

A comparative analysis of irrigation between Povidone iodine and ciprofloxacin in chronic chest empyema patients

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Citation this Article: Dr. Rajesh Vaswani, Dr. Ankit Kumar, Dr. Shahid Hussain, “A comparative analysis of irrigation between Povidone iodine and ciprofloxacin in chronic chest empyema patients”, IJMSIR- March - 2021, Vol – 6, Issue - 2, P. No. 314 – 323.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Background: Empyema is a condition in which pus gathers in the pleural space. Bacterial, fungal and sometimes mixed infection are the causative agents. Proper history taking, thorough clinical examination, repeated chest skiagrams, thoraco-centesis and pus for microscopic examination and culture are useful tools in making the final diagnosis. Sputum for Acid-Fast-bacilli with culture and sensitivity, ultra-sonography and CT scan chest are necessary. The objective of this study is to compare the effect of povidone iodine and ciprofloxacin irrigation in chronic chest empyema patients without bronchopleural fistula and then response in relation to morbidity, stay in hospital and also the residual function and to prevent chronicity and eradication of infection.

Method: A Prospective study of all case of chronic chest empyema patients at New Medical College Hospital, Kota from 2016 to 2018. Study of all 45 case in which 15 case were irrigated with povidone iodine, 15 case were irrigated with ciprofloxacin and 15

patients as control group. In case of povidone-iodine we allow the solution to remain inside the empyema cavity for 15 to 30 minutes, while in case of ciprofloxacin we allow the solution to remain inside the empyema cavity for 2 hours.

Results: There was male predominance in both control and study group. Staphylococcus was the Commonest invader among both groups and Second organism was Pseudomonas. Improvement in saturation and air entry was much faster in study groups, and we observed that chest tube was also removed earlier in study group patients. The clinical improvement was fast in study group as compared to control group.

Conclusions: Patients who were irrigated with ciprofloxacin have low morbidity and early discharge to hospital compared to patient irrigated with povidone iodine.

Keywords: Povidone Iodine, Ciprofloxacin, Chest empyema, Irrigation.

Introduction

Collection of pus in pleural space known as Empyema thoracic. It is almost invariably unilateral, if whole of pleural cavity is filled with pus then it is termed total empyema and seldom it is localised/ loculated/ encysted.⁸

Initially in 1930s, and 1940s before the resurgence of antibacterial agent pleural empyema was usual complication of pneumonic bacteria but with the development of antibiotic the complication reduced to one percent. The common bacterial causative agents including pneumococci, streptococci, staphylococci, Klebsiella, pseudomonas, E. coli, mycobacterium tuberculosis and anaerobic bacteria strains. Sometimes few of Fungi are also responsible for it. Mixed infection is acquired when there is open communication of pleural space from the outside as in case of trauma, Broncho-pleural fistula, and externally drained empyema.

Most common cause of empyema thoracic including following lung abscess, thoracocentesis, ruptured subdiaphragmatic abscess, ruptured, mediastinal nodes, para sternal abscess, ruptured oesophagus (either spontaneously or iatrogenic) (Takaro et al 1977).⁷

Empyema is a serious condition particularly in children, old age, and debilitated persons. Correct etiological and bacteriological diagnosis is important. Carefully taking history thorough clinical examination, repeated chest skiagram in PA and Lateral views, thoraco-centesis and examination of pus for microscopic examination and Pus culture. Sputum for Acid-Fast-bacilli with culture and sensitivity, ultra-sonography and CT scan chest are necessary.

The American thoracic society (1962) has classified empyema into three phases based on the natural history of the disease.

1. Acute phase or exudative phase:

Acute phase is also termed as exudative phase which is characterised by pleural fluid with low viscosity and low cell count. Here the lungs are expandable [reversible phase] (Takaro et al 1977).⁷

2. Transitional phase or Fibrino-purulent phase:

Because of increased cell content i.e. polymorphonuclear leucocytes. The fluid become turbid, fibrin is deposited on both pleural surfaces causing pleural thickening, that prevents extension of the empyema and also begins to trap and fix the lung expansion, that's why it is called Fibrino-purulent phase too (Takaro et al 1977).⁷

3. Chronic phase or Organising phase:

There is aggregation of pleural peels with ingrowth of capillaries and fibroblast. The pleural fluid is very turbid. transformation of acute to chronic phase take 4 to 6weeks (Takaro et al 1977).⁷

The treatment of empyema includes 3 objectives.

1. Control of local and systemic infection with specific antibiotic therapy either orally or parenterally.
2. Drainage of the empyema by one of method, selected on the basis of aetiology, stages of empyema etc.

I. Aspiration of pleural fluid i.e. thoracocentesis.

II. Tube thoracostomy and under water inter costal drainage tube.

III. Open flap drainage [pleurocutaneous fistula] and closed rib resection.

3. MAJOR SURGICAL PROCEDURES; - these are advised in lung not expanded after adequate conservative method.

I. Decortication

II. Empyemectomy

III. Obliteration of pleural dead space, it is done with thoracoplasty

Sterilization procedure or irrigation procedure originally described by Clagett and Garaci 1963.¹ They irrigated empyema patients with the use of Dakin's solution that is 5% aqueous sodium hypochlorite. He reported a new method of sterilization used in post pneumonectomy empyema which later on modified by Dietor 1970³ by treating a patient with a closed tube with neomycin solution. Later on, other solution was also added for irrigation in different operations.

Clagett O.T.² in 1973, described that in pleural empyema, if the empyema cavity contained clotted material that cannot be evacuated efficiently by tube drainage, irrigation of the empyema cavity with saline solutions to liquefy the clotted material and use of appropriate antibiotic determined by bacteriologic findings can result in effective treatment without resorting to any other measures.

In recent years povidone iodine had shown to be a powerful germicidal agent against a various wide range of organisms. It causes little or no pain when applied to open raw wounds and is active in the presence of pus and organic matter (Rabinowitz, 1961). It does not allow the emergence of antibiotic resistant strains as it kills pathogenic organisms in an unselective manner and is apparently effective against antibiotic resistant strains. (Veins S.B., 1971).⁶

Povidone iodine is the iodine antiseptic of choice since it retains all the desirable antimicrobial properties of elemental iodine without any of its disadvantages, even patients allergic to elemental iodine do not react to povidone iodine on patch testing (Shelanski and Shelanski, 1956).⁵

In a laboratory study it was found that haemolytic staphylococcus aureus and pseudomonas aeruginosa were killed after 15 seconds contact with povidone iodine. The germicidal action of povidone iodine

antiseptic solution has been demonstrated up to at least four hours after a single application. Further povidone iodine is not inhibited in the presence of pus.

In a similar study in 1993 Kishor C. Mohanty MD,¹⁰ Tilk M Dhamgaye M.D.⁹ observed that ciprofloxacin is a novel broad-spectrum fluoroquinolone drug and it had showed strong in vitro activity against Gram-negative and Gram-positive organisms, including Mycobacterium tuberculosis and Atypical mycobacterium, including pseudomonas aeruginosa, enterobacterial and staph aureus.^{9,10}

Ciprofloxacin kills bacteria quickly at a concentration 1 to 2 folds higher than its Minimal Inhibitory concentration (MIC). Ciprofloxacin eliminates 99% of bacteria in just 19 minutes.

It has significant post antibiotic effect up to 6 hours and thus prevents regrowth of bacteria. Ciprofloxacin does not disturb normal intestinal flora or vaginal flora and has no significant effect against anaerobes. Bacterial resistance with ciprofloxacin is enormously rare. It has favourable pharmacokinetics effect for systemic and topical use.

Ciprofloxacin is extremely good and the drug reaches therapeutic concentration in most tissues and fluids. Including sputum, bone, peritoneal fluid, prostate, pelvic tissue, it has potent antibacterial activity with rare side effects.^{9,10}

We used ciprofloxacin 200 mg 100 ml intravenous solution for irrigation of the empyema cavity.

The goal of our study is to assess the efficacy of povidone-iodine and ciprofloxacin irrigation of chronic thoracic empyema patients.

Aims and Objectives

1. To compare the effects of Povidone – Iodine and ciprofloxacin irrigation in chronic chest empyema without bronchopleural fistula and then response in

relation to morbidity of stay in hospital and also the residual function.

2. To prevent chronicity and eradication of infections and to reduce duration of hospital stay.
3. To avoid the necessity of major surgical procedure like decortication, empyemotomy and thoracoplasty.

Methods

This study was conducted at General Surgery and Respiratory Medicine ward at New Medical College Hospital, Kota Rajasthan. In our study we selected 45 patients of empyema thoracis in whom frank pus or purulent fluid was aspirated from pleural cavity, out of these 45 cases, 15 cases were subjected to the effect of ciprofloxacin solution and 15 cases treated with povidone iodine and 15 were without irrigation. We exclude the patients having bronchopleural fistula.

A detailed clinical study was made with investigated thoroughly. Routine investigations of blood include HB, TLC, DLC, ESR, Blood Sugar, Blood Urea, total protein, BT, CT etc. Urine examination is done for albumin and Sugar.

Special investigations include sputum studies for acid fast bacilli by concentration method, the consecutive samples were sent for report to be negative, sputum sample was also sent for culture and sensitivity for the bacteriological study and institution of proper therapy.

Statistical analysis

Data was entered in computerised database and was analysed using pertinent statistical tests. The study variable was presented as percentage.

Radiological Investigation

Skiagram of chest PA and lateral views were obtained in all cases to establish the clinical diagnosis and before performing thoracentesis for accurate localization of empyema. Chest X- Rays were also done following

intercostals drainage and then at intervals to see for expansion of lung.

Thoracentesis

It was performed under local infiltration anaesthesia in sitting position of the patient, aspiration was performed from 8th intercostals space in posterior or mid axillary line in all cases with a wide bore needle, introduced into the pleural cavity from the upper border of the lower rib to avoid damage to intercostals vessels and nerves. When pus or purulent material was obtained on aspiration. It was collected in a sterile vial and sent for culture and sensitivity, colony count, and for biochemical examination.

Method of Irrigation

povidone iodine solution is available as 5 per cent povidone iodine, for irrigation we made 2.5 per cent povidone iodine solution by taking 20 ml. of povidone iodine solution and adding it to 20 ml. of normal saline in a sterile bowl and with this solution we irrigated the pleural cavity. The solution is pushed into the pleural cavity with an asepto syringe, the amount of solution depends upon the size to the cavity. After pushing a required amount of solution, we clamp the malecot catheter and allow the solution to remain inside the empyema cavity for 15 to 30 minutes and after that the clamp is taken off and irrigation fluid is taken out and malecot catheter is connected to under water seal drainage bottle through a connecting tube.

Method of Irrigation

Ciprofloxacin solution is available as 100 ml iv solution for irrigating empyema cavity. The solution is pushed into the pleural cavity with an asepto syringe, the amount of solution depends upon the size of the cavity. After pushing a required amount of solution, we clamp the malecot catheter and allow the solution to remain inside the empyema cavity for 2 hours and after that the

clamp is take off and irrigation fluid is taken out and malecot catheter is connected to under water seal drainage bottle through a connecting tube. We exclude

patients having bronchopleural fistula and children having post pneumatic empyema.

Result

In our study we included 45 patients, with male predominance in both control and study group.

Sex	Number of Pt. T/t with in Controlled Group	Pt. Treated with Ciprofloxacin	Pt. Treated with Povidone-Iodine
Male	11	11	12
Female	4	4	3
Total	15	15	15

Table 1: Showing Sex Distribution

In this study we included patients of 11-70 years of age group, more younger Patients in control group than Study group. Both control and study group had equal

numbers of tubercular and pyogenic empyema cases i.e. 10 and 5 cases respectively.

Name of Organism	Control Group No. Percentage	Pt. with Ciprofloxacin No. Percentage	Pt, with Povidone-Iodine No. Percentage
1. Staphylococci	60	60	60
Coagulase +ve	7	6	7
Coagulase -ve	2	3	2
2. Pseudomonas	5 33	6 40	5 33
3. B. Proteus	3 20	5 33	5 33
4. Klebsiella	3 20	4 26.66	5 33
5. E. Coli	3 20	3 20	3 20
6. Sreptococci			
Strep. Hemolyticum	1 13.33	1 20	1 20
Strep. Viridence	1	2	2
7. Pneumococci	2 13.33	3 20	3 20
8. Others	6.66	6.66	6.66
Enterobacteria	Nil	Nil	1
Diphtheria	Nil	Nil	Nil
Aerobacter	Nil	1	Nil
Aerogenes	1	Nil	Nil

Table 2: Frequency of Causative Organisms

Staphylococcus was the Commonest invader among both groups and Second organism was Pseudomonas. The Rarest organism were Enterobacter in both groups

Symptoms	Control Group (in Days)	Pt. with Ciprofloxacin (in Days)	Pt. with Povidone-Iodine (in Days)
Chest Pain	7	3	5
Cough	12	6	9
Dyspnoea	5	2	3
Fever	9	3	5
Anorexia	15	5	7
Malaise	7	3	5
Toxemia	10	3	3
Weight Gain	0-1 kg/week	1-2 kg/week	1-2 kg/week

Table 3: Average Time for Clinical Improvement after Irrigation

The clinical improvement was fast in study group as compared to control group, in study group patients which were irrigated with ciprofloxacin improved earlier than with Povidone- iodine.

Sn.	Symptoms	Control Group with Parental and Oral Antibiotics	Irrigation with Ciprofloxacin	Irrigation with Povidone-Iodine
1	Daily drain output	Average 100-200 very slow reduces	Subside in 7 to 5 days, started decreasing from 5 th day, reduced to about 10ml in 15 days	Drain up to 1 month, drain decreased but slowly reduces in 30-50 ml in 15-30 days
2	Pus i) Amount ii) Color iii) Consistency	Thick Yellow pus in variable amnt.	Thin creamy color pus with significantly decrease amnt.	Thin Yellow color pus with decrease amnt.
3	Surrounding area of Draining Tube	Infected	Healthy	Healthy

Table 4: Local Examination

The drain output and amount of pus were decreases very earlier in both the study group, out of which improvement with ciprofloxacin was quite better than Povidone iodine.

Sn.	Symptoms	Control Group	Irrigation with Ciprofloxacin	Irrigation with Povidone-Iodine
1	SPO2	Variable as chest condition	Markedly Improved with time	Improved with tube
2	Breathlessness	Same as 1 st day of T/t	Improved	Decreased

		increase on exercise		
3	Air Entry	Same as 1 st day	A/E Increased	A/E Increased
4	Xray Findings	Thickened Pleura with Hydropneumothorax emphysema present	Clear lung field with no Hydropneumothorax	Haziness of lung field with no Hydropneumothorax
5	Chest tube removal Duration	Continue drain	1 to 1.5 months converted to empyema tube, small drain often present	2.5 to 3 months, converted into empyema tube

Table 5: Chest Examination

In our study improvement in saturation and air entry was much faster in study groups, and we observed that chest tube was also removed earlier in study group patients.

It is observed that in study and control group we used various oral or iv antibiotics, After Ciprofloxacin, Gentamycin was the antibiotic used most commonly.

Most of the patients in Ciprofloxacin irrigation group required antibiotics for duration of around 1 month. While in Povidone-iodine irrigation group, about half of the patients required antibiotics for more than 1 and half months. In control group patients required antibiotics for longer duration with ATT.

Name of Bacteria	Control Group	Irrigation with Ciprofloxacin	Irrigation with Povidone-Iodine
Pseudomonas Pyocyaneus	4-5 th weeks	2-3 weeks	3-4 weeks
Pseudomonas Aeruginosa	4-5 th weeks		
Staphylococci			
Coagulase +ve	3-4 th weeks	1-2 weeks	6-10 days
Coagulase -ve	3-4 th weeks		10 days
Streptococci			
Strept. Hemolyticus	2-3 weeks	10 days	15 days
Strept. Viridans	2-3 weeks	10 days	15 days
E. coli	2-3 weeks	4-10 days	6-10 days
Klebsiella	2-3 weeks	4-8 days	6-10 days
Diphtheroids	2-3 weeks	5 days	7 days
Enterobacteria	1-2 weeks	4-7 days	10 days
Pneumococci	10 days	3 days	5 days
Aerobacter Aerogenes	-	8 days	10 days

Table 6: Showing Average Time for Negative-Culture

Most of bacteria disappeared in 2 weeks in Ciprofloxacin Irrigation from the cavity and cavity

become sterile in 15 days. It takes 20-30 days in Povidone-iodine.

It was observed that the average Hospital stay was less in Patients Irrigated with Ciprofloxacin rather than in

Povidone-iodine Irrigation.

Treatment	Control Group	Irrigation with Ciprofloxacin	Irrigation with Povidone-Iodine
Intercostal Drainage	All	15	15
De cortication	1	Nil	Nil
Upper Drainage	Nil	Nil	Nil
Thoracoplasty	3	Nil	1

Table 7: Treatment

In Control Group 1 Patient needed decortications, while in Control group 3 patients required Thoracoplasty for their treatment and it is to be noted that all the Thoracoplasties were done in Tubercular Empyema cases. Incidence of mortality decreases in patients with Irrigating Ciprofloxacin and Povidone-Iodine.

Discussion

Pulmonary empyema is still a frequent complication of the underling lung disease in spite of the advent of effective antibiotics. The incidence of empyema reduced with the introduction of antibiotics but after a sharp fall the incidence rise again, as irrational use of chemotherapeutic agents leads to emergence of resistant strains of bacteria.

This study consists of comparative analysis of irrigation between povidone-Iodine and ciprofloxacin in chronic chest empyema. We studied fifteen patients of chronic chest empyema with irrigation with ciprofloxacin and fifteen patients with povidone – iodine and fifteen patients for control study without irrigation.

In all three-group, attempt was made to choose similar type of cases. In each series ten cases of tubercular empyema and five cases of pyogenic empyema were taken.

In our study an effort was made to include similar age group patients, besides comparatively younger age group patients were selected in control group to keep efficacy of results.

The commonest invading organism among all groups was Staphylococcus (60 % study group, 60 % control group), next was pseudomonas in both groups, others were B. Proteus, Klebsiella, E. coli and streptococci in order of frequency. Similar incidence was reported by a study of simmonus E.M. et al ¹² the commonest invading organism was staph aureus in 50 % and pseudomonas in 33 % cases, other organisms were having different incidence.

Patients with ciprofloxacin irrigation shows faster improvement in their symptoms as compared to the povidone –Iodine irrigation. In most of the patient’s toxic symptoms such as fever, tachycardia, dyspnoea, hypotension disappeared in 3 days as compared to povidone –iodine where the time for same was about 7 days. H.R.P. Sinha (1981)¹¹ also observed that fever and pulse settles down faster with the use of ciprofloxacin in empyema case.

Appetite of the patients in ciprofloxacin irrigation group improved after 5 days, the patients show sense of well-being within a week while in povidone –iodine irrigation patients remained apathetic ever after 10 days. There is also a marked difference in the weight gain of the two groups. It is almost 2 to 3 times in ciprofloxacin group compared to povidone- iodine group.

With ciprofloxacin irrigation the pus became sterile on culture in 4-10 days while in povidone – Iodine irrigation it took 2 to 2 and half time more.

Pseudomonas was the most resistant group of bacteria as it took more time to disappear in both groups.

Almost same results were observed by using ciprofloxacin and povidone- iodine in E- coli bacterial eradication.

The oral ciprofloxacin was the commonest antibiotic use in both groups. Aminoglycosides with gentamycin or amikacin either alone or in combination rank the second. Only few patients of control group required other forms of antibiotics e.g. cephalixin, linezolid, ampicillin.

If patients did not have improvement in the symptomatology with these antibiotics then they were switched over to other antibiotic or in combination. The choice of second or 3rd antibiotics was made on the culture and sensitivity report. In the control series it is necessary to switch over to various antibiotics frequently as compared to the study group.

It was observed that in ciprofloxacin irrigation group where the duration of antibiotic therapy is much shorter than in povidone Iodine group.

This shows that ciprofloxacin is major quinolones commercially available for used at present, better absorbability after oral administration and ciprofloxacin irrigation is capable of replacing the antibiotics therapy in empyema cases or wound sepsis duration of antibiotic therapy can be reduced by its use as observed in our present series. Further patient can be saved from the toxic side effects of antibiotics and their high dose. Povidone –iodine has fewer efficacies compared to ciprofloxacin.

When the average length of hospital stay per patient was calculated it comes to 54 days for ciprofloxacin

irrigation group as compared to 84 days for povidone – iodine group. This indicates that irrigation with ciprofloxacin shorten the hospital the stay and the duration of treatment also.

It has been observed that the ciprofloxacin irrigation certainly reduced the need for surgery as in the present series, Povidone – iodine irrigation patient has one thoracoplasty out of 15 patients while in control group three thoracoplasty was done.

The mortality was 6.7 % in study group. There is no mortality was noted in both Povidone- iodine and Ciprofloxacin group.

Conclusion

- The clinical study consisted of comparison between ciprofloxacin irrigation and povidone – iodine irrigation. Each group have 15 patients of chronic chest empyema studied.
- It was tried to take almost similar type of patients in control group in respect of age, sex and etiologically and excluding Broncho pleural fistulas.
- Staphylococci and pseudomonas were the commonest invading organisms in both the series. By using ciprofloxacin irrigation in empyema cavities most of culture stains disappear in 4-10 days. While in povidone – iodine irrigation it took 10-15 days to become sterile.
- There was an earlier symptomatic relief by using ciprofloxacin irrigation as compared with the povidone – iodine irrigation.
- Ciprofloxacin solution reduces drain out put more effectively compared to povidone -Iodine.
- In tubercular empyema's ciprofloxacin irrigation eliminates the mixed infection and makes the cavity sterile, while antitubercular treatment takes care of underlying disease.

- In ciprofloxacin irrigation group out of 15 patients, no one need surgical intervention and no mortality, while in povidone iodine irrigation one patient need surgery and no mortality noted.
- Average hospital stay of pyogenic empyema cases and tubercular empyema in ciprofloxacin irrigation group is less as compared to Povidone – iodine.
- Mortality was reduced both in ciprofloxacin and povidone iodine irrigation patients.

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