A SURVEY OF BACTERIAL INFECTIONS IN THE SURGICAL INTENSIVE CARE UNIT

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SYNOPSIS

During the period January 1977 to June 1977, a total of 56 patients were admitted to the Surgical Intensive Care Unit. The bacterial cultures of these 56 patients obtained from bronchial secretions, abdominal swaps and wound swaps were studied. Usually more than one cultures were obtained from each source. 124 cultures were obtained from the bronchial secretions. 55.6% grew Pseudomonas Aeruginosa. 46.7% grew Klebsiella pneumoniae. 95.6% of the Pseudomonas cultured were sensitive to Gentamycin and Polymyxin B. 71% were sensitive to Carbenicillin. In vitro sensitivity test showed 89.6% of the Klebsiella grown to be sensitive to Gentamycin. 74.1% were sensitive to Kanamycin and 70.6% sensitive to Cephaloridine.

Fourteen cultures were obtained drom peritoneal swaps taken at the time of laparotomy. 57.1% grew Klebsiella and 42.9% grew E. Coli. 75% of the Klebsiella cultured were sensitive to Gentamycin, Cephaloridine and Kanamycin. Only 50% were sensitive to Ampicillin.

Swaps taken from infected wounds grew a large variety of organisms. The main organisms were Klebsiella, Pseudomonas, E Coli and Staphyloccoccus pyogenes. Wounds infected with Pseudomonas were all sensitive to Polymyxin B. 86.7% were sensitive to Gentamycin. Only 23% of wounds infected with E Coli were sensitive to Ampicillin. 70% of wounds infected with Staphylococcus pyogenes were sensitive to Rifampicin.

INTRODUCTION

The Surgical Intensive Care Unit started in June 1975 and since then a total of 336 patients have been nursed in the Intensive Care ward. Majority of these patients were admitted because they required respiratory support. A small minority were admitted for ECG monitoring. Those who required intermittent positive ventilation either had clinical and radiological signs of chest infec-

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tions or after a period of respiratory support in the ICU, the routine culture of bronchial secretions grew various organisms. This survey was taken with the aim of finding the common infective organisms and their in-vitro sensitivity to the various antibiotics. As majority of the patients had undergone some form of surgery, bacterial cultures of swaps taken from the peritoneal cavity and from the skin wounds were also studied.

MATERIAL

From January 1977 to June 1977 a total of 56 patients were admitted to the Surgical Intensive Care Unit. The bacterial cultures of these patients were studied.

METHOD

On admission to the Intensive Care unit, bronchial secretions were obtained by suction through the endotracheal tube. Subsequently, cultures were sent at least once a week and sometimes more frequently, to detect any changes in the infective organisms or its sensitivity to the antibiotics in used.

RESULTS

Of the 56 patients that were admitted, 124 positive cultures were obtained. The results are shown in Table 1. 55.6% of the cultures grew Pseudomonas aeruginosa and 46.7% grew Klebsiella pneumoniae. The other organisms isolated included the Proteus species, Staphylococcus pyogenes and E Coli.

TABLE 1: Bacterias isolated from Bronchial Secretions

Organisms	No of cultures	Percentage
Pseudomonas aeniginosa	69	55.6
Klebsiella pneumoniae	58	46.7
Proteus	26	22.6
Staphylococcus pyogenes	24	19.3
Acinetobacter	11	9.5
E Coli	5	4.3
Enterobacter species	3	2.6
Group D streptococcus	1	0.86

The in-vitro sensitivity to antibiotics of these organisms are shown in Tables 2, 3, 4, and 5. 95.6% of the Pseudomonas aeruginosa grown were sensitive to Gentamycin and Polymyxin b. Those that were not sensitive to Gentamycin were sensitive to Polymyxin B. There was no culture that was resistant to both Polymyxin B and Gentamycin. 71% of the cultures were sensitive to Carbenicillin.

The Klebsiella species was sensitive to the antibiotics shown in Table 3. 89.6% of the Klebsiella grown were sensitive to Gentamycin. Those not sensitive to Gentamycin were sensitive to Kanamycin or Cephaloridine. The in vitro sensitivity of Proteus species and Staphylococcus pyogenes are shown in Table 4 and in Table 5.

Pseudomonas aeruginosa possess little power of initiating infection by itself. Hence both Klebsiella and Pseudomonas are often isolated from patients who have pre-existing chest infection and are frequently already being treated with Ampicillin for several days. By the time such patients are transferred to the Intensive Care Unit for respiratory support they should be started on Gentamycin rather than wait for culture and sensitivity results.

Fourteen positive cultures were obtained from swaps taken from the peritoneal cavity at laparotomy.

TABLE 2: In Vitro Sensitivity of Pseudomonas to Antibiotics

Antibiotics	No of cultures	Percentage
Gentamycin	66	95.6
Polymyxin B	66	95.6
Carbenicillin	49	71
Streptomycin	17	27
Kanamycin	1	1.6
Tetracycline	1	1.6

TABLE 3: In Vitro Sensitivity of Klebsiella to Antibiotics

Antibiotics	No of cultures	Percentage
Gentamycin	52	89.6
Kanamycin	43	74.1
Cephaloridine	41	70.6
Tetracycline	26	44.8
Streptomycin	23	45.0
Polymyxin	5	9.8
Bactrim	3	5.17
Ampicillin	2	3.4

TABLE 4: In Vitro Sensitivity of Proteus to Antibiotics

Antibiotics	No of cultures	Percentage
Kanamycin	26	100
Gentamycin	25	96.2
Streptomycin	22	84.6
Cephaloridine	21	80.8
Ampicillin	20	76.9
Carbenicillin	18	69.2
Bactrim	2	7.7
Polymyxin B	1	3.8

TABLE 5: In Vitro Sensitivity of Staphylococcus pyogenes to Antibiotics

Antibiotics	No of cultures	Percentage
Rifampicin	16	65.2
Cephaloridine	10	43.5
Bactrim	10	39.1
Lincomycin	8	30.4
Methicillin	6	26.1
Erythromycin	4	17.4
Gentamycin	2	8.7
Streptomycin	2	8.7

TABLE 6: Bacterias isolated from Peritoneal Cavity

Organisms	No of cultures	Percentage
Klebsiella	8	57.1
E Coli	6	42.9
Pseudomonas	4	28.6
Proteus	3	21.4
Staphylococcus pyogenes	2	14.2
Anaerobic streptococcus	1	7.1
Enterobacter	1	7.1

The organisms that were isolated are shown in Table 6. Not surprisingly, the two commonest organisms grown are the Klebsiella species and E Coli; both of which belong to the coliform group of commensal intestinal bacteria. Pseudomonas infection occurs as a secondary invader. The in vitro sensitivity of these organism to the various antibiotics are shown in Tables 7, 8, 9, and 10.

TABLE 7: In Vitro Sensitivity of Klebsiella to Antibiotics

Antibiotics	No of cultures	Percentage
Gentamycin	6	75
Cephaloridine	6	75
Kanamycin	6	75
Polymyxin B	4	50
Streptomycin	4	50
Tetracycline	4	50
Bactrim	2	25
Amikacyn	2	25

TABLE 8: In Vitro Sensitivity of E Coli to Antibiotics

Antibiotics	No of cultures	Percentage
Gentamycin	6	100
Cephaloridine	6	100
Kanamycin	4	66.7
Ampicillin	3	50.0
Streptomycin	2	33.3
Tetracycline	2	33.3

TABLE 9: In Vitro Sensitivity of Pseudomonas to Antibiotics

Antibiotics	No of cultures	Percentage
Gentamycin	4	100
Polymyxin	4	100
Carbenicillin	2	50
Amikacyn	1	25

TABLE 10: In Vitro Sensitivity of Proteus to Antibiotics

Antibiotics	No of cultures	Percentage
Gentamycin	3	100
Kanamycin	3	100
Streptomycin	3	100
Ampicillin	1	33
Cephaloridine	1	33

The Klebsiella species isolated from the peritoneal cavity showed the same sensitivity to antibiotics as those isolated from the endotracheal tube, namely Gentamycin, Cephaloridine and Kanamycin. All the E Coli isolated were sensitive to Gentamycin and

Cephaloridine and only 50% were sensitive to Ampicillin. When superinfection with Pseudomonas or Proteus organisms occur they were all sensitive to Gentamycin.

Thus, in cases of peritonitis or any inflammation of the abdominal organs treatment with Ampicillin would be effective in only 50% of cases. For the others the antibiotics of choice would be Gentamycin.

Thirty-six positive cultures were obtained from infected wounds. The organisms cultured Klebsiella, Pseudomonas, E Coli, Staphylococcus pyogenes, Proteus, Group D Streptococci, Acinetobacter Calcoaceticus and Achromobacter. The frequency at which these organisms are isolated is shown in Table 11. The antibiotics to which these organisms are sensitive to are shown in Tables 12, 13, 14, 15 and 16. Wounds infected with Pseudomonas were all sensitive to Polymyxin B. 86.7% were sensitive to Gentamycin. Frequently, patients who have a tracheostomy done and has Pseudomonas chest infection would also have their tracjeostomy wound infected with Pseudomonas. In such instances, Polymyxin B cream or Rikospray anti-

TABLE 11: Bacterias isolated from Infected Wounds

Organisms	No of cultures	Percentage
Klebsiella	15	41.6
Pseudomonas	15	41.6
E Coli	13	36.1
Staphylococcus pyogenes	10	27.0
Proteus	5	13.8
Acinetobacter calcoaceticus	2	5.5
Achromobacter	2	5.5
Gram negative bacilli	1	2.7
Group D streptococci	1	2.7

TABLE 12: In Vitro Sensitivity of Klebsiella to Antibiotics

Antibiotics	No of cultures	Percentage
Gentamycin	10	66.7
Cephaloridine	10	66.7
Kanamycin	10	66.7
Tetracycline	9	60
Streptomycin	6	40
Polymyxin	5	33
Amikacyn	3	20
Ampicillin	1	6.7
Bactrim	1	6.7

TABLE 13: In Vitro Sensitivity of Pseudomonas to Antibiotics

Antibiotics	No of cultures	Percentage
Polymyxin B	15	100
Gentamycin	13	86.7
Carbenicillin	8	53.3
Amikacyn	6	40
Streptomycin	2	13.3

TABLE 14: In Vitro Sensitivity of E Coli to Antibiotics

Antibiotics	No of cultures	Percentage
Gentamycin	11	84.6
Cephaloridine	8	61.5
Kanamycin	8	61.5
Ampicillin	3	23.0
Tetracycline	1	7.7

TABLE 15: In Vitro SEnsitivity of Staphylococcus Pyogenes to Antibiotics

Antibiotics	No of cultures	Percentage
Rifampicin	7	70
Bactrim	5	50
Cephaloridine	3	30
Methicillin	3	30
Lincomycin	3	30
Erythromycin	1	10
Streptomycin	1	10
Tetracycline	1	10

TABLE 16: In Vitro Sensitivity of Proteus to Antibiotics

Antibiotics	No of cultures	Percentage
Gentamycin	5	100
Cephaloridine	4	80
Kanamycin	4	80
Ampicillin	2	40
Streptomycin	2	40

biotic could be applied. Rikospray antibiotic is an aerosol spray containing Neomycin sulphate, Zinc Bacitracin and Polymyxin B.

DISCUSSIONS

The present study has shown that the two most common organisms infecting the chest in patients nursed in the Surgical Intensive Care Unit are Pseudomonas aeruginosa and Klebsiella pneumoniae. Pseudomonas aeruginosa is an aerobic gram negative non-sporing rod. Klebsiella pneunoniae belong to the Coliform group of commensal intestinal bacteria and which not infrequently is found both as commensals and as pathogens in the respiratory tract. In a 30 month study of Pseudomonas infection in the respiratory-surgical Intensive Care Unit of the Beth Israel Hospital, Stevens and colleagues found that where Pseudomonas was the sole pathogen in cases of pneumonia, the mortality rate was 73%. Where Pseudomonas was not the only pathogen grown but was associated with moderate to abundant numbers of any pathogens, either gram-negative, gram-positive or both, the mortality was 68%. Patients with pure Klebsiella pneumoniae had a mortality of 33%.

Out of the 56 patients that we studied, 53 patients had penumonia together with other associated surgical conditions. 14 of these patients died. One patient died of paraquant poisoning. 3 patients died of head injuries 1 patient died of myocardial infarct. 5 patients died from scepticaemia as a result of infection within the abdominal cavity. There was a case of scepticaemia from empyema of the gall bladder. 3 patients had repeated laparotomies from breakdown of gut anastomosis and one child died from scepticaemia resulting from gastroenteritis. Thus only four died from bronchopneumonia. Out of these, 1 patient's endotracheal secretions grew only Klebsiella organism. 1 patient had pseudomonas pneumonia and 2 patients had a combination of pseudomonas and Klebsiella infection. All these 4 patients were on Gentamycin and Ampicillin.

The important components of the respiratory tract's defence mechanisms are:

1. The cough reflex.
2. The mucociliary esclator network.
3. The alveolar macrophage defence network.

In a patient who is intubated, the cough reflex is suppressed. Frequent tracheal toilet can damage the delicate ciliary epithelium and in patients with chronic bronchitis, areas of ciliated epithelium undergo squamous metaplasia and uncoordinated ciliary activity. The very ill patients who requires Intensive Care nursing often have neligible alveolar macrophage defence network. Hence such patients are very susceptible to colonisation by the aerobic gram negative rods. This study have shown that in vito, Pseudomonas aeruginosa is most sensitive to Genramycin and Polymyxin B. There were only 3 cultures grown which were not sensitive to both Gentamycin and Carbenicillin, whereas 30% of the Pseudomonas cultured were resistant to Carbenicillin. Gerald P. Bodey and colleagues in a study on Carbenicillin therapy for Pseudomonas infections found that 7% of Pseudomonas infections responded only partially to Carbenicillin, 10% relapsed when therapy was discontinued and 7% became resistant during Carbenicillin therapy. Klebsiella pneumoniae is also highly sensitive to Gentamycin. The other antibiotics to which it is sensitive to are Kanamycin and Cephaloridine.

In abdominal infections, the most common causative organisms are Escherchai coli and Klebsiella pneumoniae. They are most sensitive to Gentamycin and Cephaloridine. Only 50% of the E Coli grown was sensitive to Ampicillin. Thus any surgical patients who have peritonitis and is not responding to Ampicillin should be started on Gentamycin.

Swaps taken from infected wounds grew a large variety of organisms. The main organisms were Klebsiella, Pseudomonas, E Coli and Staphylococcus pyogenes. Wounds infected with Pseudomonas were all sensitive to Polymyxin B. 86.7% were sensitive to Gentamycin. Only 23% of wounds infected with E Coli were sensitive to Ampicillin. 70% of wounds infected with Staphylococcus pyogenes were sensitive to Rifampicin.

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