The Journal of Laryngology & Otology

cambridge.org/jlo

Necrotising otitis externa: the increasing financial burden on the National Health Service

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Main Article

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Cite this article: Godbehere J, Hutson KH, Watson GJ. Necrotising otitis externa: the increasing financial burden on the National Health Service. *J Laryngol Otol* 2022;**136**: 730–733. https://doi.org/10.1017/S0022215121003443

Accepted: 5 March 2021
First published online: 10 November 2021

Key words:
Skull Base; Otitis Externa; Pseudomonas Management

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Abstract

Objective. Necrotising otitis externa is increasingly being seen and treated within the UK. The aim of this study was to explore the potential cost of a cohort of patients with necrotising otitis externa presenting to a single tertiary NHS trust.

Method. This was a retrospective study with data from 14 patients with confirmed necrotising otitis externa who were treated, monitored, discharged or who died between October 2016 and November 2018. Direct costs using the tariffs from the 2018 to 2019 financial year included in-patient stay, imaging, peripheral inserted central catheter line cost, ENT and out-patient parenteral antibiotic therapy visits and antimicrobial duration.

Results. The mean cost of treatment per patient was £17 615 (range, £9407 to £38 230) with an extreme outlier costing more than £122 000.

Conclusion. Awareness and education at a primary care level and research into robust imaging to aid termination of treatment may lower costs in the future by catching pathology early and reducing treatment duration.

Introduction

Malignant otitis externa was first described by Chandler in 1968 as a serious infection of the external auditory canal causing osteomyelitis of the temporal bone and skull base.[1] Necrotising otitis externa was used synonymously to describe this disease and reflect the high mortality associated with it, which was as high as 50 per cent prior to the introduction of antibiotic therapy.[2]

Although still considered a rare complication of unresolved otitis externa, a recent UK-based study reported a six-fold increase in hospital admissions between 1999 and 2013.[2] The precise reason is not fully understood, but increasing incidence of diabetes, longer lifespan, emergence of microbial resistance and increasing awareness all undoubtedly play a role.[3]

Despite the condition being known for more than 50 years, there is still a lack of consensus regarding the definition, diagnosis and management of necrotising otitis externa on a national and international basis.[4,5] This confusion can delay diagnosis, leading to suboptimal treatment with significant morbidity and mortality to the patient. Besides this disease burden, there is also a cost associated with management.

The aim of this study was to explore the potential cost of patients with necrotising otitis externa presenting to a single tertiary NHS Trust throughout the duration of their treatment and to summarise the key clinical findings.

Materials and methods

Patient selection

All patients with confirmed necrotising otitis externa who were treated, monitored, discharged or died in a single tertiary NHS trust were included in this retrospective case series between October 2016 and November 2018.

Patient data collection

The following data was collected: age, gender, risk factors, precipitating events, diagnostic imaging, microbiology results, antimicrobial therapy, duration of in-patient hospital stay, duration of treatment, recurrence, surgery and mortality recorded as a direct result of necrotising otitis externa.

Costing data

Costing tariffs were sought from the Trust's finance department for the year 2018 to 2019. The domains included: cost of in-patient stay, imaging, peripheral inserted central

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catheter line cost, ENT and out-patient parenteral antibiotic therapy visits and antimicrobial duration cost for the duration of treatment.

Results

Over the time period, 14 patients (11 male, 3 female) were diagnosed, monitored and discharged without recurrence of necrotising otitis externa. One male patient had recurrent disease and despite prolonged antimicrobial therapy, surgery and hyperbaric oxygen therapy succumbed to necrotising otitis externa.

All patients were admitted under the senior author and managed jointly with infectious disease and microbiology teams following local necrotising otitis externa management guidelines.[6]

Patients had swabs taken from the external auditory meatus for culture and sensitivity as well as biopsies to exclude malignancy. They all had computed tomography (CT) and post-contrast magnetic resonance imaging to determine bony erosion as well as volume of soft tissue disease and evidence of intracranial complications. Patients underwent regular aural toileting, pain and diabetic control if needed.

A total of 75 per cent of patients were commenced on tazobactam and piperacillin (Tazocin®) as first line anti-pseudomonal intravenous therapy following the Trust's necrotising otitis externa antimicrobial guidelines. The remaining patients received ceftazidime in combination with either metronidazole, teicoplanin or oral fluconazole as directed by microbiology and infectious diseases teams. Most patients required at least 1 change in antibiotic therapy with a mean of 2.9 antibiotics for each case and with a maximum of 5 in one case.

Where possible, patients had peripheral inserted central catheter lines inserted shortly after admission and were discharged from the acute tertiary centre for ongoing antimicrobial therapy in the community. The mean length of hospital stay was 12 days with a range from 6 to 221 days. The significant fluctuating length of stay between patients was a result of social circumstances delaying safe discharge into the community, medical complications such as poor diabetic control or disease recurrence, and the need for palliation (surgery, adjunct hyperbaric oxygen therapy and in-patient stay (221 patients)).

Treatment was continued for a minimum of six weeks. The length of antimicrobial therapy varied between 8 and 31 weeks with a mean of 18 weeks. Termination of treatment was based on resolution of clinical symptoms and return to normal of the ear canal and inflammatory markers (white cell count, erythrocyte sedimentation rate and C-reactive protein).

All patients were reviewed on a 6-to-8-week basis (or sooner if they developed recurrent symptoms) for a full year. Table 1 is a summary of the key patient findings.

Table 2 provides a summary of the domains that were collected for each patient with their associated tariff based on the 2018 to 2019 financial year.

Table 3 provides details of the duration of in-patients in days, number of imaging modalities, different antimicrobial regimes, number of peripheral inserted central catheter lines, and follow up for out-patient parenteral antibiotic therapy and ENT for 13 patients, with the individual and mean costs in the last column. The average cost for this group of patients was £17 615 (range, £9407 to £38 230).

The cost related to the patient who succumbed to necrotising otitis externa was calculated separately in Table 4; the total cost for this patient was £122 864. This was calculated separately because this patient had a prolonged treatment and would have skewed the direct costs of the other patients. The cost of major ear surgery and hyperbaric treatment for this patient was not included.

Table 1. Summary of 14 patients with necrotising otitis externa managed over the specified time period

Parameter	Value
Age (mean (range); years)	72 (40–89)
Male:female (*n*)	11:3
Diabetic (*n*/total *n* (%))	8/14 (57.1)
Immunosuppressed (*n*/total *n* (%))	3/14 (21.4)
Preceding trauma: ear syringing (*n*/total *n* (%))	3/14 (21.4)
Imaging: CT & post-contrast MRI (*n*/total *n* (%))	14/14 (100)
Pseudomonas aeruginosa positive (*n*/total *n* (%))	12/14 (85.7)
Enterococcus (*n*/total *n* (%))	1/14 (7.1)
Candida species (*n*/total *n* (%))	1/14 (7.1)
Tazobactam & piperacillin (*n*/total *n* (%))	11/14 (78)
Ceftazidime (*n*/total *n* (%))	8/14 (57)
Teicoplanin (*n*/total *n* (%))	6/14 (42)
Metronidazole (*n*/total *n* (%))	8/14 (57)
Oral fluconazole (*n*/total *n* (%))	1/14 (7.1)
In-patient stay (mean (range); days)	12 (6–221*)
Duration of therapy (mean (range); weeks)	18 (8–33)
Out-patient parenteral antibiotic therapy visits (*n* (range))	14 (8–18)
ENT out-patient department visits (*n* (range))	6 (3–12)
Recurrence without mortality (%)	0
Recurrence with mortality (*n*/total *n* (%))	1/14 (7.1)

*Outlier due to severe recurrent disease. CT = computed tomography; MRI = magnetic resonance imaging

Table 2. Costing domains based on 2018 to 2019 financial years

Parameter	Cost (£)
Computed tomography	70
Magnetic resonance imaging	110
Peripheral inserted central catheter	384
In-patient	271
Tazocin per week	58.70
Ceftazidime per week	5.14
Teicoplanin per week	16.31
Metronidazole per week	0.36
Out-patient parenteral antibiotic therapy follow-up visit	53
ENT follow-up visit	53

Discussion

Despite being a recognised condition for more than 50 years, there is still no consensus on the definition, diagnostic parameters and management of malignant or necrotising otitis externa.[5] This can lead to confusion and delay in diagnosis with resulting increasing morbidity and disease burden for the patient.

https://doi.org/10.1017/S0022215121003443 Published online by Cambridge University Press

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Table 3. Individual and mean costs for 13 of the 14 patients (excluding the outlying patient)

Sex	Age (years)	Microbiology	Length of stay (days)	CT (*n*)*	MRI (*n*)†	Antibiotics	Antibiotic cost including OPAT (£)	PICC line‡ (*n*)	Total length of treatment (weeks)	OPAT appointments** (*n*)	ENT OPD§ (*n*)	Total cost (£)
Female	77	Pseudomonas	31	1 CT IAM	1 MRI IAM	Tazocin	5224	1	12	16	3	15 196
Male	81	Pseudomonas	6	1 CT IAM	1 MRI IAM	Tazocin, metronidazole, topical ciprofloxacin	7195	1	12	12	5	10 286
Male	58	Pseudomonas	8	1 CT IAM	2 MRI IAM, 1 MRI head	Tazocin, ceftazidime	12 331	1	12	16	3	16 290
Male	77	Pseudomonas	6	1 CT IAM, 1 CT head	2 MRI IAM, 1 MRI head	Tazocin, ceftazidime	9.20	1	21	12	7	12 682
Male	84	Pseudomonas	17	1 CT IAM	1 MRI IAM, 1 MRI head	Tazocin, metronidazole, teicoplanin, topical ciprofloxacin	3384	1	30	8	6	9407
Female	91	Pseudomonas	14	1 CT IAM, 1 CT head	1 MRI IAM, 1 MRI head	Ceftazidime, oral fluconazole	5984	1	10	9	2	11 105
Female	86	Pseudomonas	8	2 CT IAM	3 MRI head	Tazocin, metronidazole, teicoplanin, cefuroxime	10 212	1	8	18	8	14 612
Male	67	Pseudomonas	10	1 CT IAM, 1 CT head	1 MRI IAM, 1 MRI head	Metronidazole, ceftazidime, teicoplanin	34 352	1	33	8	8	38 230
Male	76	Pseudomonas	8	1 CT IAM	1 MRI IAM, 2 MRI head	Metronidazole, ceftazidime, teicoplanin	5647	1	16	10	5	9414
Male	88	Pseudomonas	12	2 CT IAM, 2 CT head	2 MRI IAM, 1 MRI head	Tazocin, topical ciprofloxacin	19 657	1	15	18	10	25 387
Male	81	Candida	14	5 CT IAM	2 MRI head	Tazocin, metronidazole, ceftazidime	20 130	1	13	19	12	26 521
Male	62	Pseudomonas	10	1 CT IAM, 1 CT head	1 MRI IAM, 1 MRI head	Tazocin, metronidazole, teicoplanin, ceftazidime	19 083	1	20	17	4	23 650
Male	80	Pseudomonas	6	1 CT IAM	1 MRI IAM, 1 MRI head	Tazocin,	12 361	2	26	18	5	16 214
Mean value or cost			Mean = 12	Mean cost = £140	Mean cost = £245		Mean cost = £12 673		Mean = 18	Mean = 14	Mean = 6	Mean cost = £17 615

*Computed tomography (CT) cost was £70 each; †magnetic resonance imaging (MRI) was £110 each; ‡peripheral inserted central catheter (PICC) line cost was £384 each; **out-patient parenteral antibiotic therapy (OPAT) appointments cost £53 each; §ENT out-patient department (OPD) appointments cost £53 each. IAM = internal auditory meatus

Table 4. Individual costs of patient who succumbed to necrotising otitis externa

Parameter	Value
Sex	Male
Age (years)	66
Microbiology	Pseudomonas
Length of stay (days)	221
Computed tomography* (*n*)	5 CT IAM, 5 CT head
Magnetic resonance imaging† (*n*)	1 MRI IAM, 3 MRI head
Antibiotics	Tazocin, metronidazole, teicoplanin, ceftazidime
Antibiotic cost, including OPAT (£)	60 456
PICC line‡ (*n*)	3
Total length of treatment (weeks)	31
OPAT appointments** (*n*)	5
ENT OPD§ (*n*)	0
Total cost (£)	122 224

*Computed tomography (CT) cost was £70 each; †magnetic resonance imaging (MRI) was £110 each; ‡peripheral inserted central catheter (PICC) line cost was £384 each; **out-patient parenteral antibiotic therapy (OPAT) appointments cost £53 each; §ENT out-patient department (OPD) appointments cost £53 each. IAM = internal auditory meatus

It is clear in recent times, for reasons not fully appreciated, that there is an increase in the number of cases of necrotising otitis externa being admitted and treated in the NHS.[5] These cases still fit the profile of largely older, diabetic male patients with pseudomonal infections. Despite a minimum of six weeks of intravenous antimicrobial therapy being set as the minimum treatment duration,[7] our duration showed a mean of 18 weeks (range, 8–33 weeks). Without robust evidence-based management pathways and varying disease volumes, treatment duration will vary considerably and thus drive up costs.[6]

In our series, the average cost was £17 615 per patient. This ranged from £9414 through to a staggering £122 864. The latter figure arose because of refractory residual disease that resulted in palliation and death. These costs were in fact higher as we did not take into account the surgery the patient had as well as adjunct hyperbaric oxygen therapy (the only patient to receive these adjunct treatments in this cohort).

By close monitoring of patients by a single named clinician as well as managing them under a dedicated multidisciplinary team, antimicrobial usage is optimised and duration kept as short as possible, which helps to reduce costs.[8]

Research work on robust diagnostic and monitoring imaging modalities (in particular positron emission tomography-CT) is looking very promising and will be useful at directing termination of treatment in the future.[9–14]

- Necrotising otitis externa secondary to otitis externa is an increasing disease entity within the UK and is associated with significant morbidity and socio-economic costs
- In the UK there is still no common consensus with regard to diagnosis, management and length of treatment for necrotising otitis externa
- This article estimates the high financial burden of necrotising otitis externa within one tertiary referral centre
- Awareness and education at a primary care level and developing evidence-based management pathways may help reduce the health and economic costs

Awareness and education in the primary care setting is also a potential key area to focus on. Early recognition of a progressing otitis externa with timely intervention may reduce disease volume and cost.

Meticulous care while cleaning or syringing ears in vulnerable patient groups (elderly, diabetic or immunocompromised patients) is paramount. Should this group develop acute otitis externa irrespective of the precipitating factor, then the utmost vigilance is required to ensure they respond to topical antimicrobial treatment within a 7 to 10 day period. Should treatment fail or patients deteriorate, then there should be a low threshold for an expert ENT opinion with an interest in necrotising otitis externa.[15]

In this study, we have only considered direct costs to the Trust. We did not consider the economic impact of younger patients who may have had employment disrupted or the burden to carers bringing relatives to multiple appointments, transport costs for frail patients and the burden of increased care for older patients.

Competing interests. None declared

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