

## A comparative study of post injection bacterial isolates in deltoid and gluteal abscesses in a tertiary care hospital in Kashmir

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### Abstract

Abscess formation is one of the most common complications of intramuscular injections, a procedure routinely performed in the hospital settings. Though the incidence of such complications is low among the overall recipients of intramuscular injections, it may cause considerable morbidity among those who suffer such complications. In our study, all patients with post intramuscular injection abscess at gluteal and deltoid region were compared for a difference in the patterns of the causative organisms at these two sites. Thus a retrospective analysis of cases was done in reference to the past seven years. It was observed that *Staphylococcus aureus* was the most common organism at the two sites. However *Escherichia coli* was isolated only from the gluteal region.

**Keywords:** Gluteal abscess, Deltoid abscess, Complications, Intramuscular injection.

### Introduction

Intramuscular (IM) injection has been a common method of parenteral drug administration for more than a century. Improperly administered intramuscular injections have often led to patient complications, validated by numerous reports in the literature.<sup>1-3</sup> These complications commonly include skeletal muscle fibrosis and contracture,<sup>4-6</sup> abscess at the injection site,<sup>7-9</sup> gangrene<sup>6,10,11</sup> and nerve injury.<sup>12</sup> The incidence of developing a complication from intramuscular injection ranges from 0.4 to 19.3%.<sup>1,13</sup> These complications, categorized broadly into infectious and non infectious could range from being trivial to seriously jeopardizing the life of the recipient. Non infectious complications include damage to the important nerves and vessels around the site of injection. A significant number of important nerves and vessels pass through the dorso-gluteal region and become vulnerable. However such injuries in gluteal area in particular may be prevented by the correct injection techniques.<sup>14,15</sup> Abscess formation is one of the most common complications of unsterile and improper injection techniques and is defined as a localized collection of pus at the site of injection.<sup>16</sup> In a study from Iraq about 60% of patients with gluteal abscess as a complication of intramuscular injection were suffering from co-morbid conditions like diabetes mellitus, malignancy and jaundice and were hospitalized.<sup>17</sup> In most cases pus formation is septic and results from infection with a single or polymicrobial species. However in some cases no organism can be grown or detected in the pus sample. Such sterile abscesses may result from introduction of irritants like drugs by means of injection techniques<sup>1</sup> or by injudicious empirical therapies. The complications of abscess formation after intramuscular injections may be the result of improper injection techniques, contaminated vials or unsterile injection practices or a combination of all these factors.<sup>1,16</sup> In the present study an attempt was made to analyze the etiological spectrum of organisms causing infections at two sites i.e. gluteal and the deltoid region. A retrospective study

of all the cases of post intramuscular injection abscesses registered in this institute over the past seven years was done. A comparison of the etiological bacteria at the two respective sites was done and the frequency of occurrence of the individual bacteria at these sites was compared.

### Aims and Objectives

Following are the main aims of carrying out the current study:

1. To study the bacteriological profile of post intramuscular injection abscesses at the two common sites of intramuscular injections viz gluteal and deltoid.
2. To compare the bacteriological profile at the two injection sites.

### 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 Type

This is a retrospective observational study.

#### Study Period

Seven years period from January 2012 to December 2018.

#### Samples

Pus samples from abscesses in gluteal and deltoid areas from patients presenting in outpatient or in patient departments of Sher-i-Kashmir Institute of Medical Sciences (SKIMS) medical college as cases of post intramuscular injection failure.

#### 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 assigned an appropriate laboratory number.

2. These were subjected to direct microscopy after Gram staining technique.
3. This was followed by inoculation on routine laboratory culture media including blood agar, MacConkey agar and Chocolate agar.<sup>18</sup>
4. All inoculated culture plates were kept for an overnight incubation at 37°C and were looked for any observable growth the next day. 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.
5. The presumptive evidence of a particular bacterial group was put to confirmation by various spot tests and biochemical tests<sup>19</sup> followed by drug sensitivity testing on Mueller Hinton Agar by Kirby Bauer technique.<sup>20</sup>
6. No growth obtained even after 48 hours of incubation on these media were labeled as sterile pus and were included in the study.

### Observations and Results

A total of 241 cases of abscess formation post intramuscular injection were noticed over a seven year period from January 2012 to December 2018. This included 183 pus samples from gluteal region and 58 pus samples from the deltoid region. A year wise study of abscesses from two different injection sites was made for a comparison of etiological bacteria. A significant difference between pathogenic bacteria isolated from pus culture from gluteal and deltoid regions was found during each year. *Escherichia coli* was noted to be the most frequent pathogen isolated

from 80 pus samples all of which were obtained from the gluteal region. This was followed by 74 *Staphylococcus aureus* isolates of which 44 were isolated from pus samples taken from gluteal abscesses and 30 from pus samples taken from abscesses in the deltoid region post intramuscular injection. *Pseudomonas* spp., *Klebsiella* spp., *Acinetobacter* spp., *Citrobacter* spp., *Enterococcus* spp. and *Proteus* spp. were the less frequent isolates. Culture media showed no growth after 48 hours incubation in 44 pus samples that were labeled as sterile. Of these sterile pus samples, 28 were obtained from gluteal region and 16 from deltoid region. However keeping in view the far lesser number of pus samples from the deltoid abscesses included in our study compared to the gluteal abscesses, the lesser number of sterile pus samples from deltoid region was still significant (27.5%).

A year wise segregation of results of our study is given in Table 1.

Out of these 241 samples 77 samples (31.9%) were positive on microscopy following the Gram staining techniques. Of the 14 *Pseudomonas* isolates, 8 isolates were obtained from pus samples taken from deltoid region and 6 isolates were obtained from pus taken from gluteal region. *Acinetobacter* spp. was isolated from nine samples of which 6 pus samples were taken from gluteal region and 3 from deltoid region. The *Klebsiella* species were isolated from nine pus samples from gluteal region and one pus sample from the deltoid region. 5 *Citrobacter* spp., 3 *Proteus* spp. and 2 *Enterococcus* spp. were isolated during the entire study period and all the pus samples were taken from post intramuscular injection gluteal abscesses signifying the role of gut contaminants in causing these abscesses.

**Table 1:** Bacterial profile of post IM injection abscess from 2012 to 2018.

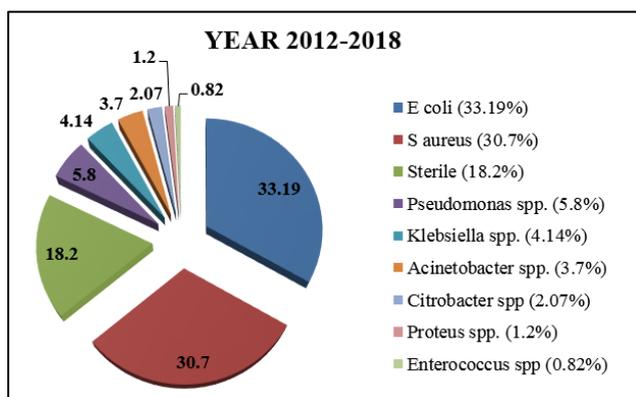
Year	Year 2012	Year 2013	Year 2014	Year 2015	Year 2016	Year 2017	Year 2018	Total	Gluteal	Deltoid
Total pus samples	31	32	25	39	33	36	45	241	183	58
<i>Escherichia coli</i>	10	12	08	11	14	17	08	80	80	00
<i>Staphylococcus aureus</i>	07	10	04	13	12	14	14	74	44	30
<i>Pseudomonas</i> spp.	07	01	01	03	00	01	01	14	06	08
<i>Klebsiella</i> spp.	01	01	02	03	01	00	02	10	09	01
<i>Acinetobacter</i> spp.	01	02	03	02	01	00	00	09	06	03
<i>Citrobacter</i> spp.	00	00	02	01	00	01	01	05	05	00
<i>Enterococcus</i> spp.	00	01	01	00	00	00	00	02	02	00
<i>Proteus</i> spp.	01	00	00	01	01	00	00	03	03	00
Sterile	04	05	04	05	04	03	19	44	28 (15.3%)	16 (27.5%)

**Table 2:** Demographic patterns associated with seven years collection of pus samples from post intramuscular injection abscesses from gluteal and deltoid areas.

Age group	Males (IPD)	Males (OPD)	Females (IPD)	Females (OPD)
0-10 years	9	3	14	2
10-20 years	12	6	11	5
20-30 years	17	9	18	4
30-40 years	16	6	12	4
40-50 years	12	5	12	2
50-60 years	7	5	12	3
60-70 years	8	5	9	2
Above 80 years	3	2	5	1
Total	84	41	93	23

As can be observed from table 2, there is not much difference in the frequency of occurrence between the two genders in IPD patients but males are affected almost twice as common compared to females visiting the out patient department.

Following is the graphical representation of the data depicting the bacterial profile observed during seven years in reference to the two major sites of intramuscular injections viz gluteal region and the deltoid region.



**Fig. 1:** A seven year distribution of bacterial isolates from post injection abscesses at the gluteal and deltoid regions.

#### Data Analysis

Appropriate descriptive statistical methods helped in analyzing the collected data and the results were generated. Chi-Square test of association was used for the purpose. This test utilized a contingency table to analyze the data. Statistical independence or association between pus samples from two sites relative to the bacteria was thus projected.

The P-values calculated for the individual pathogens isolated suggest the statistical significance of *Escherichia coli*, *Klebsiella spp.*, *Acinetobacter spp.*, *Citrobacter spp.*, *Enterococcus spp.* and *Proteus spp.* in gluteal abscesses. On the other hand *Staphylococcus aureus* and *Pseudomonas aeruginosa* was found significantly in both these sites.

#### Discussion

Different routes of drug administration including oral, parenteral and topical are chosen for therapeutic drug benefits to the patients.<sup>21</sup> Among the various methods of parenteral drug administration, intramuscular injection is one of the most common methods used for delivering the therapeutic drug to the patient.<sup>15</sup> This procedure is not free from complications that are found to occur at an incidence ranging from 0.4% to 19.3%.<sup>1</sup> These complications may vary in severity from local infectious complications such as abscesses, intra-articular infections and dermal necrosis to some rare progressions to generalized septicemia and multi-organ failure.<sup>22</sup> In our study the total number of patients receiving intramuscular injections was 10567 with 241 registered cases of post intramuscular abscess formation. Thus 2.28% of those who received intramuscular injections developed abscess at the injection site. The incidence range of all complications mentioned was well within the

concordance range of the study done by Greenblatt. In his same study of post intramuscular injection complications, the incidence of abscess formation was noticed to be 31% by Greenblatt *et al.*<sup>1</sup> In our study a total of 241 cases of abscess formation was noticed among 735 recorded cases who had received intramuscular injections and developed one or the other complication afterwards including muscle contracture, nerve injury, pyomyositis, septicemia and abscess formation. Thus the incidence of abscess formation was noticed to be 32.78% that was in accordance with the study by Greenblatt *et al.* The high incidence of abscess formation post intramuscular injection emphasizes the need for both the training of the nursing staff and the paramedics for improved skills of the technique and improved infection control policies.

The bacteriological profile observed in our study for a seven years period clearly indicated *Escherichia coli* as the leading pathogen causing abscess formation in the gluteal region (approx 44%) followed by *Staphylococcus aureus* (approx 24%) and *Klebsiella spp.* (approx 5%) among the total of 183 pus samples received from the gluteal area. Pus samples from gluteal region showed growth of 5 *Citrobacter spp.*, 3 *Proteus* species and 2 *Enterococcus spp.* However tests for identification from the culture growths of 58 pus samples from deltoid region clearly indicated *Staphylococcus aureus* as the most frequent isolate (52%) followed by *Pseudomonas aeruginosa* (14%) and *Acinetobacter spp.* (5%). Not a single isolate of *Escherichia coli*, *Citrobacter spp.*, *Proteus spp.* or *Enterococcus spp.* could be recovered from pus samples from deltoid region. The 100% isolation of these organisms from the gluteal abscesses clearly indicated discrepancy in maintaining the sterile injection practices with the possibility of contamination with the perianal flora in the gluteal region. These organisms constitute the normal flora of our gut. *Staphylococcus aureus* was isolated frequently from both the areas. A few studies on *Staphylococcus aureus* clearly indicate it to be one of the most common causes of pyogenic skin and soft tissue infections.<sup>22,23</sup> A few of the cases of intramuscular injection abscesses caused by *Staphylococcus aureus* may proceed to cause septicemia.<sup>24</sup> In other group of patients *S aureus* led to acute infection of skeletal muscles termed pyomyositis.<sup>25</sup> *Staphylococcus aureus* is normally present on the human skin and has an array of significant virulence factors causing life threatening complications that leads to increased morbidity and mortality.

In our study 18.2% of pus samples showed no growth of facultative anaerobic/aerobic organisms that could be either due to the abscess caused by anaerobes or use of broad spectrum antibiotics. A significantly higher incidence of pus with no growth from deltoid region (27.5%) compared to gluteal region (15.3%) indicates a much greater rates of contamination of gluteal region by the gut and perianal flora. These abscess causing bacteria may extend to blood and other sterile sites causing much severe complications and significantly raising the cost of health budget. According to one study, more than 1.3 million deaths annually are caused by unsafe injection practices and

this increases the direct medical costs in health sector by \$535 million every year.<sup>26</sup>

### Conclusion

Abscess formation is a common occurrence among the complications of intramuscular injections that are mostly given in the gluteal and deltoid regions. This is most often the result of poor antiseptic practices in combination with improper administration of injections and can be minimised by means of sterile competent techniques. Organisms that inhabit human gut may contaminate the perineal area giving rise to abscesses after intramuscular injections in gluteal region. This emphasizes the need of following strict sterile precautions while delivering drugs through this route. The injection procedures must be done at this site only once there is an absolute indication.

**Conflicts of Interest:** None.

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**How to cite this article:** Kohli A, Yusuf R, Rashid A, Qayoom S, Khursheed S. A comparative study of post injection bacterial isolates in deltoid and gluteal abscesses in a tertiary care hospital in Kashmir. *Indian J Microbiol Res* 2019;6(2):146-9.