

# THE ROLE OF AEROBIC BACTERIA IN ACUTE OSTEOMYELITIS

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## Abstract:

This study included the isolation and identification of microorganisms causing chronic osteomyelitis to determine the most common bacteria cause of osteomyelitis in different age groups and sexes in Al-Yarmouk Teaching Hospital and Red Crescent Surgical Hospital in Baghdad for the period from October 2003 to July 2004.

The total studied specimens was 387, they were taken as 343 swabs (88.63%) from wound and 45 aspirate (11.3%) from both hematogenous and exogenous infections.

Patients were grouped according to age, sex and type of infection, which were divided into exogenous 309 (89.84%), and hematogenous 78 (20.63%) osteomyelitis.

Exogenous group included 309 patients and was divided into acute osteomyelitis 237 (76.74%), and chronic osteomyelitis 72 (23.3%). Patients were suffering from postoperative wound infection, infected compound fracture, bullet injury and blast injury and one case diabetes mellitus. The most common age group was found to be 21-30 years.

Hematogenous group included 78 (20.3%) patients with chronic type only, it was common in young men especially in age group 21-30 years representing a statistically significant difference between infection in children and other age groups.

The present study revealed that male/female ratio was found to be 311 (80.36%)/76(19.64%). Statistical analysis showed a significant difference in the rate of osteomyelitis in relation to sex. The most common site of infection was found to be femur 147 (37.31%), 257 pathological specimens were obtained in the study.

Gram negative bacteria were the most commonly detected (84.1%) mainly *Pseudomonas aeruginosa* 87 (31.07%), *Klebsiella pneumoniae* 54 (19.29%), *Proteus mirabilis* 33 (11.79%), *E. coli* 29 (10.36%), *Citrobacter* spp 7 (2.5%), *Enterobacter cloacae* 5 (1.79%), *Serratia marcescens* 2 (0.72%), *Citrobacter braaki* 3 (1.07%), *Serratia fracaris* 2 (0.72%), and 1 (0.32%) for all of *Chysomonas luteola*, *Pasturella pneumontropica*, *Providenciae stuartii*, *Rahnella aquatilis*, and *Enterobacter baumannii*.

Gram positive bacteria representing 15.9% mainly *Staph. aureus* 25 (8.93%), then coagulase negative *Staphylococcus* (*Staph. epidermidis*) 11 (3.93%), 1 (0.37%) for all of *Staph. capitis*, *Staph. homonis*, *Staph. xyloxis* and *Streptococcus pyogenes* 2 (0.72%).

## Introduction

Osteomyelitis is a progressive infection that can include infection of one or multiple parts of the bone (e.g., periosteum, medullary cavity, and cortical bone) (1). It is usually a subacute, acute to chronic infection that can cause severe disability if

not properly treated. Common symptoms include chills followed by fever, with acute pain and swelling above the site of inflammation. The inflammation begins in the narrow cavity, causes softening, and erosion of the long bones, often with the formation of pus-containing abscesses, and soon spreads over the entire bone, with consequent death of the hard portions of the bone (2). The disease if untreated progresses from inflammatory destruction of bone, to necrosis (sequestra) followed by new bone formation (1). It is usually a bacterial infection; acute hematogenous osteomyelitis most commonly occurs in children and usually results in a single site of infection that involves the metaphysis of the long bones (e.g., tibia, femur and humerus); around 50% of cases of osteomyelitis are in preschool children. The overall prevalence of osteomyelitis is 1 per 5000 children. The prevalence of osteomyelitis in neonates is 1 per 1000 (3). Osteomyelitis can be described as 'acute or chronic' and 'hematogenous or contiguous', according to the duration and source of infection, respectively (4). There is distinct variability in the causative organisms of osteomyelitis in different parts of the world. In most European and North American reports, the most common bacterial isolates in osteomyelitis have been *Staphylococci* (5), (6), (7), (8), (9), (10). Iraq is a Middle East country with endemic pathogens characteristic of that region. The bacteria may enter the bone through an open injury to the skin, during surgery on the bone, or from the bloodstream. The most common bacteria that cause osteomyelitis include: *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Streptococci*, *E.coli*, *Pseudomonas* spp. *Salmonella* spp. *Proteus* and other types of bacteria (11). Despite advances in antibiotic treatment, other studies have shown an increasing emergence of methicillin-resistant *Staphylococci* (MRSA) and *Pneumococci* (12), (13), (14). Generally, in many parts of the world, including Iraq, information regarding the etiology and antibiotic resistance of bacteria isolated from osteomyelitis are rare or little.

### **Materials and Methods**

**Patients:** This study included 387 patients clinically diagnosed as cases of osteomyelitis, supported by positive culture and development of specific bone changes on X-ray. Patients were referred to orthopedic department at Al-Yarmouk and Al-Kindy teaching hospitals. Patients were grouped according to the type of infection, age, site of infection and the duration of the illness.

### **Specimens collection for bacteriological studies:**

- 1- Swabs were taken from patients with an open infected wound or draining sinus and also taken during surgical management.
- 2- Aspirates taken by a sterile syringe, few millimeters of pus were aspirated during management at the operation theatre, aspirates were centrifuged at 5000 rpm for 5 min. and the deposit was studied microbiologically.

### **Isolation and Identification:**

All specimens were subjected to the following:

- 1- Direct microscopical examination that included, wet preparation, Gram stained films and Ziehl Neelsen stained films.
- 2- Cultivation on Blood and MacConkey agars, each specimen was cultured on two sets of media, aerobic and under CO<sub>2</sub> condition using candle Jar.
- 3- Cultural characteristics, Biochemical tests and the use of API 20E System (BioMerieux), were used in identification.

### Results and Discussion

The type of culture obtained in osteomyelitis was studied out of 387 patients with osteomyelitis, 151 (39.02%) cases showed no growth, 196 (50.65%) yielded the growth of single organism and 40 (10.34%) yielded mixed bacterial growth. There was, statistically, no significant difference of the incidence of osteomyelitis between single and mixed infection ( $P>0.05$ ) as shown in figure 1.

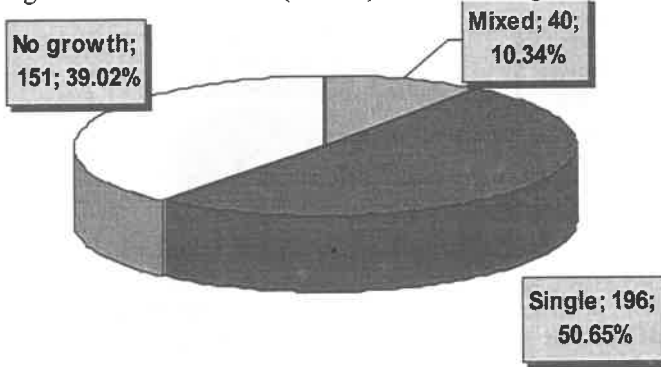


Figure 1: Rate of single and mixed infection in osteomyelitis.

The type of culture obtained in exogenous osteomyelitis was studied, out of 309 patients with osteomyelitis 127 (41.10%) cases showed no growth, 146 (47.25%) yielded the growth of single organism and 36 (11.65%) yielded mixed bacterial growth. The difference was statistically not significant between single and mixed infection ( $P>0.05$ ) as shown in figure 2.

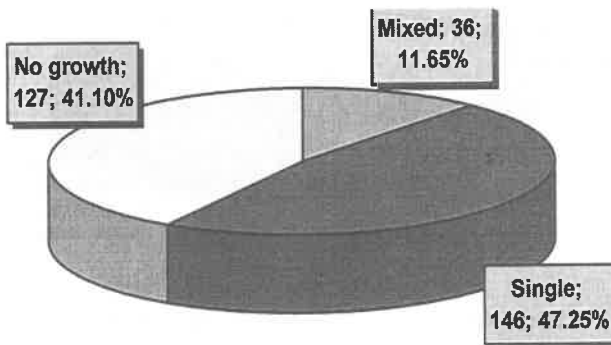


Figure 2: Rate of single and mixed infection in exogenous osteomyelitis.

The type of culture obtained in acute exogenous osteomyelitis was studied, out of 237 patients with osteomyelitis, 100 (38.91%) cases showed no growth, 137 (51.75%) yielded the growth of single and mixed organisms (total positive) including 113 yielded single organism and 24 (9.34%) yielded mixed bacterial growth. A statistically no significant difference on the incidence of osteomyelitis between single and mixed infection ( $P>0.05$ ) as shown in figure 3.

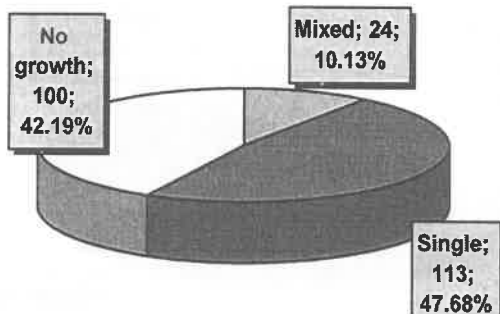


Figure 3: Rate of single and mixed infection in acute exogenous osteomyelitis

The type of culture obtain in chronic exogenous osteomyelitis was studied, out of (72) patients with osteomyelitis 25 (34.72%) cases showed no growth, 35 (48.61%) yielded the growth of single organism and 12 (16.67%) yielded mixed bacterial growth. Non-significant difference was shown on the incidence of osteomyelitis between single and mixed infection ( $P>0.05$ ) as shown in figure 4.

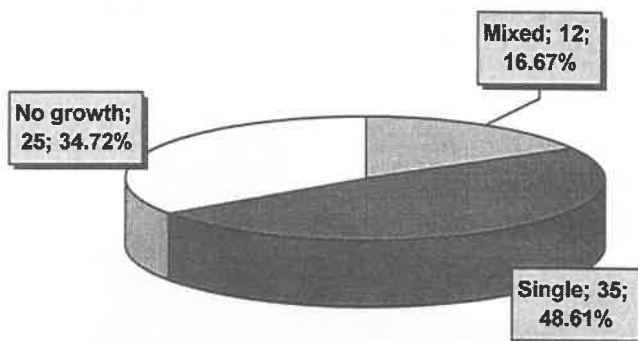


Figure 4: Rate of single and mixed infection in chronic exogenous osteomyelitis.

The type of culture in chronic hematogenous osteomyelitis was studied, out of 78 patients with chronic hematogenous osteomyelitis 24(30.77%) cases showed no growth, 50 (64.10%) yielded the growth of single organism and 4 (5.13%) yielded mixed bacterial growth. A statistically significant difference on the incidence of analysis in a chronic type of hematogenous osteomyelitis, and also

significant difference between single and mixed infection were obtained, as shown in figure 5.

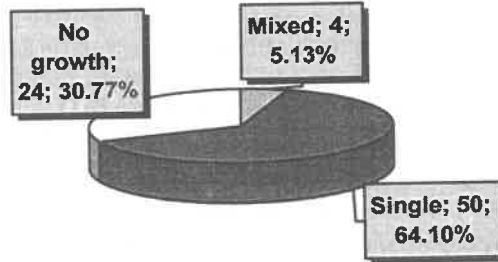


Figure 5: Rate of single and mixed infection in chronic hematogenous osteomyelitis.

The results agreed with (15), who found through his study about hemoglobinopathy and pattern of musculoskeletal infection in children. Those sixty-six bacterial pathogens were isolated from 59 patients; fifty-two were isolated in single culture and 14 in mixed cultures. While the results do not agree with (16), who showed that mixed growth bacteria in chronic hematogenous were 61.5%, while in acute was 34.5.

Table 1: Distribution of identified bacteria in exogenous osteomyelitis.

Bacteria	No.	%
<i>Pseudomonas aeruginosa</i>	72	33.8028
<i>Klebsiella pneumonia</i>	42	19.7183
<i>E.coli</i>	24	11.2676
<i>Proteus mirabilis</i>	19	8.9201
<i>Staph. Aureus</i>	16	7.5117
<i>Staph. Epidermis</i>	8	3.7558
<i>Citrobacter spp.</i>	5	2.3474
<i>Enterobacter cloacae</i>	5	2.3474
<i>Citrobacter braakii</i>	3	1.4084
<i>Serratia spp.</i>	2	0.9389
<i>Citrobacter freundii</i>	2	0.9389
<i>B. streptococcus</i>	1	0.4694
<i>Staph. Homonis</i>	1	0.4694
<i>Staph. Capitis</i>	1	0.4694
<i>Staph. Lentus</i>	1	0.4694
<i>Staph. Xylosis</i>	1	0.4694
<i>Serratia marcescens</i>	1	0.4694
<i>Serratia ficaris</i>	1	0.4694
<i>Chysomonas luteola</i>	1	0.4694
<i>Rhannella aquatilis</i>	1	0.4694
<i>Acinobacter baunmanii</i>	1	0.4694
<i>Proteus spp.</i>	1	0.4694
<i>Proteus vulgaris</i>	1	0.4694
Total	213	100

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## الخلاصة

شملت هذه الدراسة عزل وتشخيص البكتريا المسببة لألتهاب العظام لدى مرضى من مختلف الأعمار ومن كلا الجنسين من الذين راجعوا مستشفى اليرموك التعليمي ومستشفى الهلال الأحمر الجراحي في بغداد للفترة بين تشرين الأول ٢٠٠٣ وتموز ٢٠٠٤.

بلغ عدد النماذج الكلية ٣٨٧، أخذت منها ٣٤٣ كمسحة (٨٨,٦٣٪) وبوساطة رشف الجروح، و ٤٥ (١١,٣٪) لكل من خمج العظام الدموي المنشأ و خمج العظام الخارجي المنشأ. قسم المرضى إلى مجاميع حسب العمر والجنس ونوع الاصابة التي قسمت الى خارجية المنشأ ٣٠٩ (٨٩,٨٤٪) ودموية المنشأ ٧٨ (٢٠,٦٣٪).

شملت المجاميع ذات المنشأ الخارجي ٣٠٩ مريضاً وقسمت الى خمج العظام الحاد ٢٣٧ (٧٦,٧٤٪) و خمج العظام المزمن ٧٢ (٢٣,٣٪) وهم يعانون من أصابة الجروح بعد العمليات الجراحية وألتهاب الكسر المركب وجروح الطلق الناري والانفجارات وحالة سكري واحدة فقط. ان اغلب الاعمار شيوعاً كانت بين ٢١ - ٣٠ سنة.

شملت اصابة العظام الدموية المنشأ المزمنة فقط ٧٨ مريضاً (٢٠,٣٠٪) اكثرها شيوعاً عند الشباب وبصورة خاصة لعمر ٢١ - ٣٠ سنة. اظهر التحليل الاحصائي اختلافاً معنوياً بين الاصابات في الاطفال والاعمار الاخرى.

أشارت النتائج الى ان نسبة الذكور ٣١١ (٨٠,٣٦٪) ونسبة الاناث ٧٦ (١٩,٦٤٪) وأظهر التحليل الاحصائي اختلافاً معنوياً في معدل الاصابة بالتهاب العظام تبعاً للجنس. وجدت اغلب المواقع عرضة للاصابة عند الفخذ ١٤٧ (٣٧,٣١٪) والساق ١٣٨ (٣٥,٠٣٪).

شكلت البكتريا الهوائية ما عدده ٢٧٨ نموذجاً أي بنسبة ٩٩,٢٩٪ من مجموع ٢٨٠ نموذجاً مرضياً لهذه الدراسة فيما شكلت البكتريا اللاهوائية عزلتين منها (٠,٧١٪)، هما بكتريويدز والبيتوستربتوكوكس.

كانت البكتريا السالبة لصبغة كرام هي الغالبة ونسبتها (٨٤,١٪) وبصورة اساسية بكتريا سيدو مونس ايروجينوسا ٨٧ (٣١,٠٧٪) وكلسيلا نيموني ٥٤ (١٩,٢٩٪) بروتيس ميرابلس ٣٣ (١١,٧٩٪) والاشريشيا كولاي ٢٩ (١٠,٣٦٪) إضافة الى أنواع أخرى. اما البكتريا الموجبة لصبغة كرام كانت نسبتها (١٥,٩٪) الغالبية منها ستاف اوريس ٢٥ (٨,٩٣٪) وستاف ابيدرميديس ١١ (٣,٩٣٪) وستربتوكوكس بايوجينيس وستاف لنتس ٢ لكليهما (٠,٧٢٪).