivity testing was done using the Kirby-Bauer disc diffusion method according to Clinical Laboratory Standards Institute guidelines (CLSI).
Result: In our study, 11 (10.4%) patients had No Growth, 18 (17.0%) patients had Pseudomonas aeruginosa, 12 (11.3%) patients had Pseudomonas aeruginosa + Staphylococcus aureus and 17 (16.0%) patients had Staphylococcus aureus. The result is significant at $p < .05$. which exhibited high resistance to Ceftazidime (CAZ) and Meropenem (MRP), suggesting a potential limitation in their efficacy. In contrast, Imipenem (IMP) demonstrated lower resistance, indicating its continued effectiveness in treatment.
Conclusion: We concluded that, the study on the bacteriological profile of Chronic Suppurative Otitis Media (CSOM) reveals that the condition is primarily caused by a variety of pathogens, including Pseudomonas aeruginosa, Staphylococcus aureus, and Klebsiella pneumoniae.

Keywords: Bacteriological Profile, Antibiotic Resistance, Microbial Isolates and Antimicrobial Susceptibility.

INTRODUCTION

Chronic Suppurative Otitis Media (CSOM) is a chronic inflammation of the mucoperiosteal layer of the middle ear cleft and mastoid mucosa with perforation of the tympanic membrane which leads to chronic ear discharge for more than 12 weeks.[1] CSOM is a concern in children, as it may have effects on language development, early communication, auditory processing, education, cognitive, and physiological development. Low socioeconomic status, inadequate hygiene, poor living conditions, malnutrition, over-crowding are the prime predisposing factors for occurrence of CSOM in developing countries, like India.[1,2] The most common aerobic bacteria causing CSOM are *Pseudomonas aeruginosa, Escherichia coli, Staphylococcus aureus, Streptococcus pyogenes, Proteus mirabilis, Klebsiella spp etc.* The isolated organisms vary depending upon the different geographical areas and associated factors. [3] Therefore, the objective of this study is to find out the causative bacterial agents causing Chronic Suppurative Otitis Media, and to determine the Antibiotic

Susceptibility pattern of the isolates which will control the future infections at a tertiary hospital located at Haldia, East Midnipur.

OBJECTIVES

To find out the common bacterial agents causing Chronic Suppurative Otitis Media and to determine the Antibiotic Susceptibility pattern of the isolates.

MATERIALS & METHODS

The present study was an Institutional based observational, cross-sectional study. This Study was conducted from July 2023 to December 2024 (18 months) at Department of Microbiology in collaboration with Department of ENT at ICARE Institute of Medical Sciences and Research, Haldia. Total 106 patients were included in this study. Patients clinically diagnosed with CSOM are selected from the ENT Department. Pus samples from discharging ear was collected from each patients using sterile swabs which were then cultured for the bacterial flora following the standard procedures. The Antibiotic Sensitivity testing was done using the Kirby-Bauer disc diffusion method according to Clinical Laboratory Standards Institute guidelines (CLSI).

RESULTS AND DISCUSSION

18 (17.0%) patients were ≤10 years of age, 17 (16.0%) patients were 11-20 years of age, 21 (19.8%) patients were 21-30 years of age, 14 (13.2%) patients were 31-40 years of age, 17 (16.0%) patients were 41-50 years of age, 17 (16.0%) patients were 51-60 years of age and 2 (1.9%) patients were ≥61 years of age. ***Suttle TK et al*[3]** (2024) observed that the study population size of 169 enabled representative results for a confidence interval of 90%. Patients were divided into 2 age categories: children (0-12 years) and adults (>12 years).

74 (69.8%) patients were Female and 32 (30.2%) patients were Male.
76 (71.7%) patients had Safe and 30 (28.3%) patients had Unsafe Type.
13 (10.6%) patients had Klebsiella spp, 45 (36.8%) patients had Pseudomonas aeruginosa and 31 (25.4%) patients had Staphylococcus aureus in Isolated Organism.

The value of z is 5.1418. The value of p is < .00001. The result is significant at p < .05.

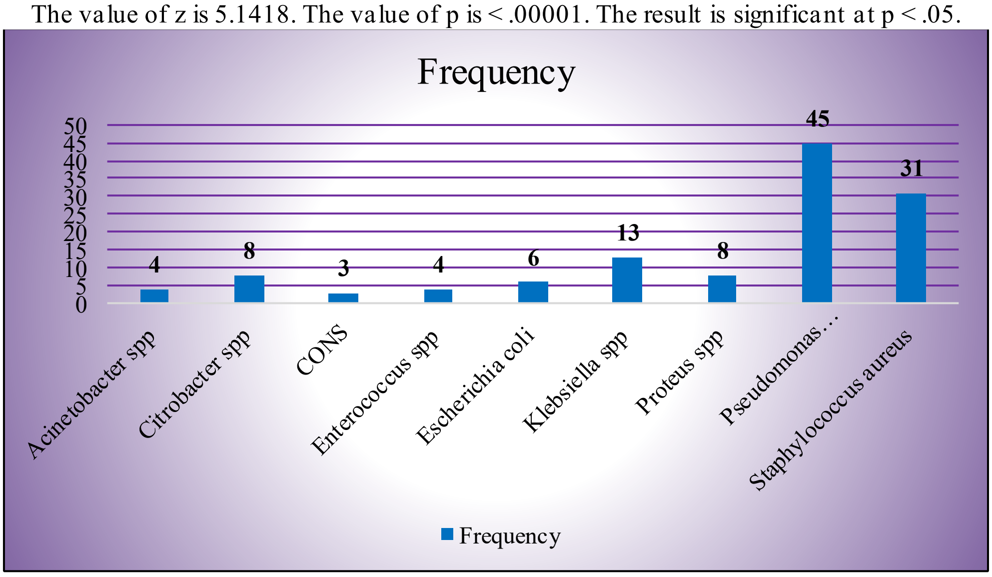

Figure 1: Distribution of Isolated Organism

The antibiotic susceptibility data indicate varying resistance patterns among bacterial species. Pseudomonas aeruginosa exhibited the highest resistance, particularly to Ceftazidime (CAZ) (p = 0.1177) and Meropenem (MRP) (p = 0.4584), while Imipenem (IMP) (p = 0.8335) showed the least resistance, suggesting better efficacy. Ofloxacin (OF) resistance was statistically significant (p < 0.0001), indicating a concerning trend. Other antibiotics had p-values above 0.05, showing no significant differences in resistance patterns. Carbapenems (IMP, MRP) remain relatively effective, though resistance is emerging in some species. High resistance to CAZ and MRP highlights the need for careful antibiotic selection and ongoing surveillance to manage bacterial infections effectively.

***Suttle TK et al*[3]** (2024) observed that the most common organisms causing CSOM are Pseudomonas aeruginosa (12.4%) followed by Staphylococcus aureus (11.8%).

The antibiotic susceptibility data for CONS, Enterococcus spp., and Staphylococcus aureus reveal varying resistance patterns. Gentamicin (GEN) ($p = 0.7879$) and Ciprofloxacin (CIP) ($p = 0.7879$) showed similar resistance rates (23 cases each), indicating widespread resistance across species. Linezolid (LZ) ($p = 0.6923$) exhibited low resistance (3 cases), while Cefotaxime (CX) ($p < 0.0001$) showed a highly significant resistance pattern (13 cases), suggesting strong selective pressure. Clindamycin (CD) ($p < 0.0001$), Erythromycin (E) ($p < 0.0001$), and Cotrimoxazole (COT) ($p < 0.0001$) also showed significant resistance, requiring careful use in treatment. Conversely, Vancomycin (VAN) showed no resistance, making it highly effective against these bacterial species. The results emphasize the need for targeted antibiotic use and resistance monitoring, particularly for CX, CD, E, and COT, where resistance is statistically significant.

The findings highlight the concerning antibiotic resistance trends among bacterial species, particularly Pseudomonas aeruginosa, which exhibited high resistance to Ceftazidime (41.67%) and Meropenem (26.20%), suggesting a potential limitation in their efficacy. In contrast, Imipenem demonstrated lower resistance, indicating its continued effectiveness in treatment. The statistically significant resistance to Ofloxacin (21.25%) raises concerns about its declining potency and the potential for widespread resistance. The non-significant p-values for other antibiotics suggest uniform resistance patterns across species, but the emerging resistance to Carbapenems underscores the need for prudent antibiotic use. Given the high resistance to CAZ and MRP, ongoing antibiotic stewardship programs, surveillance, and resistance monitoring are essential to prevent treatment failures and guide appropriate antimicrobial therapy.

Table 1: Distribution of Antibiotic Sensitivity in Gram Negative Organism

		Acinetobacter spp.	Citrobacter spp.	E. coli	Klebsiella Pneumoniae	Proteus spp.	Pseudomonas aeruginosa	TOTAL	P-VALUE
GEN	Resistant	1	1	0		0	6	9	0.6989
	Sensitive	3	7	6	12	8	39	75	
AK	Resistant	1	2	1	0	1	7	12	0.6386
	Sensitive	3	6	5	13	7	38	72	
IMP	Resistant	0	1	0	1	1	2	5	0.8335
	Sensitive	4	7	6	12	7	43	79	
MRP	Resistant	1	1	1	2	1	16	22	0.4584
	Sensitive	3	7	5	11	7	29	62	
CIP	Resistant	1	3	3	4	3	14	28	0.9506
	Sensitive	3	5	3	9	5	31	56	
PIT	Resistant	0	0	2	2	1	10	15	0.4956
	Sensitive	4	8	4	11	7	35	69	
TOB	Resistant	0	2	1	6	2	14	25	0.5393
	Sensitive	4	6	5	7	6	31	59	
COT	Resistant	2	3	1	4	3	0	13	0.8419
	Sensitive	2	5	5	9	5	0	26	
CAZ	Resistant	3	2	1	5	1	23	35	0.1177
	Sensitive	1	6	5	8	7	22	49	
LE	Resistant	1	3	2	4	2	12	24	0.9896
	Sensitive	3	5	4	9	6	33	60	
CPM	Resistant	1	1	0	4	1	13	20	0.5504
	Sensitive	3	7	6	9	7	32	64	
OF	Resistant	1	0	1	3	1	11	47	<0.0001
	Sensitive	0	8	5	10	7	34	64	
CTR	Resistant	1	1	1	7	3	13	32	0.3718
	Sensitive	3	7	5	6	5	26	52	

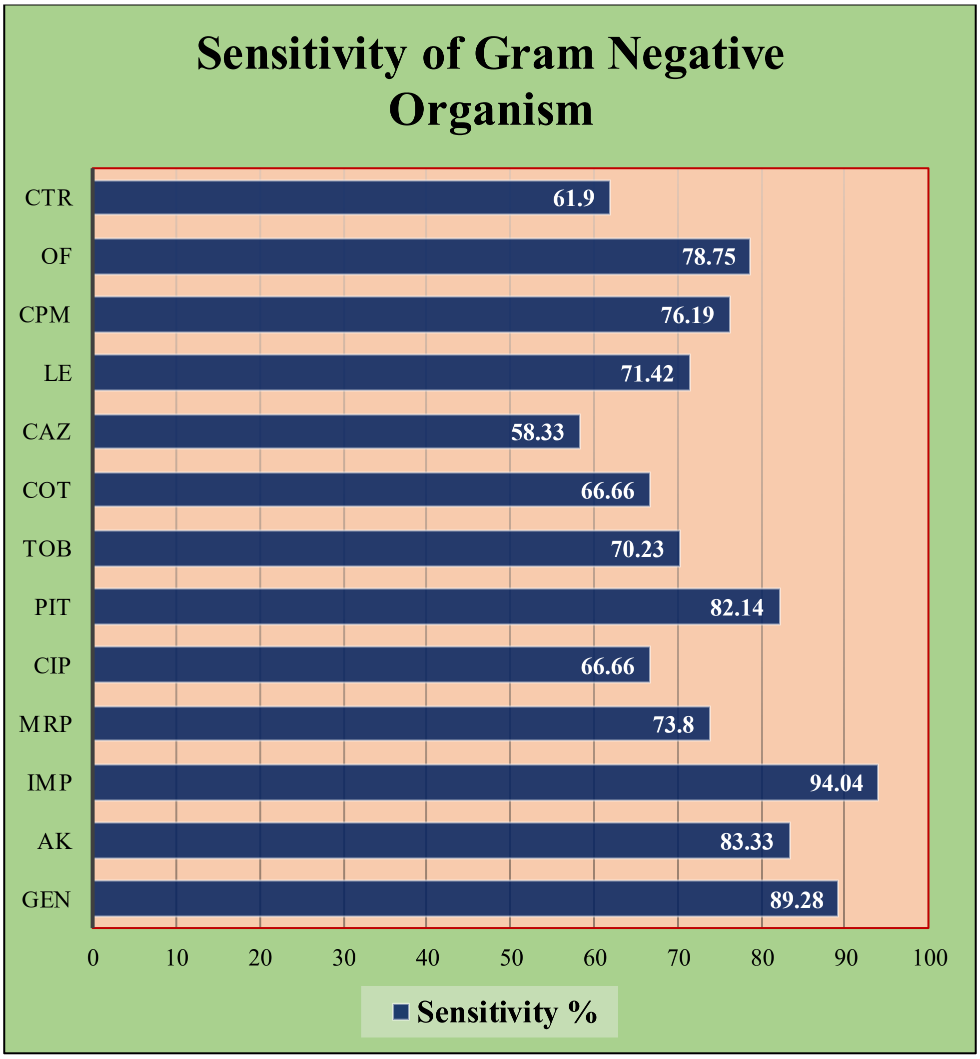

Figure 2: Distribution of Antibiotic Sensitivity in Gram Negative Organism

The observed antibiotic resistance patterns among CONS, Enterococcus spp., and Staphylococcus aureus highlight the growing challenge of antimicrobial resistance, particularly against commonly used antibiotics. The high resistance rates to Gentamicin (17.65%) and Ciprofloxacin (60.53%) indicate widespread resistance across species, which could limit their therapeutic efficacy. The significant resistance to Cefotaxime, Clindamycin, Erythromycin, and Cotrimoxazole suggests strong selective pressure, possibly due to overuse or inappropriate prescribing practices. In contrast, Linezolid (7.90%) exhibited low resistance, and Vancomycin showed no resistance, reaffirming its role as a reliable treatment option for Gram-positive infections.

Table 2: Distribution of Antibiotic Sensitivity in Gram Positive Organism

		CONS	Enterococcus spp	Staphylococcus aureus	TOTAL	P-VALUE
GEN	Resistant	2	3	18	23	0.7879
	Sensitive	1	1	13	15	
CIP	Resistant	2	3	18	23	0.7879
	Sensitive	1	1	13	15	
LZ	Resistant	0	0	3	3	0.6923
	Sensitive	3	4	28	35	
CX	Resistant	0	0	13	13	<0.0001
	Sensitive	0	0	18	18	
LE	Resistant	2	1	7	10	0.2534
	Sensitive	1	3	24	28	
TE	Resistant	0	1	6	8	0.6668
	Sensitive	3	3	25	31	

CD	Resistant	2	0	16	18	<0.0001
	Sensitive	1	0	15	16	
E	Resistant	2	0	15	17	<0.0001
	Sensitive	1	0	16	17	
COT	Resistant	0	0	8	8	<0.0001
	Sensitive	3	0	23	26	
VAN	Resistant	0	0	0	0	NA
	Sensitive	3	4	31	38	

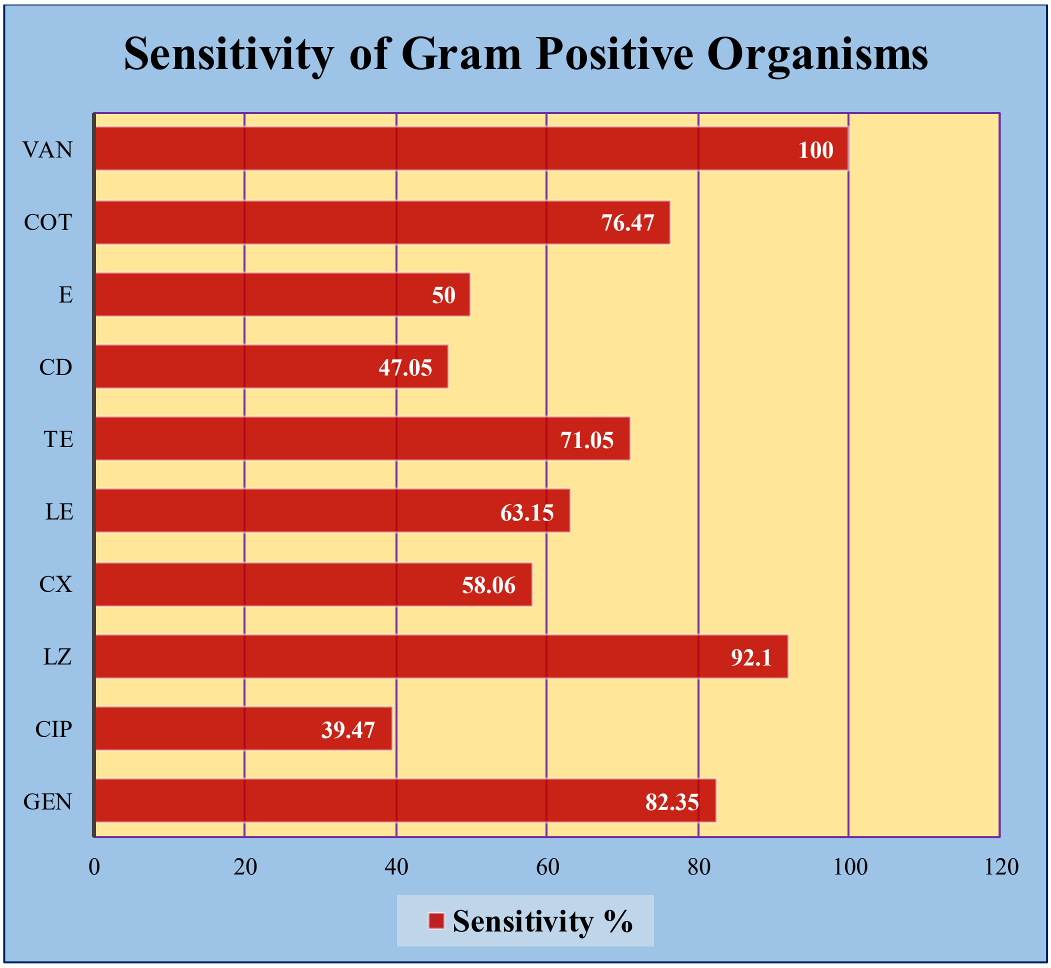

Figure 3: Distribution of Antibiotic Sensitivity in Gram Positive Organism

These findings underscore the urgent need for antibiotic stewardship programs, resistance surveillance, and judicious use of antimicrobials to prevent further escalation of resistance, especially for CX, CD, E, and COT, where resistance is statistically significant.

Inappropriate use of these antibiotics can lead to emergence of resistant strains. Therefore, judicious usage of these antibiotics by adhering to the antibiotic policies is essential.

Periodic evaluation and knowledge of the microbiological profile and their antimicrobial sensitivity pattern in that particular region is necessary to prescribe the right drug, in the right dose, at the right time. This will help to prevent complications that may arise if the infection was not properly treated and also prevents the emergence and spread of resistant strains.

Goyal D et al[4] (2025) Found that Chronic suppurative otitis media (CSOM) is defined as chronic inflammation of the middle ear and mastoid mucosa. Biofilms act as non-selective physical barriers that obstruct antibiotic diffusion and hinder immune responses facilitating chronic bacterial infections and antibiotic resistance. To study biofilm production among bacteria causing CSOM and their antibiotic resistance. This hospital-based descriptive type of observational study was done in the ENT department and Department of Microbiology. Ear discharge samples from 100 clinically diagnosed CSOM patients were collected and processed. Bacterial isolates were identified, and drug susceptibility testing was done using the Kirby–Bauer disc diffusion method. Biofilm production was detected by the microtiter plate method. Among 100 patients included in the study, the most predominant isolate was Staphylococcus aureus (44.0%), followed by Pseudomonas aeruginosa (36.0%). Biofilm production was detected in 59.0% of isolates. Biofilm production was observed in 97.7%. Among Gram-negative isolates, biofilm production was observed in 40.0% of Klebsiella spp, S. aureus isolates spp., 36.0% P. aeruginosa, and 22.2% E. coli. All isolates of S. aureus were susceptible to Vancomycin, Tigecycline, and Linezolid (100%). Methicillin resistance was found in 25.6% S. aureus isolates. A susceptibility of 100% was observed with Colistin and Piperacillin-tazobactam among P. aeruginosa isolates. Ear discharge should be sent for culture and antibiotic susceptibility testing before initiation of empirical antibiotic treatment. Biofilm production is frequently associated with multi-drug resistance, so it should be tested routinely in laboratories. This was help in effective management of CSOM, prevent development of complications, and thereby prevent deafness.

Statistical Analysis: For statistical analysis data were entered into a Microsoft excel spreadsheet and then analyzed by SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and GraphPad Prism version 5. Data had been summarized as mean and standard deviation for numerical variables and count and percentages for categorical variables. Two-sample t-tests for a difference in mean involved independent samples or unpaired samples. Paired t-tests were a form of blocking and had greater power than unpaired tests.

Z-test (Standard Normal Deviate) was used to test the significant difference of proportions.

Explicit expressions that can be used to carry out various *t*-tests are given below. In each case, the formula for a test statistic that either exactly follows or closely approximates a *t*-distribution under the null hypothesis is given. Also, the appropriate degrees of freedom are given in each case. Each of these statistics can be used to carry out either a one-tailed test or a two-tailed test.

Once a *t* value is determined, a *p*-value can be found using a table of values from Student's t-distribution. If the calculated *p*-value is below the threshold chosen for statistical significance (usually the 0.10, the 0.05, or 0.01 level), then the null hypothesis is rejected in favour of the alternative hypothesis.
p-value $\leq$ 0.05 was considered for statistically significant.

CONCLUSION
In our study, maximum cases were 21-30 years old, showing female predominance, the greatest number of patients had Right Ear involved having previous history of CSOM. The duration of disease was >24 months. Higher number of patients had Safe type of CSOM. A greater number of patients had Pseudomonas aeruginosa as Isolated Organism followed by Staphylococcus aureus, Klebsiella pneumoniae, Citrobacter spp., Proteus spp., E. coli, Acinetobacter spp., Enterococcus and CONS. The observed antibiotic resistance patterns among CONS, Enterococcus spp., and Staphylococcus aureus highlight the growing challenge of antimicrobial resistance, particularly against commonly used antibiotics. Our study on the bacteriological profile of chronic suppurative otitis media (CSOM) reveals that the condition is primarily caused by a variety of pathogens, including Pseudomonas aeruginosa, Staphylococcus aureus, and Klebsiella pneumoniae. The antimicrobial susceptibility testing indicates that Pseudomonas species are often resistant to multiple antibiotics, while Staphylococcus aureus shows a higher susceptibility to antibiotics like Vancomycin and Linezolid. Invention of newer antibiotics as well as combination therapy can be useful to fight against this problem. The results emphasize the need for targeted antibiotic therapy based on bacterial culture and susceptibility testing to effectively manage CSOM and prevent complications such as hearing loss and chronic infection.

Limitations of the Study: In spite of every sincere effort my study has lacunae.

The notable short comings of this study are:

1. The sample size was small. Only 106 cases are not sufficient for this kind of study.
2. The study has been done in a single centre.
3. The study was carried out in a tertiary care hospital, so hospital bias cannot be ruled out.

Ethical Consideration
The study Proposal and other relevant documents was submitted to the Institutional Ethical Committee and were approved. All case reports and other study documents were analysed without disclosing the identity of the participating patients. The study material was kept protected under strict supervision of the investigators. Sterility and universal precautions were maintained during the entire process.

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