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Complications of Atticoantral Otitis Media – Revisited

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Complications of chronic otitis media are still a common otological problem in the developing countries. Though the incidence has been reduced with the introduction of higher antibiotics, they are still seen commonly in the developing countries and in rural areas. The incidence of multiple complications is increasing in the present days. This is due to lack of adequate otological surgical & radiological facilities in the developing countries. Despite the advent of antibiotics and advancement in our knowledge and skills in managing otitis media, serious complications still exist. This prospective study was undertaken to study the presentations and management of atticoantral type of chronic suppurative otitis media with complications. This study was done in a tertiary care medical college hospital from 2008 to 2013.

Keywords: Atticoantral; otitis media; complications.

1. INTRODUCTION

Chronic suppurative otitis media, infection of the middle ear, is a common disease in the developing countries and the complications associated with it still pose a major problem. Complications are seen more in the rural population than in urban population. The complications of chronic suppurative otitis media remain a serious concern, particularly in

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developing countries and socioeconomically poor regions. This prospective study was undertaken to study the presentations and management of atticofacial type of chronic suppurative otitis media with complications.

2. MATERIALS AND METHODS

This prospective descriptive study was undertaken in a tertiary care medical college hospital from 2008 to 2013. The institute caters to both urban and rural population and it is a referral centre in the state.

In this study there were 81 patients with 124 complications. Only cases of atticofacial ear disease with complications were included in this study. All these patients underwent otoscopy, ear swab for culture and sensitivity and high resolution CT scan of the temporal bone. In required cases MRI was also done. All the patients were started on combination of broad spectrum antibiotics. The commonly used combination was ceftriaxone or cefotaxime along with gentamycin and metronidazole. The doses of the drugs were adjusted according to the age of the patients. In required cases antibiotics was changed according to culture and sensitivity report. Patients with intracranial complications first underwent neurosurgical intervention and mastoid exploration was planned as soon as the general condition of the patient improved. Surgical clearance of sigmoid sinus thrombosis through the transmastoid route was undertaken immediately. Mastoid abscess were also drained and mastoid exploration was performed later. All patients underwent canal wall down mastoidectomy. All the patients were followed up for minimum period of three months.

2.1 Inclusion Criteria

Only patients with atticofacial ear disease with complications were included in this study.

2.2 Exclusion Criteria

Patient with complications due to tubotympanic ear disease were excluded from the study.

3. OBSERVATIONS AND RESULTS

3.1 Age

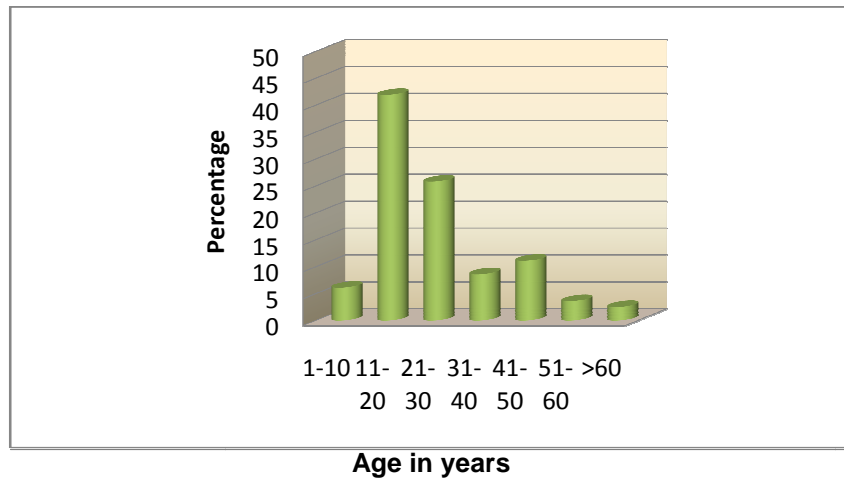
Age of the patients ranged from 5 years to 65 years. Most of the complications occurred below the age of 20 years.

39 (48.1%) patients were in the age group 1-20 years, 28(34.6%) patients were in the age group 21-40 years, 12(14.8%) patients were in the age group 41-60 years and two patients age was more than 60 years [Table 1]. Further analysis showed that the largest number of complications (34) occurred in the age group of 11 to 20 yrs (41.9%), out of which 16 cases (47.05%) were in the age group of 11 to 15 and 18 cases (52.9%) were in the age group of 16 to 20 yrs. Only 6.1% of the complications were seen in the age group 1-10 yrs [Graph 1].

Table 1. Age distribution of the patients

Age in years	Number of patients	%
1-20	39	48.1
21-40	28	34.6
41-60	12	14.8
>60	2	2.5
Total	81	100.0

Mean ± SD: 25.78.±14.24



Graph 1. Age distribution of the patients

Correlation of extracranial and intracranial complications according to age showed that facial palsy was more common in age below 20 yrs (p value 0.012*), labyrinthine fistula was more common between 20 to 40 yrs of age (p value 0.054+) and cerebellar abscess was more common in age below 20 yrs (p value 0.095+) and it was statistically significant [Table 2].

Table 2. Correlation of extracranial and intracranial complications according to the age

Complications	Age in years				P value
	<20 (n=39)	21-40 (n=28)	41-60 (n=12)	>60 (n=2)	
Extracranial					
• 1.Subperiosteal mastoid abscess	10(25.6%)	9(32.1%)	3(25%)	1(50%)	0.763
• 2.Mastoiditis	3(7.7%)	3(10.7%)	2(16.7%)	0(0%)	0.685
• 3.Post aural fistula	4(10.3%)	6(21.4%)	2(16.7%)	0(0%)	0.589
• 4.Facial nerve palsy	5(12.8%)	3(10.7%)	4(33.3%)	2(100%)	0.012*
• 5.Labyrinthine fistula	1(2.6%)	5(17.9%)	2(16.7%)	0(0%)	0.054+
• 6.Petrositis	4(10.3%)	0(0%)	0(0%)	0(0%)	0.279

Table 2 Continued.....

Intracranial					
• 1.Temporal lobe abscess	10(25.6%)	4(14.3%)	2(16.7%)	1(50%)	0.397
• 2.Cerebellar abscess	8(20.5%)	1(3.6%)	0(0%)	0(0%)	0.095+
• 3.Occipital lobe abscess	1(2.6%)	0(0%)	0(0%)	0(0%)	1.00
• 4.Lateral sinus thrombosis	8(20.5%)	4(14.3%)	0(0%)	0(0%)	0.390
• 5.Otitic hydrocephalus	6(15.4%)	2(7.1%)	0(0%)	0(0%)	0.512
• 6.Meningitis	3(7.7%)	1(3.6%)	0(0%)	0(0%)	0.832
• 7.Subdural abscess	3(7.7%)	0(0%)	0(0%)	0(0%)	0.430
• 8.Extradural abscess	0(0%)	1(3.6%)	0(0%)	0(0%)	0.519

+ Suggestive significance (P value: 0.05<P<0.10)

* Moderately significant (P value: 0.01<P ≤ 0.05)

** Strongly significant (P value: P≤0.01)

3.2 Gender

Out of 81 patients 64 (79%) were male and 17 (21%) were female. The male to female ratio was 3.7:1.

Correlation of extracranial and intracranial complications with gender showed that post aural fistula is more common in men (p value 0.062) and it was statistically significant. All the complications were found to be more common in male patients [Table 3].

Table 3. Correlation of extracranial and intracranial complications according to the gender

Complications	Gender		P value
	Male (n=64)	Female (n=17)	
Extracranial			
• 1.Subperiosteal mastoid abscess	17(26.6%)	6(35.3%)	0.549
• 2.Mastoiditis	6(9.4%)	2(11.8%)	0.672
• 3.Post aural fistula	12(18.8%)	0(0%)	0.062+
• 4.Facial nerve palsy	11(17.2%)	3(17.6%)	1.000
• 5.Labyrinthine fistula	7(10.9%)	1(5.9%)	1.000
• 6.Petrositis	3(4.7%)	1(5.9%)	1.000
Intracranial			
• 1.Temporal lobe abscess	15(23.4%)	2(11.8%)	0.503
• 2.Cerebellar abscess	6(9.4%)	3(17.6%)	0.388
• 3.Occipital lobe abscess	0(0%)	1(5.9%)	0.210
• 4.Lateral sinus thrombosis	10(15.6%)	2(11.8%)	1.000
• 5.Otitic hydrocephalus	5(7.8%)	3(17.6%)	0.355
• 6.Meningitis	3(4.7%)	1(5.9%)	1.000
• 7.Subdural abscess	1(1.6%)	2(11.8%)	0.111
• 8.Extradural abscess	1(1.6%)	0(0%)	1.000

3.3 Domicile

52 patients (64.19%) were from rural area and 29 (35.8%) patients were from urban area.

3.4 Literacy

Complications were seen more in the literate patients (55.55%) as compared to illiterate patients (44.44%).

3.5 Socio Economic Status

There were 42 patients (51.9%) from the low socioeconomic group and 39 (48.1%) patients from middle socioeconomic group.

Correlation of extracranial and intracranial complications according to socio-economic status showed that mastoiditis is more common in middle socio economic status patients (p value 0.056+) and temporal lobe abscess is more common in low socio economic status patients (p value 0.055+) and it was statistically significant [Table 4].

Table 4. Correlation of extracranial and intracranial complications according to socio-economic status

Complications	Socio-economic status		P value
	Low (n=42)	Middle (n=39)	
Extracranial			
• 1.Subperiosteal mastoid abscess	12(28.6%)	11(28.2%)	1.000
• 2.Mastoiditis	2(4.8%)	6(15.4%)	0.056+
• 3.Post aurial fistula	6(14.3%)	6(15.4%)	1.000
• 4.Facial nerve palsy	7(16.7%)	7(17.9%)	1.000
• 5.Labyrinthine fistula	2(4.8%)	6(15.4%)	0.146
• 6.Petrositis	4(9.5%)	0(0%)	0.117
Intracranial			
• 1.Temporal lobe abscess	10(23.8%)	7(17.9%)	0.055+
• 2.Cerebellar abscess	5(11.9%)	4(10.3%)	1.000
• 3.Occipital lobe abscess	1(2.4%)	0(0%)	1.000
• 4.Lateral sinus thrombosis	6(14.3%)	6(15.4%)	1.000
• 5.Otitic hydrocephalus	6(14.3%)	2(5.1%)	0.267
• 6.Meningitis	2(4.8%)	2(5.1%)	1.000
• 7.Subdural abscess	1(2.4%)	2(5.1%)	0.606
• 8.Extradural abscess	1(2.4%)	0(0%)	1.000

3.6 Pre-disposing Focus Nose/Throat

Predisposing focus of infection was present in 19 cases (23.4%) & 7 patients had symptomatic deviated nasal septum, 6 patients had chronic tonsillitis, 3 patients had chronic sinusitis and 3 patients had chronic adenotonsillitis [Table 5]. Correlation of extra and Intra cranial complications according to clinical evidence of predisposing focus in nose sinuses & throat did not show any statistical significance.

Table 5. Pre disposing focus nose/throat in the patients

Nose sinuses & throat	Number of patients (n=81)	%
Normal	62	76.5
Abnormal	19	23.5
• deviated nasal septum	7	8.6
• chronic tonsillitis	6	7.4
• chronic sinusitis	3	3.7
• chronic adeno tonsillitis	3	3.7

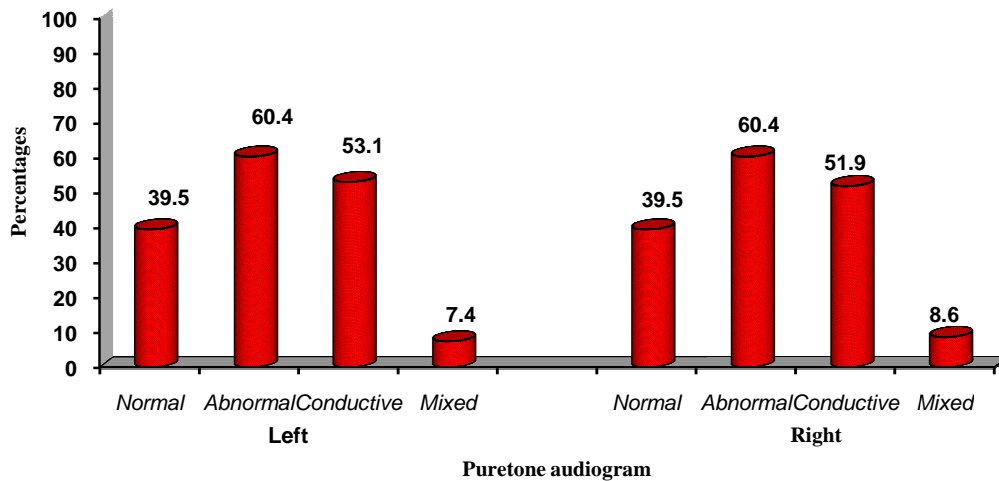
3.7 Duration of Ear Discharge

Majority of patients had prolonged history of ear discharge [Table 10]. Correlation of extracranial and intracranial complications according to clinical evidence of ear discharge did not show any significance.

3.8 Hearing Loss

Majority of patients had hearing loss for more than 2 years.

Mixed hearing loss was present in 13 patients and rest of the patients had conductive hearing loss [Table 6, Graph 2].



Graph 2. Pure tone audiogram results

Table 6. Pure tone audiogram results of the patients

Pure tone audiogram	Number of patients (n=81)	%
Left		
Normal	32	39.5
Abnormal	49	60.4
• conductive hearing loss	43	53.1
• mixed hearing loss	6	7.4
Right		
Normal	32	39.5
Abnormal	49	60.4
• conductive hearing loss	42	51.9
• mixed hearing loss	7	8.6

There were 81 patients and out of which 13 patients had mixed hearing loss. In extracranial infection group 2 patients had mixed hearing loss, in intracranial complications group 7 patients had mixed hearing loss and in both intracranial and extracranial complications group 4 patients had mixed hearing loss. [Table 7] Mixed hearing loss is significantly more with intracranial group and in group with both intracranial and extracranial complications (P=0.025).

Table 7. Distribution of mixed hearing loss in different types of complications

Group number	Name of the complication [Number of patients (n=81)]	Number of patients with mixed hearing loss
1	Extracranial complications	2
2	Intracranial complications	7
3	Both intracranial and extracranial complications	4
	Total	13

3.9 Symptoms

Headache (58%) and fever (54.3%) were the commonest symptoms of complications. Otalgia was present in 39.5% of the patients, giddiness was present in 38.2% of the patients and vomiting was present in 27.1% of patients.

3.10 Signs

Imbalance (38.2%) and swelling behind the ear (33.3%) were the important signs of complications. Other signs were discharge behind the ear (13.5%), facial weakness (14.8%), lateral rectus palsy, papilloedema and convulsion.

3.11 Ear Examination Findings

Abscess and fistula were the common abnormal findings seen in the post aural area. Other findings were healed fistula scar and oedema. Polyp was seen in 19 cases (23.5%) and

granulations were seen in 7 cases (8.6%). Polyp & granulations together constituted 32%. Posterosuperior wall sagging was seen in 8cases (9.9%).

Attic perforation was seen in 34 patients (41.9%), posterosuperior quadrant marginal perforation was seen in 18 patients (22.2%) and total perforation was seen in 8 patients (9.8%). Central perforation was seen in the opposite ear in 8 patients (9.8%). Tympanic membrane was not visualised on right side in 15 patients and on the left side in 17 patients.

Facial palsy was present in 14 (17.2%) patients. Right facial nerve was involved in 8 patients and left facial nerve was involved in 6 patients.

3.12 Bacteriology Study of Ear Discharge

12 patients had mixed infections.7 patients with intracranial complication, 4 patients with intra and extracranial complication and 1 patient with extracranial complication had mixed infections. Mixed infections were more common in patients with intracranial complication. Pseudomonas and Proteus combination was more common [Table 8, Graph 3].

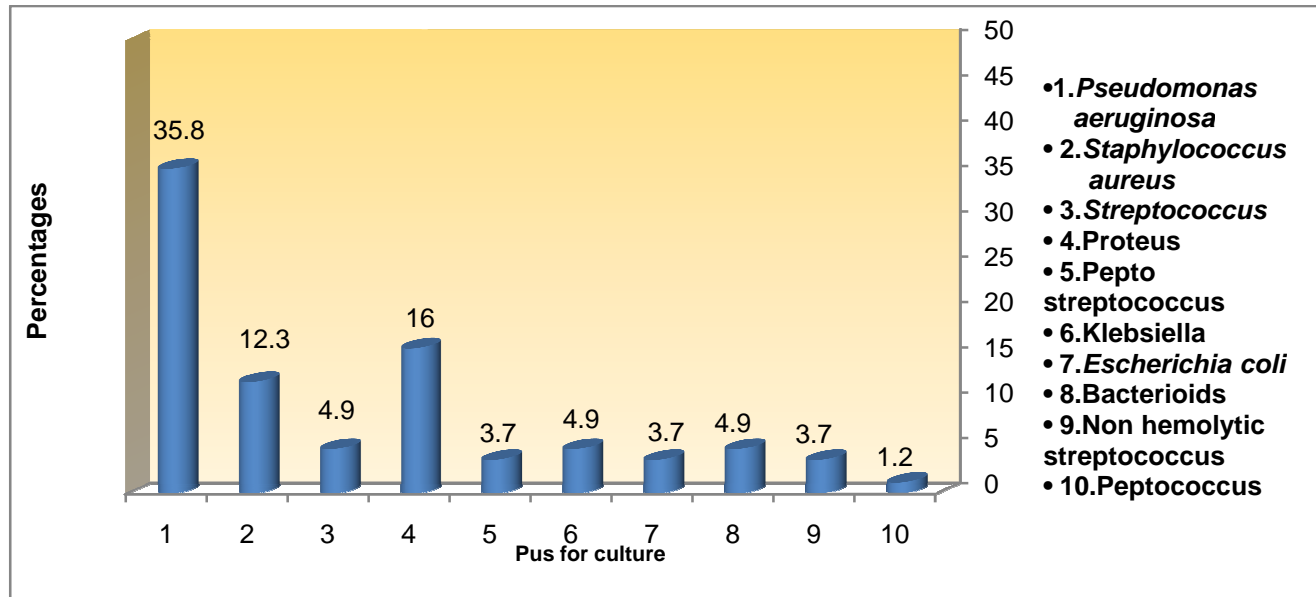
Table 8. Ear pus culture results

Pus for culture	Number of patients (n=81)	%
No growth	19	23.5
Growth	62	76.5
• 1.Pseudomonas aeruginosa	29	35.8
• 2.Staphylococcus aureus	10	12.3
• 3.Streptococcus	4	4.9
• 4.Proteus	13	16
• 5.Peptostreptococcus	3	3.7
• 6.Klebsiella	4	4.9
• 7.Escherichia coli	3	3.7
• 8.Bacterioids	4	4.9
• 9.Non hemolytic streptococcus	3	3.7
• 10.Peptococcus	1	1.2

95% Confidence Interval has been computed to find the significant features. Confidence Interval with lower limit more than 50% is associated with statistical significance. Presence of cholesteatoma and granulations were found to be significant [Table 9].

Table 9. Ear pathology in the patients

Pathology	Number of patients (n=81)	%	95%CI
Granulations Present	66	81.5	71.67-88.44
Cholesteatoma Present	59	72.8	52.28-81.33
Both Present	44	54.32	50.57-58.02



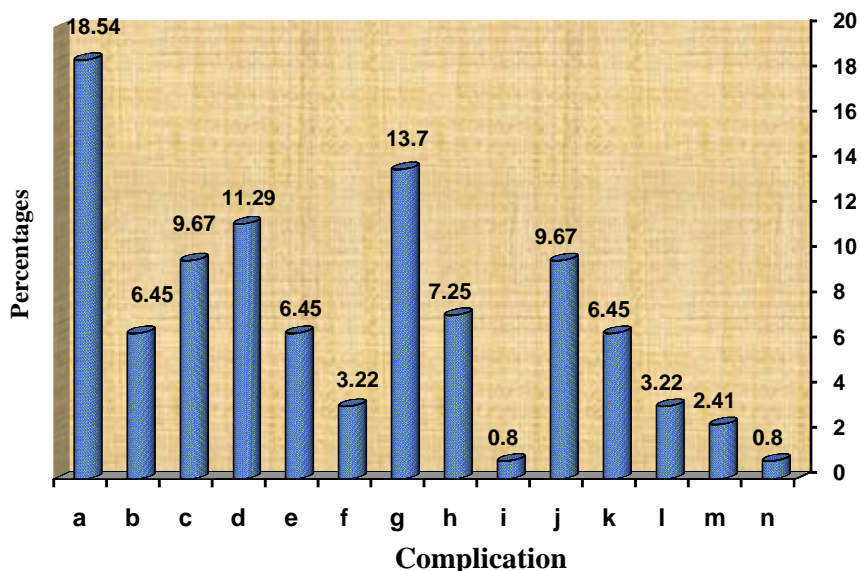
Graph 3. Organisms isolated in pus culture

3.13 Otogenic Complications

In this study there were 81 patients with atticoantral type of chronic otitis media with complications. Number of patients are 81 but complications are 124. This is because many patients had more than one complication. There were 69 extracranial complications and 55 intracranial complications. The incidence of extracranial complications was more than intracranial complications. The commonest extracranial complication was subperiosteal mastoid abscess and the commonest intracranial complication was brain abscess [Table 10, Graph 4].

Table 10. Otogenic (extracranial and intracranial) complications

Complication	Right	Left	Total	%
Subperiosteal mastoid abscess(a)	11	12	23	18.54
Mastoiditis(b)	2	6	8	6.45
Post aural fistula ©	6	6	12	9.67
Facial nerve palsy(d)	8	6	14	11.29
Labyrinthine fistula(e)	4	4	8	6.45
Petrositis(f)	2	2	4	3.22
Temporal lobe abscess(g)	9	8	17	13.70
Cerebellar abscess(h)	3	6	9	7.25
Occipital lobe abscess(i)	0	1	1	0.80
Lateral sinus thrombosis(j)	6	6	12	9.67
Otitic hydrocephalus(k)	--	--	8	6.45
Meningitis(l)	--	--	4	3.22
Subdural abscess(m)	0	3	3	2.41
Extradural abscess(n)	1	0	1	0.80
Total	52	60	124	

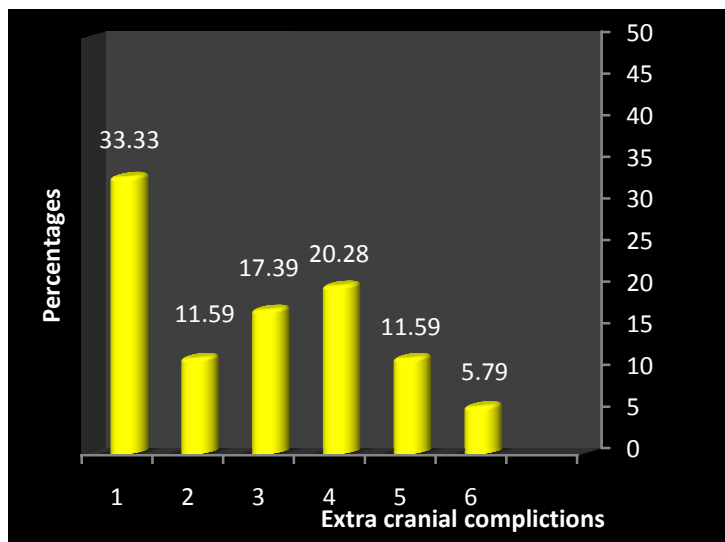


Graph 4. Otogenic (extracranial and intracranial) complications

Subperiosteal mastoid abscess (33.33%) and facial palsy (20.8%) were the commonest complications encountered. Post aural fistula was present in 12 (17.39%) patients, mastoiditis was present in 8 (11.59%) patients, labyrinthine fistula was present in 8 (11.59%) patients, and petrositis was present in 4 (5.79%) patients [Table 11, Graph 5].

Table 11. Extracranial complications

Number of complications: 69				
Extracranial complication	Right	Left	Total	%
1.Subperiosteal mastoid abscess	11	12	23	33.33
2.Mastoiditis	2	6	8	11.59
3.Post aural fistula	6	6	12	17.39
4.Facial nerve palsy	8	6	14	20.28
5.Labyrinthine fistula	4	4	8	11.59
6.Petrositis	2	2	4	5.79
Total	33	36	69	



Graph 5. Extracranial complications

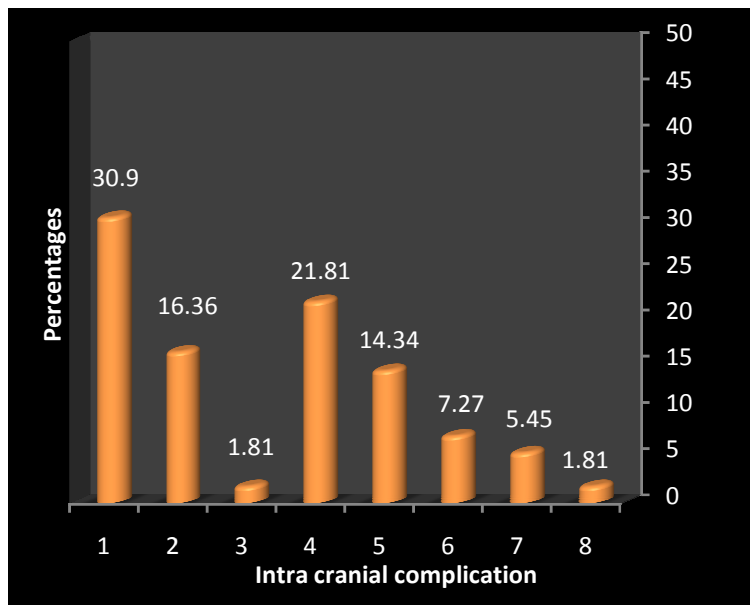
[Brain abscess was the commonest intracranial complication (49.09%) followed by lateral sinus thrombosis (21.8%). Otitic hydrocephalus was present in 8 (14.345%) patients, meningitis was present in 4 (7.27%) patients, subdural abscess was present in 3 (5.45%) patients and extradural abscess was present in 1 (1.81%) patient. Lateral sinus thrombosis was present in 12 cases. Associated complications in lateral sinus thrombosis were seen in 11 patients. Associated intracranial complications were brain abscess and otitic hydrocephalus. Associated extra cranial complications were subperiosteal mastoid abscess, post aural fistula, labyrinthine fistula and facial nerve paresis. Lateral sinus thrombosis was seen as an operative finding in four cases on the left side.

Otitic hydrocephalus was present in 8 cases. It was due to right side ear disease in 2 cases and left side ear disease in 6 cases. It was present in association with cerebellar abscess in

4 cases, temporal lobe abscess in 2 cases and lateral sinus thrombosis in 2 cases [Table 12, Graph 6].

Table 12. Intracranial complications

Intracranial complication	Right	Left	Total	%
1.Temporal lobe abscess	9	8	17	30.90
2.Cerebellar abscess	3	6	9	16.36
3.Occipital lobe abscess	0	1	1	1.81
4.Lateral sinus thrombosis	6	6	12	21.81
5.Otitic hydrocephalus	--	--	8	14.34
6.Meningitis	--	--	4	7.27
7.Subdural abscess	0	3	3	5.45
8.Extradural abscess	1	0	1	1.81
Total	19	24	55	



Graph 6. Intracranial complications

3.14 Surgical Treatment

Patient with intracranial complication underwent neurosurgical intervention first (except three patients with small abscess in the temporal lobe) and later they underwent mastoid exploration. The neurosurgical interventions included craniotomy and abscess excision, craniectomy and abscess excision, burr hole and ventriculo peritoneal shunt procedure [Table 13].

All patients in the study underwent canal wall down mastoidectomy of which 49 underwent concurrent tympanoplasty as well [Table 14]. After 3 months following surgery, 62(76.5%) patients had dry mastoid cavity and 19(23.5%) patients mastoid cavity was wet.

Table 13. Neurosurgical interventional done

Prior surgery	Number of patients (n=81)	%
Nil	54	66.7
Present	27	33.3
• 1.Craniotomy and abscess excision	13	16.1
• 2.Craniectomy and abscess excision	9	11.1
• 3.Burr hole	5	6.2
• 4.Ventriculo peritoneal shunt	3	3.7

Table 14. Surgical procedures performed on the patients

Surgical procedure	Number of patients (n=81)	%
Canal wall down mastoidectomy & tympanoplasty	49	60.4
Canal wall down mastoidectomy	32	39.5

4. DISCUSSION

In the present study there were 81 patients with 124 complications. 44 (54.3%) patients had single complication, 32 (39.5%) patients had two complication, 4 (4.9%) patients had three complication and one patient (1.2%) had 4 complication. Overall 37 (45.6%) patients had more than one complication. 41 patients (50.6%) had only extracranial complication, 21 patients (25.9%) had only intracranial complication and 19 patients (23.4%) had both extracranial and intracranial complication. Among 41 extracranial complication patients, 8 patients (19.5%) had more than one extracranial complication. Among 21 intracranial complication patients, 10 patients (47.6%) had more than one intracranial complication. This study showed that intracranial complication is frequently associated with another intracranial complication. Earlier studies [1,2,3,4,5] have shown that the incidence of multiple complications were low. In the present study, an increase in the incidence of multiple complications was observed. Long et al. [6] are of the opinion that the presence of extracranial complications is an indication for further radiological investigation, to rule out concomitant intracranial complications.

In a report published by Yorgancilar et al. [3] majority of the patients were in the age group 21-30 years whereas a study by Gandhi et al. [5] from India showed that majority of patients (67.8%) were under the age of 15. In the present study there were 39 (48.1%) patients in the age group 1-20 years. The incidence of complications was found to be more in young adolescent age group.

Earlier studies have shown that cholesteatoma in children differs significantly in two main aspects: it is associated with more pathological changes and is associated with higher morbidity. Moreover, patients younger than 12 years are at high risk for complications [7]. Experimental studies have shown that paediatric cholesteatomas present with an exacerbated inflammatory degree, produce more metalloproteinases, factors that, when combined, could characterize paediatric cholesteatomas as more aggressive than adult cholesteatomas [8] Present study showed that complications due to cholesteatoma are more common in young adolescent age group, there by indicating its aggressiveness in this age group.

Statistical correlation of extracranial and intracranial complications to the age showed that facial palsy was more common in age below 20 yrs (p value 0.012), labyrinthine fistula was more common between 20 to 40 yrs of age (p value 0.054) and cerebellar abscess was more common in age below 20 yrs (p value 0.095). In 1992 Murthy et al. [9] in a case series of 8 patients, found increased incidence of cerebellar abscess in children. The present study is first to correlate the complications of atticointral type of chronic suppurative otitis media with the age of the patients.

In a ten years retrospective study by Mustafa et al. [2] on complications of otitis media with cholesteatoma, there were 55(60.4%) and 36 (39.6%) women and the difference was statistically significant. Gandhi et al. [5] from India in their study showed that male to female ratio was 2.1:1. Yogancilar et al. [3] in his study showed a male to female ratio of 1.16:1. Only one study, by Gupta et al. [10] from India showed that females were more prone for complications (M: F =1:1.10). In the series by Osma et al. [1] the authors found a significant difference in the men-to-women ratio of 2:1. In a retrospective study by Dubey et al. [4] male to female ratio was 3:1. In the present study out of 81 patients 64 (79%) were male and 17 (21%) were female. The male to female ratio was. 3.7:1. Correlation of extracranial and intracranial complications according to gender showed that post aural fistula was more common in men (p value 0.062).

Mustafa et al. [2] did not find significant difference among urban and rural patients. Osma et al. [1] found that the complications were more common in rural patients than in urban patients. In study by Vakinpelu et al. [11] from Nigeria, most patients were from rural areas and had been previously managed by unlicensed, untrained practitioners. Complications were mostly present in children.

In the present study 64.19% of the patients were from the rural area where there were no otology surgery facilities and 35.8% of the patients were from the urban area. The probable reason why these complications are still encountered more in the rural areas, may be due to decreased awareness and ignorance towards the seriousness of persistent and sometimes offensive ear discharge. Incidentally in the present study it was found that complications were seen more in the literate patients (55.55%) as compared to illiterate patients (44.44%), which may be attributed to the shift in literacy patterns in the country.

In the present study there were 42 patients (51.9%) from the low socioeconomic group and 39 (48.1%) patients from middle socioeconomic group. Correlation of extracranial and intracranial complications according to socio-economic status showed that mastoiditis was more common in middle socio economic status patients (p value 0.056+) and temporal lobe abscess was more common in low socio economic status patients (p value 0.055+). Study by Shaheen et al. [12] revealed statistically significant association of chronic otitis media with yearly income of guardian (P< 0.005), maternal education (P<0.001), bathing habit (P< 0.001), ear cleaning habit (P<0.05), pattern of primary medical consultation (P< 0.05).

Mustafa et al [2] found that complications were seen more in young patients from a lower socioeconomic class and without sex preponderance. Lasisi et al. [13] were of the opinion that low socioeconomic class, malnutrition, congestion from high number of children in the household and bottle feeding constitute significant risk factor.

Prinsley [14] identified several families with affected individuals over several generations. He suggested that there is likely to be a genetic propensity for cholesteatoma in some individuals. In the present study there were two patients with family history of complications

due to cholesteatoma. 19 patients had predisposing focus of infection, but it was not found to be statistically significant.

Yorgancilar et al. [3] reported 12 patients with sensorineural hearing loss. Osma et al. [1] in his study observed 5 cases with profound deafness of which 2 were associated with extracranial and other 3 with intracranial complications. They had 5 patients with profound hearing loss in the study group of 93 patients. Leskinen [15] reported permanent hearing loss in 13 (26%) patients. Kasliwal et al. [16] suggested that more severe middle ear disease may result in sensorineural hearing loss and they suggested early intervention in cases of chronic suppurative otitis media. Kolo et al. [17] found that patients with chronic suppurative otitis media had a significant degree of sensorineural hearing loss. The higher frequencies were more affected. Patient's age and duration of otorrhea seem not to have any correlation with the degree of sensorineural hearing loss. Blakley et al. [18] showed a highly significant association between the presence of chronic otitis media and sensorineural hearing loss. The greatest variability of data implied that sensorineural hearing loss is associated with ear infection with some persons being particularly vulnerable. In this series by Kaur et al. [19] the incidence of sensorineural hearing loss was 24% and particularly it was seen in higher frequencies. Authors also found that the incidence of sensorineural hearing loss progressively increased with the duration of chronic suppurative otitis media.

Of the 81 patients in this study, 13 patients had mixed hearing loss of which 2 were associated with extracranial complications, 7 with intracranial complications and 4 with both extracranial and intracranial complications. Mixed hearing loss was significantly more with the latter two ($p=0.025$). All the patients had long history of ear discharge. Both higher and lower frequencies were found to be affected.

Study by Pendio et al. [20] showed that persistent fever, headache, and purulent otorrhea were the main symptoms. Kangasanarak [21] stated that purulent malodorous otorrhea, cholesteatoma, headache fever and otalgia were the significant alarming manifestations. According to Huseyin Seven [22] headache (93%), fever (87%) and altered mental status (62%) were the most common presenting symptoms and signs, along with symptoms of chronic otitis media. In study of early neurotological clinical features of otitis media, Schwaber et al. [23] are of the opinion that purulent, malodorous discharge, headache and fever are the significant early signs and symptoms that should raise the index of suspicion. Altered mental status is a late finding and usually indicates established intracranial spread of infection. In the present study otorrhea, Headache (58%) and fever (54.3%) were the commonest symptoms associated with complications. Other symptoms were otalgia (39.5%), giddiness (38.2%) and vomiting (27.1%).

On external ear canal examination polyp was seen in 19 cases (23.5%) and granulations were seen in 7 cases (8.6%), completely filling the ear canal. Polyp & granulations together constituted 32%. Prasannaraj et al. [24] stated that the presence of an aural polyp signifies well-established disease of the middle ear cleft with a greater potential for complications and often obscures an underlying cholesteatoma. They proposed that all cases of aural polyps should be considered as unsafe disease and recommends mastoid exploration. In the present study also most specimens of polyps and granulation tissue were associated with cholesteatoma. Hence any granulation or polyp should be considered as a sign of impending complication.

Attic perforation was seen in 34 patients (41.9%), posterosuperior quadrant marginal perforation in 18 patients (22.2%) and total perforation in 8 patients (9.8%).

In the present study pus culture showed growth in 62 (76.5%) patients. *Pseudomonas aeruginosa* was present in 29 (35.8%) patients and *Proteus* in 13 (16%) patients. 12 patients had mixed infections. Seven patients with intracranial complication, four patients with intracranial and extracranial complication and one patient with extracranial complication had mixed infections. Mixed infections were more common in patients with intracranial complication. *Pseudomonas* and *Proteus* combination was more common. *Peptostreptococci* was commonly isolated in young adolescent patients with intracranial abscesses.

In many studies *Pseudomonas aeruginosa*, *Proteus mirabilis*, *Staphylococcal* organisms were the most commonly isolated organisms [2,20,21,25]. In a study by Modak et al. [26] the organisms isolated from the 68 cases of abscesses included *Staphylococcus coagulase positive* (40%), *Pseudomonas species* (30%), *Proteus* and *Streptococci* indicating high virulent strains. Study by Migirov et al. [27] showed that cholesteatoma and brain abscess were usually associated with gram-negative bacterial infection. In another study by Hafidh et al [28] anaerobic bacteria were the most commonly isolated organisms followed by *Staphylococcus aureus*, *Proteus mirabilis*, and *Pseudomonas aeruginosa*. In a study of intracranial abscesses by Seven et al. [22] gram negative bacilli and anaerobes were the most common organisms cultured from the abscesses. Panda et al. [29] stated that anaerobes are responsible for complications in majority of the patients. Similarly in study by Rupa et al [30] culture of cerebrospinal fluid and pus from patients who developed intracranial complications showed mixed flora in majority of cases. *Proteus species* was the most common isolate and anaerobes were present in 21.3% of specimens. Ricciardiello et al [31] did a study on microbiology of cholesteatoma. This study showed that the floral bacteria which proved to play the most important role (60.3%) were the aerobic type and the highest levels were those of *Pseudomonas aeruginosa* (31.1%) followed by *Staphylococcus aureus* (19.1%), *Proteus mirabilis* (7.7%), *Escherichia coli* (1.4%) and *Klebsiella pneumoniae* (1%). Anaerobic floral bacteria were found in a fairly high percentage of cases (38.2%); particularly, anaerobic gram-positive cocci (*Peptococcus* 12.4% and *Peptostreptococcus* in 4.8% of cases), *Bacteroides* (12.4%).

Sharma et al. [32] in their study on bacteriology of bilateral chronic otitis media concluded that the infecting organisms in case of bilateral chronic suppurative otitis media are remarkably similar. In the present study also infecting organisms in case of bilateral chronic suppurative otitis media were similar.

Biofilms have been shown to play a role in many infections, including: chronic otitis media, cholesteatoma, chronic tonsillitis, and chronic sinusitis. Biofilm-producing bacteria that cause infections in the head and neck include *Streptococcus pneumoniae*, *Staphylococcus aureus*, and *Pseudomonas aeruginosa* [33]. In studies by Saunders et al. [34] biofilms were identified in 60% of cholesteatoma cases (3 of 5). On the other hand, only 1 of 7 cases with chronic suppurative otitis media had evidence of biofilms. They concluded that bacterial biofilms are common in chronic infections associated with cholesteatoma and are present in some cases of chronic suppurative otitis media without cholesteatoma. Akyıldız et al. [35] stated that in the middle ear mucosa of patients with chronic otitis media, biofilm formation is common, especially when ear discharge history is present. Some studies have shown that otopathogenic strains of *Pseudomonas aeruginosa* are capable of forming biofilm and become highly resistant to antimicrobial therapy [36].

Poorey et al. [37] are of the opinion that the bacteriology and antibiotic sensitivity pattern in chronic suppurative otitis media has been changing from time to time. In the era of

antibiotics the emergence of antibiotic resistance is becoming more common. Human negligence is a factor responsible for the development of antibiotic resistance. Yeo et al [38] stated that bacterial predominance and antibiotic sensitivity have changed over time, making continuous and periodic surveillance necessary in guiding appropriate antibacterial therapy.

Sade & Fuchs [39] compared mastoid pneumatization in adults and children with cholesteatoma. In this study two main types of cholesteatomas were found in both adults and children, most of them (82.3%) associated with sclerotic or diploic mastoids (i.e., poorly pneumatized mastoids) and the rest (17.3%) with pneumatized mastoids. The former type was found more often in adults (96.3%) than in children (57.8%), while the latter was more frequent in children (42.2% as compared to 3.7% in adults). In both adults and children, cholesteatomas associated with poorly pneumatized mastoids showed mainly an attic and mastoid distribution communicating with a pars tensa or pars flaccida retraction or marginal perforation. Hildmann & Sudhoff [40] stated that the complications, like destruction of the ossicular chain and the biological behaviour of cholesteatoma seem to be related to the pneumatization of the mastoid process, the duration of the disease and the degree of inflammation rather than the age of the patient.

In the present study in 49.4% of patients mastoid was hypocellular, in 33.3% mastoid was acellular and in 17.3% patients' mastoid was cellular. Complications were seen more in patients with hypocellular mastoids.

CT scan has become an inevitable part of the diagnostic algorithm rendered, when a patient with chronic otitis media presents with signs of intracranial complication. In the present study CT was useful in detecting associated complications. When petrous apicitis is suspected, a CT scan should be performed to make the diagnosis and to evaluate surrounding anatomy. A CT scan will also aid in the diagnosis of intracranial complications that often accompany this condition [36,41,42,43].

In cases of meningitis, a contrasted CT scan or MRI will show characteristic meningeal enhancement and rule out additional intracranial complications known to occur in up to 50% of these cases. In cases of brain abscesses, although the MRI gives better detail regarding the abscess itself, a CT scan gives valuable information about bony erosion of the mastoid, and can help in determining the cause of the abscess and the most appropriate treatment options. Imaging is required to rule out concomitant intracranial complications, or evidence of increased intracranial pressure [36,41,43].

In lateral sinus thrombosis imaging is considered a diagnostic aid, as definitive diagnosis is made at surgery. On gadolinium-enhanced MRI, thrombus appears as soft tissue signal associated with vascular bright appearance of the dural wall – the “delta” sign as seen with gadolinium enhanced MRI. Additionally, MR venography, which can demonstrate the loss of signal and the absence of flow in the sinus, has proven to be more sensitive diagnostic tool in identifying lateral sinus thrombosis. MRI is the investigation of choice, and should be performed in conjunction with CT, there by fully evaluating associated otologic and cerebral pathology [36,44,45,46,47].

A contrasted CT scan or MRI is sufficient to diagnose extradural abscess. Even with a careful evaluation, this diagnosis is often made at the time of surgery. In cases of otitic hydrocephalus, an MRI and magnetic resonance venogram should be performed to evaluate for ventricular enlargement, or coexisting intracranial complications, such as significant sinus thrombosis with obstruction. Magnetic resonance venogram will also confirm the presence of

lateral sinus thrombosis, but is not required to make a diagnosis of otitic hydrocephalus [36,48]. In developing countries taking repeat CT scans routinely after surgery is still financially challenging to most of the patients. This makes it necessary for the surgeon to know the situations during the postoperative period when a repeat CT scan is inevitable and should be asked for.

Osma et al. [1] observed cholesteatoma and granulation tissue in the middle ear/mastoid as the major findings in both the groups. Cholesteatoma was present in 78.5% and granulations in 21.5%. Panda et al. [25] reported that granulation tissue was seen in a significant number of cases with complications during surgery. Yorgancilar et al. [3] found cholesteatoma as the most frequent intraoperative finding in complicated chronic suppurative otitis media, with the exception of patients with facial nerve paralysis. There was no any statistically significant difference between cholesteatomatous and non cholesteatomatous patients in terms of complication with the exception of facial nerve paralysis. Gupta & agarwal [10] reported cholesteatoma in 75% of complicated cases and granulations in 16.68%. Gandhi and Agarwal [5] found granulations in 14 patients and cholesteatoma in 13 cases. In 2 cases, both were found to be the offending pathology. Samuel et al. [71] stated that granulations had a bigger role in the spread of disease than the cholesteatoma. In their study granulations were present in 62% of cases and cholesteatoma in 38% of cases. In a study by Rupa et al. [30] cholesteatoma was found more frequently than granulations in both the groups of patients. The ratio of cholesteatoma to granulations alone was approximately 3:1 in both the groups. Modak et al. [26] stated that presence of granulations is the main preceding risk factor for severe intracranial complications.

In the present study only cholesteatoma was present in 15 cases and only granulations in 22 cases and both were present in 44 patients. Presence of both cholesteatoma and granulations was found to be a potentially a risk factor.

In a retrospective study of 91 patients with complications by Mustafa et al. [2] extracranial complications were present in 57.1% cases, intracranial complications in 29 patients (31.9%) and 12 patients (11%) had multiple complications. Among extracranial complications subperiosteal mastoid abscess was present in 26.4%, facial nerve palsy in 16.48%, Labrynthine fistula in 10%, acute mastoiditis in 4.4%, zygomatic abscess in 1.1% and Bezold's abscess in 1.1%. Intracranial complications were present in 31.8% patients of which meningitis (19.7%) and perisinus abscess (15.3%) were the most common complications.

In a similar study done by Yorgancilar et al. [3] out of 121 cases of chronic suppurative otitis media with complications, 57 patients (47.1%) had extracranial complications, 37 patients (30.6%) had intracranial complications and multiple combined complications were present in 27 patients (22.3%). Again mastoid abscess was the commonest extracranial complication (28.3%) followed by labyrinthitis (9%), facial nerve paralysis (8.4%), and Bezold's abscess (1.3%). The most common intracranial complication was lateral sinus thrombophlebitis (19.5%), followed by perisigmoid sinus abscess (13.5%), meningitis (9%), brain abscess (6.5%), and extradural abscess (4.5%). In a review by Osma et al [1] of the 93 cases of chronic suppurative otitis media with complications 57 patients had extracranial complication, 39 had intracranial complication and 3 patients had more than one complication. Meningitis and brain abscess were the common complications observed in the first group and subperiosteal abscess was more common among the extracranial complications. Dubey & Larawin [4] in their series of 70 cases with complications observed that 47 (67%) had a single complication, of which eight (11%) had intracranial and 39 (56%)

had extracranial complications. Twenty-three (33%) had two or more complications. The commonly encountered intracranial complications were otitic meningitis, lateral sinus thrombosis, and cerebellar abscess, which were seen in 13 (19%), 10 (14%), and 6 (9%) cases, respectively. Among the extracranial complications, mastoid abscess, postauricular fistula, and facial palsy were encountered in 26 (37%), 17 (24%) and 10 (14%) patients, respectively. In 1998, Gupta et al. [10] reported meningitis (45.45%) as the commonest intracranial complication and mastoiditis (61.04%) as the commonest extracranial complication.

Migirov et al. [27] observed that meningitis was the commonest complication (46.4%), followed by brain abscess, epidural abscess, sigmoid sinus thrombosis, subdural empyema, perisinus abscess and transverse and cavernous sinus thrombosis.

In a study by Modak et al. [26] commonest complication detected was extradural abscess (28%), followed by brain abscesses (27%) and meningitis (21%). Of the brain abscess cases (27%), 55% were of cerebellar and 45% of temporal lobe variety. Only three cases of otitic hydrocephalus were seen.

Study by Seven et al. [22] included 32 patients presenting with intracranial abscesses from 780 patients hospitalized for treatment of chronic otitis media. The 32 patients had 59 intracranial complications. Perisinus abscess (13 of 32) was the most common intracranial abscess, followed by temporal lobe abscess (8 of 32), epidural abscess (7 of 32), cerebellar abscess (6 of 32) and subdural empyema (2 of 32).

Dubey et al. [49] found that among all the intracranial complications in the 32 patients, otitic meningitis was the commonest intracranial complication and was seen in 14 (43.7%) patients; it was followed by lateral sinus thrombosis in 10 (31.2%), cerebellar abscess in 6 (18.7%), epidural abscess in 7 (21.8%), and perisinus abscess in 5 (15.6%). Other less common but serious intracranial complications encountered were cerebral abscess and interhemispheric abscess in 2 (6.2%) each, and subdural abscess, otitic hydrocephalus, and otogenic cavernous sinus thrombosis in 1 (3.1%) each.

Bento et al. [50] stated the most common intracranial complication was brain abscess (33.3%), followed by meningitis (29.2%), lateral sinus thrombosis (20.8%), and epidural abscess (16.7%). According to Kurien et al. [51] again meningitis was the most frequent intracranial complication, followed by cerebellar abscess.

In this study there were 81 patients with 124 complications. 44 (54.3%) patients had single complication, 32 (39.5%) patients had two complication, 4 (4.9%) patients had three complication and one patient (1.2%) had 4 complication. 37 (45.6%) patients had more than one complication. 41 patients (50.6%) had only extracranial complication, 21 patients (25.9%) had only intracranial complication and 19 patients (23.4%) had both extracranial and intracranial complication. Among 41 extra cranial complication patients, 8 patients (19.5%) had more than one complication. Among 21 extracranial complication patients, 10 patients (47.6%) had more than one complication.

Extracranial complications were subperiosteal mastoid abscess (18.54), mastoiditis (6.45%), post aural fistula (9.67%), facial nerve palsy (11.29), labyrinthine fistula (6.45%) and petrositis (3.22%). Intracranial complications were temporal lobe abscess (13.70%), cerebellar abscess (7.25%), occipital lobe abscess (0.80%), lateral sinus thrombosis

(9.67%), otitic hydrocephalus (6.45%), meningitis (3.22%), subdural abscess (2.41%) and extradural abscess (0.80%).

Subperiosteal abscess is the most common extratemporal complication of chronic otitis media. This abscess occurs over the mastoid cortex due to extension of the infectious process into the subperiosteal space. Cholesteatoma can block the aditus ad antrum, preventing communication of the infected contents of the mastoid with the middle ear space and the Eustachian tube. This obstruction results in infectious decompression through the mastoid cortex and clinically presents as a subperiosteal abscess [36]. Migirov et al [52] suggested that underlying cholesteatoma should be suspected in older children first presenting with a subperiosteal abscess or with acute mastoiditis and mastoid-cutaneous fistula formation. Surgical eradication of a mastoid subperiosteal abscess is essential in this group of children.

In Rupa and Raman's study [30] mastoid abscess occurred in more than half of the patients with complications. In a study by Osma et al. [1] it accounted for 64.1% of the extracranial complications. In a study by Mustafa et al. [2] the incidence of subperiosteal mastoid abscess was found to be 26.4%. Study by Dubey et al. [4] showed the incidence of 21% and is of the opinion that it is common in young patients and its incidence is variable. In the present study subperiosteal mastoid abscess was the commonest extracranial complications and it was present in 18.54% of the cases. It accounted for 33.3% of extracranial complications. Compared to earlier reports, the incidence of subperiosteal abscess is found to have decreased.

Some authors [4] are of the opinion that the development of subperiosteal abscess with or without fistula leads to reduction of pressure of pus within the middle ear cleft, which in turn reduces the chances of infection spreading intracranially. But this study showed that intracranial complications can occur frequently with mastoid abscess as it was present in 21.7% of patients with subperiosteal abscess. One patient (4.34%) had two intracranial complications. Extracranial complication was present in 17.3% of patients with subperiosteal abscess and all had facial nerve palsy. Therefore, all patients with subperiosteal abscess should be investigated to rule out associated complications.

Pus culture showed pseudomonas in 8 patients (34.7%), *Staphylococcus aureus* in 3 patients (13.04%), Proteus in 3 patients (13.04%), Streptococcus in 2 patients, Klebsiella in 1 patient, and both Klebsiella with *E. coli* in one patient. There was no growth in 5 patients.

Subperiosteal abscess secondary to cholesteatoma warrants surgical intervention. In the present study abscess that were more than 1cm were drained and pus was sent for culture and sensitivity and later patients underwent mastoidectomy. Small abscess were drained during mastoidectomy.

In the present study post aural fistula was present in 12 patients and this represents 9.67% of total complications. Out of 12 cases of post aural fistula, 5 patients (41.6%) had associated intracranial complications and 2 patients (16.6%) had associated extra cranial complications. 58.3% patients had other associated complications. This disproves the theory that formation of fistula leads to reduction of pressure of pus within the middle ear cleft and reduces the chances of infection spreading intracranially.

Pus culture showed pseudomonas in 5 patients, Staph aureus in 1 patient, Proteus in 1 patient, *E. coli* in one patient and Bacteroids with non haemolytic streptococci in one patient.

There was no growth in 2 patients. All patients underwent canal wall down mastoidectomy with closure of the fistula.

In many studies mastoiditis was found to be most frequent extracranial complication of chronic otitis media [53,54]. Khan et al [55] found that cholesteatoma was present in 80.7% of the cases and granulations in 19.3% of the mastoid cavities. Authors are of the opinion that acute mastoiditis with abscess develops from the chronic suppurative otitis media and cholesteatoma. Immediate surgical intervention is required to prevent complications in these cases.

In the present study mastoiditis was present in 8 patients and accounted for 6.45% of total complications. All patients presented with sagging of posterior canal wall. Associated complications were present in 75% of patients. 5 cases had associated intracranial complication and 2 cases had associated extracranial complication. Pseudomonas was the main organism isolated and it was isolated in 4 (50%) cases, streptococci in one case and there was no growth in 3 cases. Associated complications were present in 75% of patients.

As many as 25% cases of coalescent mastoiditis have been reported to occur in a sclerotic temporal bone with chronic suppurative otitis media and cholesteatoma [36]. The presence of a cholesteatoma is a surgical indication, and surgical treatment should be done early to prevent multiple complications. In the present study 80% of the patients with mastoiditis had hypocellular mastoid. All the patients underwent canal wall down mastoidectomy and in cases with intracranial complications; mastoidectomy was done after the neurosurgical intervention.

Facial nerve palsy is an important complication of chronic suppurative otitis media. Chronic otitis media with or without cholesteatoma can result in facial paralysis through involvement of a dehiscence nerve, or through bony erosion. Although cholesteatoma can involve the facial nerve at any point through its intratemporal course, the tympanic segment and second genu are involved most commonly. According to Magliulo [56], the site of dehiscence most frequently involved by cholesteatoma was the tympanic segment. The presence of a semicircular canal fistula increases the risk of facial nerve dehiscence. They recommend CT scans for the prediction of facial nerve dehiscence. Djerić [57], in his study on facial palsy in chronic suppurative otitis, suggested that facial paralysis occurs in chronic suppurative otitis when the inflammatory process specifically involves the facial nerve trunk. In a study by Yetiser [58] tympanic segment involvement was present in 14 patients (58.3%) where gradual onset of facial paralysis was the most frequent pattern.

The incidence of facial nerve paralysis in chronic suppurative otitis media cases was found to be 1.7% in a study by Altuntas [59]. Cholesteatoma was present in the majority of the cases (70%). Destruction of the facial canal was also evident in most of the patients (70%) but facial nerve paralysis could occur without obvious destruction of the canal. Mostly the defect is located in the tympanic segment of the canal (35.7%). Complete recovery rate was seen in 75% of cases. Siddiq et al. [60] are of the opinion that facial palsy is a rare presenting feature of cholesteatoma. Facial palsy associated with cholesteatoma should be treated as early as possible. Recovery can occur even if treatment is delayed for up to seven months. In the present study facial palsy was present in 14 (17.2%) of the patients.

Labrynthine fistula continues to be among the most common complications of chronic otitis with associated cholesteatoma, and have been reported in approximately 7% of cases. Due to its location near the antrum, the horizontal semicircular canal is the most commonly

involved portion of the labyrinth, and accounts for approximately 90% of these fistulae [36]. In the present study there were 8 (6.45%) cases of labyrinthine fistula and it was found over the horizontal semicircular canal in all the cases. Study by Monolidis et al. [61] showed that labyrinthine fistula is encountered during surgery for chronic otitis media with an average frequency of 7.5%. Patients with neglected chronic otitis media have an incidence of labyrinthine fistula twice that reported in the literature.

Dornhoffer and Milewski [62] classification was used in the present study. In this classification, fistulas are classified into three types. Fistula with bony erosion and intact endosteum are classified as type I fistula. If the endosteum is violated, but the perilymphatic space is preserved, the fistula is staged as type IIa. When the perilymph is violated by disease or inadvertently suctioned, the fistula is labelled as type IIb. Type III fistula indicates that the membranous labyrinth and endolymph have been disrupted by disease. In the present study there were 8 cases (6.45%) of labyrinthine fistula. 3 patients had type I fistula and 5 patients had type II fistula. In all the cases it was present over the horizontal semicircular canal.

Patients with labyrinthine fistula usually present with subjective vertigo and a positive fistula test on examination. The fistula test is positive only in 32% to 50% of patients [36]. Although sensorineural hearing loss is found in most of these patients (68%), it is not a sensitive indicator of fistula. In the present study fistula test was present in 50% of patients and two patients had sensorineural hearing loss. One patient had lateral sinus thrombosis and cerebellar abscess with labyrinthine fistula. In these patients pus culture showed *Pseudomonas* in 3 patients and *Staphylococcus aureus* in 3 patients.

In any patients with cholesteatoma presenting with sensorineural hearing loss, vertigo, and a positive fistula test should raise a suspicion of fistula but their absence does not guarantee an intact bony labyrinth. In the present study 50% of fistulas were found during surgery. It is better to look for a fistula in every case of cholesteatoma, to prevent unexpected complications. Corticosteroids were seen to have a beneficial impact on postoperative outcome in those cases involving injury to the membranous labyrinth or removal of perilymph [62]. Soda-Merhy et al. [63] are of the opinion that open surgery with removal of the cholesteatoma matrix and sealing of the fistula with temporalis fascia in a canal-wall-down manner is a safe procedure that can make vertigo disappear and helps to preserve cochlear function.

Ueda et al. [64] used canal wall down technique in 27 (87 per cent) patients. The cholesteatoma matrix was completely removed in the first stage in all patients. Bone dust and/or temporalis fascia was inserted to seal the fistula in 29 (94 per cent) patients. A post-operative hearing test was undertaken in 27 patients; seven (26 per cent) patients showed improved hearing, 17 (63 per cent) showed no change and three (11 per cent) showed a deterioration. Authors suggested that labyrinthine fistula should be treated according to the degree of eradication required. The choice of surgical method should depend on various factors, such as the patient's general health, auditory and vestibular condition, location and classification of the fistula, and the skill and experience of the surgeon.

In the present study after canal wall down mastoidectomy cholesteatoma removal, fistula was covered with bone pate and fascia. Corticosteroids were given to the patients at the time of cholesteatoma removal from fistulae. Patients did not have any decreased hearing following surgery. The use of corticosteroids at the time of cholesteatoma removal from fistulae may have a protective effect on hearing.

Wennmo [65] stated that, ears with cholesteatoma combined with labyrinthine symptoms are more frequently associated with a dehiscent facial nerve than other ears and disturbed facial function is then more common. During surgery it is important to be aware of the risk of an uncovered facial nerve. Recent review of the literature found that hearing preservation for patients who underwent complete removal was equivalent to patients where the matrix was left over the fistula [36].

The petrous apex is pneumatized in 30% of individuals and they are in continuity with the middle ear and mastoid through well-described cell tracts around the labyrinth, allowing extension of infection from the mastoid and middle ear cleft to the petrous apex. Petrous apicitis is a spectrum of disease much like mastoiditis, and can involve anything from an asymptomatic effusion to coalescence and abscess formation [36]. In this study there were 4 cases with petrous apicitis (3.22%). All the patient underwent canal down mastoidectomy and following surgery, patients recovered completely.

Intra cranial complications seen in this study were temporal lobe abscess (13.70%), cerebellar abscess (7.25%), occipital lobe abscess (0.80%), lateral sinus thrombosis (9.67%), otitic hydrocephalus (6.45%), meningitis (3.22%), subdural abscess (2.41%) and extradural abscess (0.80%).

In the present study temporal lobe abscess was present in 17 patients (13.70%), cerebellar abscess in 9 patients (7.25%) and occipital lobe abscess in one patient (0.80%). Associated complications were seen in 11 patients. Occipital lobe abscess was seen on the contralateral side. Cerebellar abscess was more common in the patients below 20 years and it was statistically significant. Correlation of extracranial and intracranial complications according to socio-economic status showed that temporal lobe abscess was more common in patients belonging to the low socio economic status (p value 0.055+).

Brain abscess is a dreaded complication of otitis media and it almost exclusively result from chronic otitis media [36,66]. The temporal lobe and cerebellum are the two locations for otogenic brain abscess [66]. The temporal lobe abscess usually occurs in the middle and basal portions of the temporal lobe, adherent to the dura over the roof of the petrous bone [9]. In a study by Sennaroglu & Sozeri [66], abscess was located in the temporal lobe in 54%, in the cerebellum in 44%, and in both locations in 2% of the cases. Taddon et al. [67] showed that streptococcal species predominated as causative organisms, with a high percentage of anaerobic bacteria in otogenic abscesses. In the present study *Pseudomonas* and *proteus* were the common organisms isolated in cerebral abscess and peptostreptococci was isolated in majority cases of cerebellar abscess.

The treatment of choice for brain abscess is neurosurgical drainage. Patient must be stabilized before neurosurgical intervention. Neurosurgical drainage is performed, either through an open craniotomy with drainage or excision, or by stereotactic aspiration through a burr hole. After draining otogenic brain abscess, mastoidectomy should be done to remove the source of infection. The appropriate time to perform the mastoidectomy is controversial [36]. Morwani & Jayashankar [68] stated that single stage, transmastoid approach to both the chronic ear infection and the intracranial abscess is a safe and effective treatment strategy to decrease the mortality and morbidity arising from this pathology. Syal et al. [69] recommend that transmastoid drainage of pus can successfully treat mastoid disease and brain abscess with single surgical intervention. Sinha et al. [70] are of the opinion that endoscopic aspiration of brain abscess is a safe and effective alternative method of treatment. According to Kurien et al. [51] craniotomy with concurrent mastoidectomy is not

only safe, but also removes the source of infection at the same time the complication is being treated. Current recommendations, however, are to perform a mastoidectomy at the time of abscess drainage to remove the infectious focus, assuming the patient is stable enough to tolerate this additional surgery [36].

In the present study there were 17 cases of temporal lobe abscess, one case of occipital lobe abscess and 9 cases of cerebellar abscess. Except in three cases of temporal lobe abscess (abscess size less than 1.6cms), all patients underwent neurosurgical intervention for the management of brain abscess. All the patients who underwent neurosurgical drainage of the brain abscess underwent canal wall down mastoidectomy, as soon as they recovered from the abscess and neurosurgical drainage.

Three patients had small temporal lobe abscess which were less than 1.6cms and all three patients started showing clinical improvement with the commencement of intravenous antibiotics. As the abscess size was less than 1.6 cms and serial CT scan did not show any increase in abscess size, neurosurgical drainage was not done. Neurosurgical intervention was not required. All the three patients underwent canal wall down mastoidectomy. They responded well to medical management. Antibiotic therapy was continued for 6 weeks and post treatment CT scan showed abscess resolution. This study showed that small otogenic brain abscess, which were less than 1.6 cm in size responded to treatment with antibiotics and could be managed by medical therapy. Surgery was required only for the management of atticofacial ear disease.

Lateral sinus thrombosis was present in 12 cases [Right – 6, Left- 6]. Association between lateral sinus thrombosis and otitic hydrocephalus was not statistically significant. Culture showed Proteus and Pseudomonas in majority of the cases. Poly microbial infection was present in 33.33% of cases Kaplan et al. [46] stated that lateral sinus thrombosis may be difficult to diagnose due to previous antibiotic treatment and overlap of clinical findings with other entities such as meningitis.

Otitic hydrocephalus is a rare complication of ear disease. The pathophysiology of this rare condition is unknown. In the present study otitic hydrocephalus was present in 8 cases [due to right side disease in 2 cases and left side disease in 6 cases]. It was associated with cerebellar abscess in 4 cases, temporal lobe abscess in 2 cases and lateral sinus thrombosis in 2 cases. In the present study the association between otitic hydrocephalus and lateral sinus thrombosis was not significant. Out of 8 cases, medical management was effective in reducing intracranial pressure in five patients while three patients underwent ventriculo peritoneal shunt procedure.

In the present study there were 4 cases of meningitis and it was associated with intracranial complication in one case and with extracranial complication in 2 cases. One patient had only meningitis with bilateral active atticofacial disease. Clinical examination and CT scans were useful in ascertaining the source of infection. In a study by Samuel et al. [71], meningitis was the most common intracranial complication. They found that type 4 pneumococci had a particular predilection for intracranial spread. It was interesting to note that 8 cases with meningitis underwent bilateral mastoidectomy as patient had bilateral discharging ear and the source of infection could not be ascertained with certainty.

Subdural empyema is the rarest complication of otitis media. Before the introduction of antibiotics, subdural empyema was almost always fatal. Since then, mortality has decreased significantly, and it now ranges from 14 to 28%. In the present study there were 3 patients

with subdural abscess. One patient had abscess in the interhemispheric region. Very rarely is it seen in an interhemispheric setting. In a series by Dubey et al. [4] out of 70 patients with complications, two had interhemispheric abscess.

A subdural empyema in an unusual location can be difficult to manage surgically. In the present study two patients underwent neurosurgical intervention first and later they underwent mastoidectomy. In the present study in one case interhemispheric subdural empyema was situated in the area of the posterior falx cerebri. In the present study extradural abscess was present in one patient. Patient underwent neurosurgical drainage and later canal wall down mastoidectomy was done.

Garap et al. [72] found that lack of health consciousness, poor socioeconomic status, and lack of health care delivery system resulted in late presentations and poor postoperative follow-up. They recommended canal-wall-down technique with wide meatoplasty to ensure a best possible one-time treatment in Papua New Guinean patients with cholesteatomatous or long-term “dangerous” chronic suppurative otitis media with or without complications. Kurien et al. [51] stated that in suppurative otitis media with intracranial complications, craniotomy with concurrent mastoidectomy was not only safe, but it also removes the source of infection at the same time when the complications were being treated, thus avoiding reinfection while the patient awaits ear surgery. In cases of intracranial complications early mastoidectomy following neurosurgical drainage is found to be effective [73].

In the present study patients with intracranial complications first underwent neurosurgical intervention (except three patients with small temporal lobe abscess) and later underwent surgery for atticointral disease. Patients with extracranial complications underwent early surgical intervention. Studies by Seven et al. [22], Pendio et al. [20] and Ibrahim [74] have reported mortality. Kurien et al. [51], Bento et al. [50], Yorgancilar et al. [3] and Hafidh et al. [28] on the other hand reported no mortality. The present study also has no mortality. In the present study 12 patients had sensorineural hearing loss, one patient developed brain abscess after undergoing surgery for lateral sinus thrombosis and 3 patients underwent ventriculoperitoneal shunt procedure for the management of otitic hydrocephalus.

5. CONCLUSION

1. The largest number of complications [34 cases] occurred in the age group of 11 to 20 yrs (41.9%). Out of which 16 cases were in the age group of 11 to 15 and 18 cases were in the age group of 16 to 20 yrs. Many earlier studies have shown that cholesteatoma is more aggressive in children and that they have increased incidence of complications. This prospective study has shown that complications have an increasing incidence in older children and adolescents. Only 6.1% of the complications were seen in the age group 1-10 yrs. Hence there is an increased incidence among older children and adolescents.
2. Earlier studies have shown that the incidence of multiple complications were low. In the present study there were 81 patients with 124 complications. 41 patients (50.6%) had only extra cranial complication, 21 patients (25.9%) had only intra cranial complication and 19 patients (23.4%) had both extra and intra cranial complication. 37 (45.6%) patients had more than one complication. An increase in the incidence of multiple complications was observed in this study.
3. It was observed that intra cranial complication was frequently associated with another intra cranial complication.

4. Correlation of extra and intra cranial complications according to gender showed that post aural fistula is more common in men (p value 0.062).
5. Statistical correlation of extra and intra cranial complications to the age showed that facial palsy was more common in the age below 20 yrs (p value 0.012), labyrinthine fistula was more common between 20 to 40 yrs of age (p value 0.054) and cerebellar abscess was more common in the age below 20 yrs (p value 0.095). The present study is the first of its kind to correlate the complications of atticointral type of chronic suppurative otitis media with the age of the patients.
6. Mastoiditis was found to be more common in middle socio economic status patients (p value 0.056+) and temporal lobe abscess was more common in low socio economic status patients (p value 0.055+).
7. In the present study there were two patients with family history of complications due to cholesteatoma.
8. Few patients had bilateral atticointral disease. Bilateral complications and contralateral complications are seen rarely. Bilateral concurrent mastoidectomy may be indicated in cases with bilateral complications.
9. Prolonged history of ear discharge was seen in majority (56.2%) of the patients.
10. Headache (58%) and fever (54.3%) were the commonest symptoms of complications.
11. Polyp or granulations completely filling deeper part of the external auditory canal are unsafe and they can lead to complications.
12. Attic perforation was seen in 34 patients, postero superior quadrant marginal perforation was seen in 18 patients and total perforation was seen in 8 patients. Majority of the complications were due to attic perforations.
13. Of the 81 patients in this study 13 patients had mixed hearing loss of which 2 were associated with extra cranial complications 7 with intra cranial complications and 4 with both extra and intra cranial complications. Mixed hearing loss was significantly more with the latter two (p=0.025).
14. Mixed infections were more common in patients with intracranial complication. Pseudomonas and Proteus combination was more common. Peptostreptococci was commonly isolated in young adolescent patients with intracranial abscesses. Anaerobic organisms were isolated predominantly in cases of otitis media associated with intracranial complications. Infecting organisms in case of bilateral chronic suppurative otitis media were similar.
15. Mastoid bone was hypocellular in majority of the cases.
16. Presence of both cholesteatoma and granulations was a potential risk factor for complications.
17. Compared to earlier reports, the incidence of subperiosteal abscess is found have decreased.
18. Lateral sinus thrombosis was seen in 12 cases and associated otitic hydrocephalus was present only in 2 cases. Lateral sinus thrombosis was seen as an operative finding in 4 cases on the left side, which was not detected preoperatively. Asymptomatic lateral sinus thrombosis was not seen on the right side.
19. Otitic hydrocephalus was present in 8 cases. It was associated with lateral sinus thrombosis in only 2 cases. Association between lateral sinus thrombosis and otitic hydrocephalus was not found to be significant.
20. Small subdural empyema in an unusual location (interhemispheric region) which responded to antibiotics therapy was managed conservatively. Early mastoidectomy helps to remove the source of infection in the ear.
21. Small otogenic brain abscess, which are less than 1.6 cm in size responded to treatment with antibiotics and was managed conservatively. Surgery was required only for the management of underlying atticointral ear disease. Close collaboration between

- otologist, neurosurgeons, and neuroradiologists, as well as adequate surgical interventions and appropriate antimicrobial therapy, remain the cornerstones of effective conservative management of small brain abscess secondary to atticofurrow ear disease.
22. Early mastoidectomy following neurosurgical drainage of the brain abscess was found to be effective in this study. However, specific parameters dictating staged versus simultaneous surgery have not yet been reported or established in literature.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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