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Prevalence and Antibiotic Sensitivity Pattern of Organisms Isolated from Post Injection Intramuscular Abscesses in a Tertiary Care Hospital, Kashmir

Amrish Kohli[1], Muzafar Amin[2], Sumaira Qayoom[3], Talat Masoodi[4], Syed Arshi[5], Syed Khurshid[6]

Author Affiliation: [1,2,3]Senior Resident/Tutor Demonstrator, [4]Lecturer, [5]Associate Professor, [6]Professor and Head, Department of Microbiology, SKIMS Medical College, Bemina, Srinagar, Jammu and Kashmir 190017, India.

Corresponding Author: **Sumaira Qayoom,** Senior resident, Department of Microbiology, SKIMS Medical College, Bemina, Srinagar, Jammu and Kashmir 190017, India.

E-mail: sumairabeigh@gmail.com

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Abstract

Background: Intramuscular injections are a routine procedure performed in the hospital settings mainly for therapeutic purpose. Improperly performed injections may lead to complications of which abscess formation is the most common particularly, where aseptic precautions are not followed. In our study, the organisms causing these abscesses were isolated and identified followed by the study of their antibiotic sensitivity patterns. Thus the trend of their sensitivity pattern was observed over the past seven years duration from January 2012 to December 2018 and used to frame the hospital antibiotic policy.

Keywords: Gluteal abscess, deltoid abscess; Complications; Intramuscular injection; Multidrug resistant Staphylococcus aureus (MRSA).

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Introduction

Abscess is a localized collection of a white to yellow fluid in an enclosed tissue space comprising of dead white blood cells, necrotic tissue and cellular debris called pus that is often caused by microbial pathogens during or after trauma in the form of breech to the normal anatomical barriers including skin and soft tissue.[1–3] Abscesses may occur at the site of intramuscular injection as one of the most common complications of this technique.[4–6] These complications also include nerve injury,[7] contracture in skeletal muscle,[8–10] and gangrene[10–12] though much less frequently. Numerous reports in literature validate that these complications are the result of improper administration of intramuscular injections coupled with unclean practices.[13,14,15] Abscess formation is by far the most common complication of post intra-muscular injection and in most instances is caused by infiltration by bacterial pathogens including both gram positive cocci like *Staphylococcus aureus* and *Enterococcus* spp. and gram negative bacilli like *Escherichia coli*, *Pseudomonas aeruginosa*, *Klebsiella* spp., *Acinetobacter* spp. and *Citrobacter* spp.[16]

Intramuscular injection is a routine procedure performed on hospitalized patients for delivering therapeutic effect of the drug to them.[17] The

intense selection pressure in hospital environment makes most of the bacterial pathogens mentioned above, resistant to a number of recommended antibiotics that causes greatly enhanced morbidity and mortality of hospitalized patients. Among the multidrug resistant pathogens, methicillin resistant *Staphylococcus aureus* (MRSA) and extended spectrum β lactamase producing *E coli* are much significant in causing disease. Most of the MRSA strains all over the world have attained resistance to multiple antibiotics including β lactams, tetracyclines, macrolides and more recently fluoroquinolones.[18] Most of the other isolates from post intramuscular injection pus samples from abscesses of hospitalized patients such as *Klebsiella* spp., *Acinetobacter* spp., and *Enterococcus* spp. are likewise found resistant to major antimicrobial groups and are difficult to be treated. Increased frequency of isolation of multidrug resistant bacteria is of global concerns and their rapid emergence is becoming a serious threat to the health of people due to much lesser pace of development of newer antimicrobials compared to a greater unresponsiveness to the classes of antibacterial drugs already in place.[19,20]

In the present study, all pus samples from post intramuscular injection abscesses of hospitalized patients were studied for the prevalence and antibiotic sensitivity pattern of all the isolates of pathogenic bacteria retrospectively over a seven year period. Both gluteal and deltoid regions were included as primary sites of intramuscular injections. The prevalence of multidrug resistant strains was analyzed in our study.

Aims and Objectives

1. To study the prevalence of prime pathogens isolated from pus samples of post intramuscular injection abscesses.
2. To study the antibiotic sensitivity pattern of all bacterial isolates (gram-positive cocci and gram-negative bacilli) from pus samples of post intramuscular injection abscesses in gluteal and deltoid regions.

Materials and methods

The present study was conducted in the department of microbiology, Sher-i-Kashmir Institute of Medical Sciences (SKIMS) medical college, Bemina, Kashmir.

Study Period and Type: This is a retrospective observational study performed over a seven years period from January 2012 to December 2018.

Samples: All pus samples from abscesses in gluteal and deltoid areas from patients of post intramuscular injection failure presenting in out-patient or in-patient departments of this institute.

Methodology: The pus samples registered retrospectively were included in the study. All samples received in the bacteriology section of the department of microbiology were processed by the standard laboratory techniques. The sequence of steps that were followed are mentioned below:

1. All samples that were submitted in the department of microbiology were subject to direct microscopy after gram staining technique for presumptive evidence.
2. This was followed by inoculation on routine laboratory culture media including blood agar, MacConkey agar and Chocolate agar.
3. All inoculated culture plates were kept for an overnight incubation at 37°C and were observed for any growth the next day.
4. Any observable growth was further identified by their colony morphology that included color, shape and size of the individual colonies on all inoculated culture media. Additional factors like hemolytic patterns and motility were taken into consideration.[21]
5. The presumptive evidence of a particular bacterial group was put to confirmation by various spot tests and biochemical tests.[22]
6. This was followed by drug sensitivity testing of identified isolates on Mueller Hinton Agar by Kirby Bauer disc diffusion technique determined according to the method recommended by the Clinical and Laboratory Standards Institute.[23]

   All isolates of gram positive cocci and gram negative bacilli were tested for their respective antimicrobial agents that included: Ampicillin (10 μg), clindamycin (2 μg), erythromycin (15 μg), azithromycin (30 μg), cefepime (30 μg), ceftriaxone (30μg), cefotaxime (30 μg), linezolid (30 μg), vancomycin (30 μg), teicoplanin (30 μg), penicillin (10 units), amoxicillin/clavulanic acid (20/10 μg), amikacin (30 μg), aztreonam (30 μg), gentamicin (30 μg), imipenem (10 μg), meropenem (10 μg), piperacillin-tazobactum (100/10 μg), ciprofloxacin (5 μg), tetracycline (30μg), co-trimoxazole (25 μg), cefoxitin (30

μg) and levofloxacin (5 μg).

7. No growth obtained even after 48 hours of incubation on these media were labeled as sterile pus and were included in the study.

Results

Of the 241 pus samples collected from different wards of this hospital, significant growth of pathogenic bacteria could be obtained from 197 samples (culture positive rate 81.74%) and the rest 44 were sterile on culture media. Of the 197 isolates cultured, 80 were identified as *Escherichia coli* (40.60%), 74 were identified as *Staphylococcus aureus* (37.56%), 14 were identified as *Pseudomonas aeruginosa* (7.10%), 10 were identified as *Klebsiella* spp. (5.07%), 9 were identified as *Acinetobacter* spp. (4.56%), 5 were identified as *Citrobacter* spp. (2.53%), 3 were identified as *Proteus* spp. (1.52%) and 2 were identified as *Enterococcus* spp. (1.01%). This is depicted in the form of pie chart in (Fig. 1).

Of all the 241 pus samples obtained, 183 (75.93%) were taken from abscesses in the gluteal region and

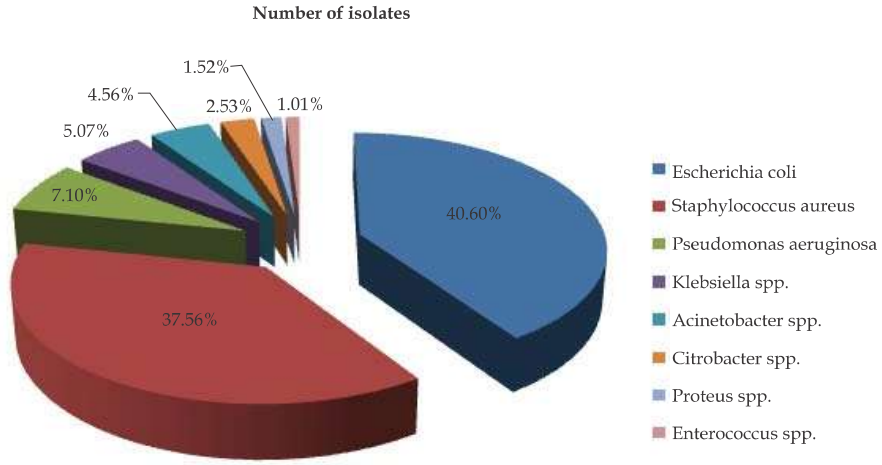

Fig. 1: Distribution of bacterial pathogens (%) isolated from post IM pus samples at a tertiary care hospital, Kashmir (a seven year data).

58 (24.06%) were taken from the abscesses in the deltoid region. It was noticed that all the 80 isolates of *Escherichia coli*, 5 isolates of *Citrobacter* spp., 3 isolates of *Proteus* spp. and 2 isolates of *Enterococcus* spp. were cultured from pus samples of gluteal region. However, 30 of the 74 isolates of *Staphylococcus aureus* and 8 of the 14 isolates of *Pseudomonas aeruginosa* were cultured from the pus samples from deltoid abscesses. Most isolates of *Klebsiella* spp. (9 out of 10) and *Acinetobacter* spp. (6 out of 9) were cultured from pus samples of gluteal abscesses. These figures reflect the possibility of contamination of the gluteal region by bacterial flora of the gut.

The antibiotic sensitivity pattern of gram negative bacilli and gram positive cocci is depicted in Table 1 and 2 respectively.

Table 1: Antibiotic sensitivity of gram negative bacilli isolated from pus samples of post IM injection abscess.

Isolate	AMP %S	AMC %S	CAC %S	CAZ %S	CPM %S	CFS %S	CTR %S	CIP %S	AK %S	GEN %S	TOB %S	IPM %S	MRP %S	PB %S	PIT %S	TGC %S
Escherichia coli	4	9	17	14	13	50	20	30	85	54	40	94	63	86	40	100
Pseudomonas spp.	0	0	14	21	21	36	28	43	50	50	86	86	78	100	50	93
Klebsiella spp.	nt	8	16	13	13	50	19	30	85	54	38	92	62	85	40	100
Acinetobacter spp.	0	0	0	0	0	0	0	11	67	22	55	44	44	100	44	67
Citrobacter spp.	60	40	40	20	40	20	40	100	80	60	100	100	80	100	60	100
Proteus spp.	0	0	33	66	33	66	66	100	100	66	100	100	100	100	66	100

AMP: Ampicillin, AMC: Amoxycillin clavulanic acid, CAC: Ceftazidime clavulanic acid, CAZ: Ceftazidime, CPM: Cefepime, CFS: Cefoperazone sulbactam, CTR: Ceftriaxone, CIP: Ciprofloxacin, AK: Amikacin, GEN: Gentamicin, , IPM: Imipenem, MRP: Meropenem, TOB: Tobramycin, PB: Polymyxin B, PIT: Piperacillin tazobactam, TGC: Tigecyclin, spp.: species, %S: percentage sensitivity.

Table 2: Antibiotic sensitivity pattern of *Staphylococcus aureus* isolated from pus samples of post IM injection abscess.

Antimicrobial agent	Antibiotic sensitivity in %	Antibiotic resistance in %
Linezolid	100	0
Vancomycin	100	0
Teicoplanin	97	3
Gentamicin	95	5
Amikacin	94	6
Oxacillin	92	8
Clindamicin	79	21
Cloxacillin	76	24
Cefoxitin	70	30
Cefazolin	66	34
Levofloxacin	64	36
Tetracyclin	62	38
Azithromycin	62	38
Erythromycin	60	40
Cotrimoxazole	47	53
Ciprofloxacin	29	71
Chloramphenicol	28	72
Amoxyclav	28	72
Ofloxacillin	26	74
Penicillin G	9	91
Amplicillin	0	100

Statistics

Chi-square test was applied for analysis of categorical data. *p*-value <0.05 was taken as significant.

Discussion

A high culture positive rate of 81.74% in our study strongly suggested the non fastidious nature of microbes that caused post intramuscular injection abscesses in the gluteal and deltoid regions. No growth obtained in the 44 pus samples could be possibly due to the empirical therapy given with broad spectrum antibiotics and the anaerobic bacteria that fail to grow on the aerobic culture media. A high rate of culture positivity in other studies done by Mohammedaman Mama *et al*.[24] (87.40%) and Rugira Trojan *et al*.[25] (60.10%) were observed concordant to our study.

A step wise identification of all the isolates based on gram staining, colony morphology, culture characteristics, motility and biochemical reactions revealed maximum number of *Escherichia coli* (80 isolates) followed by *Staphylococcus aureus* (74 isolates), *Pseudomonas aeruginosa* (14 isolates), *Klebsiella* spp. (10 isolates), *Acinetobacter* spp. (9 isolates), *Citrobacter* spp. (5 isolates), *Proteus* spp. (3 isolates) and *Enterococcus* spp. (2 isolates) (Fig. 10). These findings were correlated well with studies done by Zhang *et al*.,[26] Misic A. M. *et al*.[27] and Lockhart S. R. *et al*.[28] where a predominance of *Escherichia coli*, *Staphylococcus aureus*, *Klebsiella* spp. and *Pseudomonas aeruginosa* was found among the pus samples. A study by L. J. Bessa *et al*.[29] explored *Staphylococcus aureus* as a dominant bacterial species in pus samples.

Antibiogram results from the present study show that *Escherichia coli* was most sensitive to tigecyclin (sensitivity 100%), Imipinem (sensitivity 94%), polymyxin B (sensitivity 86%) and amikacin (sensitivity 85%). Most of the 80 isolates were resistant to ciprofloxacin (70% resistance) and β lactam antibiotics like ampicillin (96% resistance), amoxyclav (91% resistance), ceftazidime (86% resistance), ceftazidime clavulanic acid (83% resistance), cefepime (87% resistance) and ceftriaxone (80% resistance). A reasonable number of isolates were found sensitive to meropenem (64%), gentamicin (54%), cefoperazone sulbactam (50%), tobramycin (40%) and piperacillin-tazobactum (40%). The isolates of *Klebsiella* spp. showed almost a similar sensitivity to all antibiotics tested, though the number of isolates was eight times lesser compared to *Escherichia coli*. The 9 isolates of *Acinetobacter* spp. were comparatively more resistant to the antimicrobial agents than the 14 isolates of *Pseudomonas aeruginosa*, though all the

isolates of both the pathogens were found sensitive to polymyxin B and more isolates of *Acinetobacter* spp. (67%) were sensitive to amikacin compared to only 50% isolates of *Pseudomonas aeruginosa*. All isolates of *Acinetobacter* spp. and most isolates of *Pseudomonas aeruginosa* were resistant to the β lactam antibiotics tested. The antibiotic sensitivity of *Pseudomonas aeruginosa* and *Acinetobacter* spp. to ciprofloxacin was respectively 43% and 11%, to gentamicin 50% and 22%, to imipinem 86% and 44%, to meropenem 78% and 44%, to tobramycin 86% and 55%, to piperacillin-tazobactum 50% and 44% and to tigecycline 93% and 67%. These results were compared to the studies by M. Bubonja-Sonje *et al*.[30] and J. A. Labarca *et al*.[31] where a resistant pattern for carbapenems, aminoglycosides and ciprofloxacin and high sensitivity to piperacillin-tazobactum was observed. Among the 5 isolates of *Citrobacter* spp. most isolates were found sensitive to all antibiotic groups except β lactam antibiotics (Table 1.).

The 74 isolates of *Staphylococcus aureus* were highly susceptible to linezolid (100%), vancomycin (100%), teicoplanin (97%), gentamicin (95%), amikacin (94%) and oxacillin (92%). A reasonable sensitivity was observed in our study for clindamycin (79%), cloxacillin (76%), cefoxitin (70%), cefazolin (66%), levofloxacin (64%), tetracycline (62%), azithromycin (62%) and erythromycin (60%). A number of isolates were resistant to co-trimoxazole (sensitivity 47%), ciprofloxacin (sensitivity 29%), amoxyclav (sensitivity 28%), ofloxacin (sensitivity 26%), penicillin G (sensitivity 9%) and ampicillin (sensitivity 0%) (Table 2).

A high sensitivity of *Staphylococcus aureus* isolates in our study to linezolid, vancomycin, teicoplanin, gentamicin and amikacin was in complete agreement with studies by Bibi S *et al*.,[32] Shamsuzzaman A *et al*.,[33] Gautam R *et al*.,[34] and Shriyan A *et al*.[35] The high percentage of resistant isolates of *S aureus* to ofloxacin was in sharp contrast to the 76.6% sensitive isolates in a study by Emmanuel O.N. *et al*.[36] though comparative figures were obtained in the same study in reference to gentamicin. The low percentage sensitivity of *S aureus* observed in the present study against cotrimoxazole, ciprofloxacin, chloramphenicol, penicillin G and ampicillin was in concordance with the studies done by Ndip R.N. *et al*.,[37] Obiazi HAK *et al*.,[38] and Naik D *et al*.[39]

Of all the 74 isolates of *Staphylococcus aureus*, 22 isolates (30%) were found resistant to methicillin. This was in slight discordance to the study by Dryden *et al*.[40] where MRSA was found to be a major cause of soft tissue infections in hospitalized patients but was in concordance to the prevalence rate of 34.7% in a study by Taiwo SS *et al*.[41] However, much lesser prevalence rates were found in Europe in study by Denton M *et al*.[42] and a high prevalence of 83% MRSA was reported from Pakistan.[43] This clearly reflected a high geographical variations in prevalence of methicillin resistance.

Of the 197 isolates, 124 (62.94%) isolates were observed multidrug resistant (resistance to two or more antimicrobial classes). This was in line with the 85% multidrug resistant isolates in a study done by Mohammedaman Mama *et al*.[24] and some other studies.[44,45] This may directly be linked with injudicious use of antimicrobial agents by self prescription and over prescriptions, unavailability of diagnostic laboratory facilities and stewardship programmes.

Conflict of Interest: The authors declare that they have no conflict of interests.

Conclusion

Abscess formation is one of the most common and significant complications of post intramuscular injection procedure and can occur as a result of unclean and inappropriate techniques. Most commonly the therapeutic agents are delivered in the gluteal region that may be contaminated by the gut flora including *E coli*, *Klebsiella* spp., and *Citrobacter* spp. A large part of abscesses are caused by *Staphylococcus aureus* which may be present on normal skin and nonfermenters like *Pseudomonas aeruginosa* and *Acinetobacter* spp. which are widely prevalent in the hospital environments. Most of the strains of these bacteria causing pyogenic abscesses are multidrug resistant and emphasize the need for their continuous surveillance of antibiotic sensitivity pattern with a view to selecting appropriate antibiotic therapy.

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