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## RESEARCH ARTICLE

# STUDY OF COURSE OF PNEUMOPERITONEUM PRODUCED IN POST OPERATIVE PATIENTS BY SERIAL ERECT X-RAY OF ABDOMEN

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**ABSTRACT**

PNEUMOPERITONEUM is defined as gas in peritoneal cavity. Most common cause of pneumoperitoneum is laparatomy in post operative patients. Among preoperative patients most common cause is hollow viscus perforation exception is appendicular perforation which generally doesn't cause pneumoperitoneum. Other causes of pneumoperitoneum are trauma, tumour, burst abdomen etc. The presence of pneumoperitoneum does not always imply hollow viscus perforation in preoperative patients, some non surgical conditions are also associated with pneumoperitoneum. Also in female patients, air from the genital tract may ascend and cause spontaneous pneumoperitoneum. Pneumoperitoneum produced after hollow viscus perforation or after laparotomy generally remains unilateral initially and becomes bilateral due to movement, patients who remain propped up and immobile generally produced unilateral pneumoperitoneum. Certain operative procedures like dividing the falciform ligament also facilitates even distribution of gas under diaphragm. Unilateral air under diaphragm is more likely to lead to certain complications like subphrenic abscess, basal pulmonary collapse, dehiscence of abdominal wound etc. To avoid these complications, measures leading to bilateral distribution of air is to be encouraged and in this respect, free mobility of patients in early post operative period is important. X-Ray erect abdomen is good tool to study pneumoperitoneum and its course overtime along with CECT abdomen, USG abdomen, X-ray left lateral decubitus. CECT is regarded as criterion standard for detection of pneumoperitoneum, but it is expensive in terms of both radiation burden and cost. Due to change in abdominal and thoracic pressure (2:1), air in the peritoneal cavity moves to subphrenic space even in recumbent position. This study shows 62.5% shows resolution of POPP before 48 hours, 85.8% of post laparotomy shows resolution of POPP before 4th post operative day and 96.7%of cases shows resolution of POPP before 7th post operative day. In elective patients without pre-op peritonitis show early resolution of pneumoperitoneum compare to emergency cases who generally present with pre-op peritonitis. Open drain delay resolution of POPP. Increasing amount of POPP shows post operative disruption of continuity of bowel. Prolonged POPP is due to persistence of intraperitoneal infections/collection.



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## INTRODUCTION

Pneumoperitoneum is defined as gas in peritoneal cavity. Most common cause of pneumoperitoneum is laparatomy in post operative patients. Among preoperative patients most common cause is hollow viscus perforation exception is appendicular perforation which generally doesn't cause pneumoperitoneum. Other causes of pneumoperitoneum are trauma, tumour, burst abdomen etc. The presence of pneumoperitoneum does not always imply hollow viscus perforation in preoperative patients, some non surgical conditions are also associated with pneumoperitoneum. Also in female patients, air from the genital tract may ascend and cause spontaneous pneumoperitoneum. (Bailey and Love's short practice of surgery 26th edition, Maingot's abdominal operations 12th edition; Fishers mastery of surgery 6th edition) Pneumoperitoneum produced after hollow viscus perforation or after laparotomy generally remains unilateral initially and becomes bilateral due to movement, patients who remain propped up and immobile generally produced unilateral pneumoperitoneum. Certain operative procedures like dividing the falciform ligament also facilitates even distribution of gas under diaphragm. Unilateral air under diaphragm is more likely to lead to certain complications like subphrenic abscess, basal pulmonary collapse, dehiscence of abdominal wound etc. To avoid these complications, measures leading to bilateral distribution of air is to be encouraged and in this respect, free mobility of patients in early post operative period is important. X-Ray erect abdomen is good tool to study pneumoperitoneum

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and its course overtime along with CECT abdomen, USG abdomen, X-ray left lateral decubitus. CECT is regarded as criterion standard for detection of pneumoperitoneum, but it is expensive in terms of both radiation burden and cost. Due to change in abdominal and thoracic pressure (2:1), air in the peritoneal cavity moves to subphrenic space even in recumbent position. (Earls *et al*., 1993; Stapakis and Thickman, 1992)

Estimation of absolute amount of air present in peritoneal cavity is difficult.

**Grades of pneumoperitoneum (Josef EFisher *et al*., 1961)**

- Grade 1-upto 100 ml
- Grade 2-100ml to 500 ml
- Grade 3-500ml to 1000ml
- Grade 4->1000ml

A very approximate guide in patient of average built to calculate amount of gas in peritoneal cavity, a layer of air under diaphragm (cm) can help like: (Josef EFisher *et al*., 1961)

1. 3 cm- approx. 500ml
2. 5 cm- approx.1000ml

In post operative patient pneumoperitoneum usually resolves in 3-6 days after surgery, although it may persist as long as 24 days. Reabsorption of free air is expected with time. Two-thirds of cases resolve within 2 days and 97% of cases resolve within 5 days. (Mularski *et al*., 2000; Nielsen *et al*., 1997) Pnuemoperitoneum can affect several homeostatic systems, leading to alterations in acid-base balance, blood gases, and cardiovascular and pulmonary physiology. Although these changes may be well tolerated by healthy individuals, they may increase physiologic stress in patients with pre-existing conditions, placing them at increased risk for perioperative complications. (David B Safran, 1994) Number of days to resolve pneumoperitoneum completely depends on multiple factors like patients general condition, sepsis, early mobilisation etc. Lean adults have a more prolonged postoperative pneumoperitoneum than overweight patients because the bulky panniculus in obese adults restricts the distension of the peritoneal space and thus limits the volume of air collected initially. (Cho and Baker, 1994) Postoperative early mobility of patient enhances the early resolution of pneumoperitoneum. (Josef EFisher *et al*., 1961) Pneumoperitoneum, which is an useful indicator of intra-abdominal pathology in the non-operative patient, is a normal finding in patients in the post-operative period. In post operative patients, a number of potential cause of peritonitis may co-exist, making it difficult whether pneumoperitoneum in post operative patients is pathological or normal. In POPP (post operative pneumoperitoneum) Clinical concern usually relates to whether a pneumoperitonuem is part of the normal postoperative appearance, is due to a perforated viscus or has been induced/ increased by intraabdominal sepsis. A pneumoperitoneum is common after abdominal surgery; it usually resolves 3-6 days after surgery, although it may persist for long time

**Aims and objectives of the study**

1. To find out the normal period of resolution of pneumoperitoneum in post operative patients.
2. To know whether persistence of pneumoperitoneum is associated with any intra abdominal adverse event.

## MATERIALS AND METHODS

**Study design and setting**

This will be a prospective descriptive study of patients admitted and operated at Rajendra Institute of Medical sciences (RIMS) from APRIL 2014 to OCTOBER 2015. Patients underwent laparotomy, resolution of pneumoperitoneum will be observed by serial erect x-ray of abdomen, particularly gas under diaphragm, on POD2, POD4, POD7 and POD10

**(1) Source of data -** patients admitted through OPD, central emergency and operated for abdominal disease at RIMS. Serial erect x-ray of abdomen will be done.

**(2) Methods of collection of data -** data is entered in the Performa made for the study.

**(3) Inclusion criteria -** All patients operated on abdomen at RIMS during the period of study.

**(4) Exclusion criteria**

- Pregnant female
- Known cases of cardiac disease
- Patient with features of SIRS at the time of admission.

**(5) Study tools**

(a) Detailed history
(b) Thorough examination
(c) Necessary investigation
(d) Serial erect x-ray of abdomen on post operative day 2, day 4, day 7 and if needed day 10

**(6) Follow up**

(a) During hospital stay.
(b) Periodic review in OPD

During follow up patients will be examined for : -

- Time for resolution of pnuemoperitoneum
- Post-operative complications and correlation with pnuemoperitoneum
- Duration of hospital stay

**SPL. Methods followed during study**

1. Patient included in this study transferred to x-ray room in wheel chair which takes around 20 minutes (About 20minutes of sitting position before erect x-ray of abdomen done
2. Patient who died on or before POD2, excluded from the study.
3. Patient towhom second laparotomy done, is not included after second laparotomy as a new case.
4. If patients erect x-ray abdomen do not show gas under diaphragm (GUD) on post operative day7 and also no

sign and symptom suggestive of peritonitis or leak, no x-ray was done on POD10.

5. Along with x-ray erect abdomen, clinical examination and other necessary investigation was also done.
6. Patient encouraged for early mobilisation in all cases as early as possible
7. All data used (gas under diaphragm) in this study is on POD 2, POD 4, POD7 and POD10.
8. Erect x-ray of abdomen, included both dome of diaphragm in all cases.

**Case details**

CASE NO -
Type of case -
Name of patient-
Reg. No & Add. -
Age / Sex -
Post Op Day 02

| Temp(ºC) | PR(min) | BP(mm Hg) | U/O(ml) | Pneumoperitoneum Present/absent |
|---|---|---|---|---|

Clinical course –

Post-op Day 04

| Temp(ºC) | PR(min) | BP(mm Hg) | U/O(ml) | Pneumoperitoneum Present/absent |
|---|---|---|---|---|

Clinical course –

Post-op Day 07-

| Temp(ºC) | PR(min) | BP(mm Hg) | U/O(ml) | Pneumoperitoneum Present/absent |
|---|---|---|---|---|

Clinical course –

Post-op Day 10(if applicable)-

| Temp(ºC) | PR(min) | BP(mm Hg) | U/O(ml) | Pneumoperitoneum Present/absent |
|---|---|---|---|---|

Clinical course –

**Table 1. Case distribution**

| Type of case | No. of cases | Percentage (%) |
|---|---|---|
| Elective | 67 | 55.83 |
| Emergency | 53 | 44.17 |
| Total | 120 | 100 |

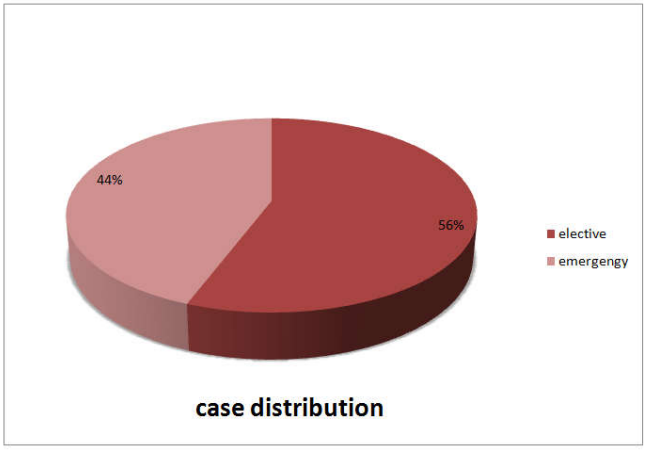



**Table 2. Sex distribution**

| Sex | No. of patient | % |
|---|---|---|
| Male | 69 | 57.5 |
| Female | 51 | 42.5 |
| Total | 120 | 100 |

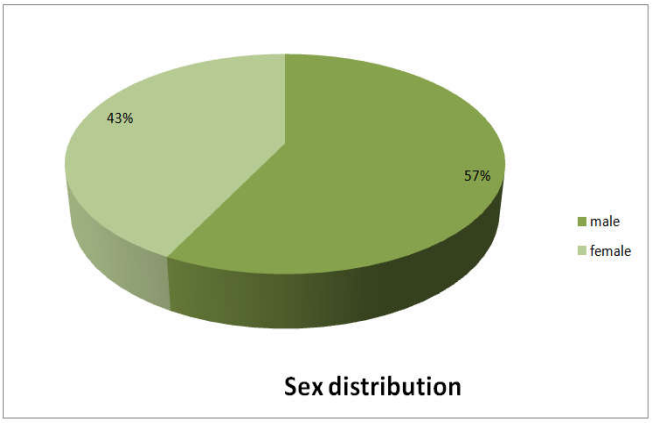



**Table 3. Age distribution (Mean as 35.67)**

| Age group (yrs) | No. of patient | Percentage (%) |
|---|---|---|
| 1 – 10 | 4 | 3.3 |
| 11 – 20 | 14 | 11.7 |
| 21-30 | 35 | 29.2 |
| 31-40 | 23 | 19.2 |
| 41-50 | 23 | 19.2 |
| 51-60 | 15 | 12.5 |
| 61-70 | 5 | 4.2 |
| 71-80 | 1 | 0.8 |
| Total | 120 | 100 |

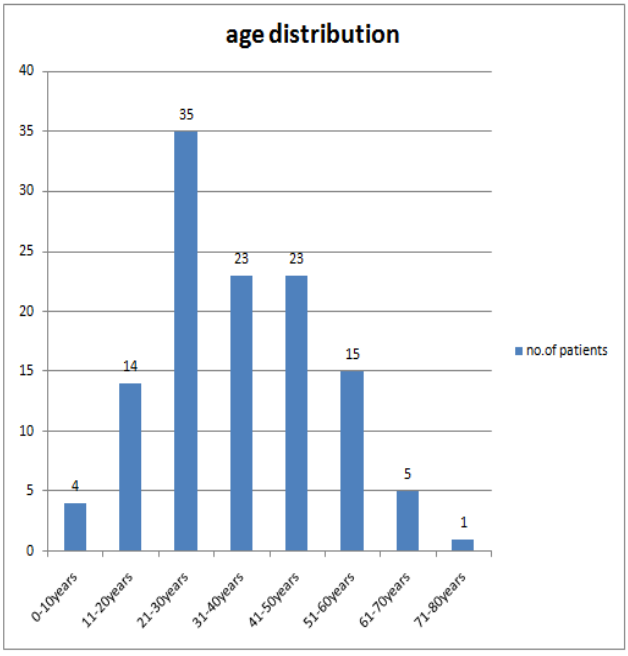



**Table 4. Resolution of Pneumoperitoneum in Elective and Emergency patients**

| Percentage show resolution | Elective | Emergency | Elective + Emergency |
|---|---|---|---|
| On post operative day - 2 | 67.2% (45) | 56.6%(30) | 62.5% (75) |
| On post operative day - 4 | 88.1%(59) | 83.0%(44) | 85.8%(103) |
| On post operative day - 7 | 100%(67) | 92.5%(49) | 96.7%(116) |

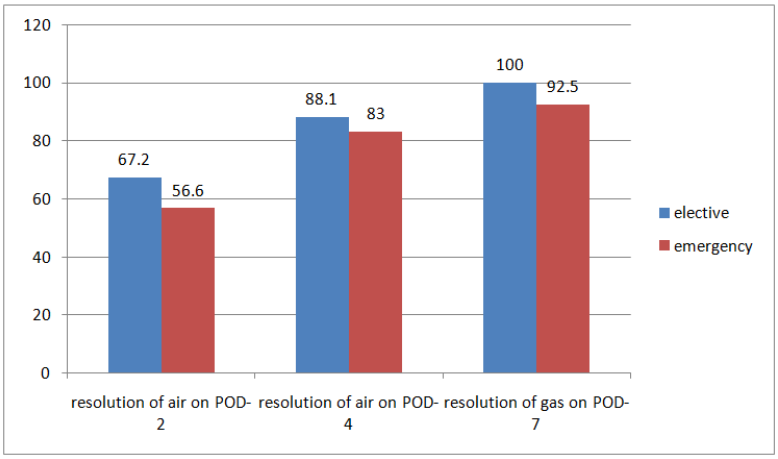



**Table 5. Resolution of Pneumoperitoneum in Elective and Emergency patients**

| Percentage show resolution (no gas) | Elective | | | Emergency | | | Elective + Emergency | | |
|---|---|---|---|---|---|---|---|---|---|
| | % | No. of patient | Out of total EL patient | % | No. of patient | Out of total EM patient | % | No. of patie-nt | Out of total EM +EL patient |
| On post operative day – 2 | 67.2 | 45 | 67 | 56.6 | 30 | 53 | 62.5 | 75 | 120 |
| On post operative day – 4 | 88.1 | 59 | 67 | 83.0 | 44 | 53 | 85.8 | 103 | 120 |
| On post operative day – 7 | 100 | 67 | 67 | 92.5 | 49 | 53 | 96.7 | 116 | 120 |

**Table 6. Resolution of Pneumoperitoneum in patient with drain and without drain**

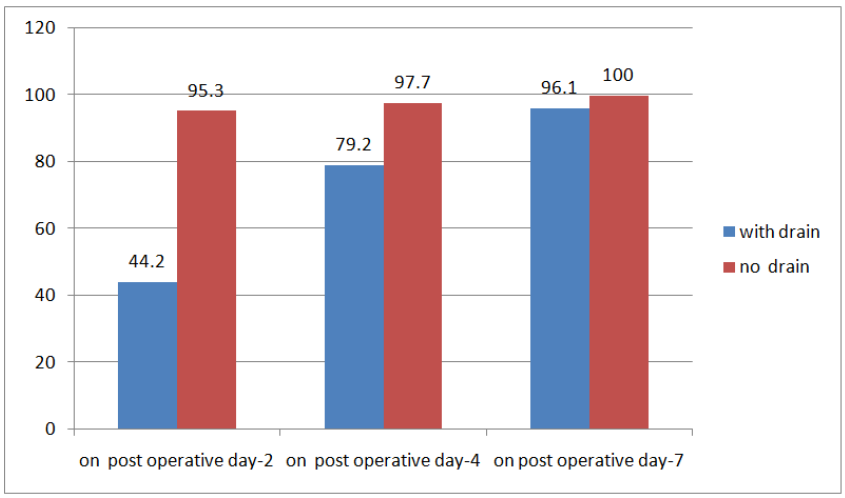
| Percentage show resolution of Pneumoperitoneum | With drain | Without drain | Both |
|---|---|---|---|
| On post operative day - 2 | 44.2 | 95.3 | 62.5 |
| On post operative day - 4 | 79.2 | 97.7 | 85.8 |
| On post operative day - 7 | 96.1 | 97.7 | 96.3 |

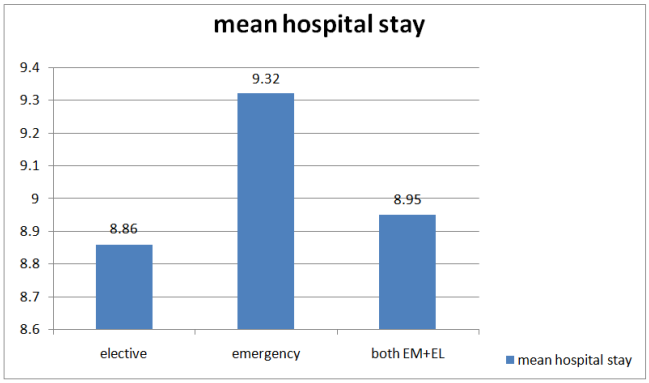
**Table 7. Effect of Drain on Resolution of Pneumoperitoneum**

| Percentage show resolution (no gas) | Drain placed | | | Drain not placed | | | Both | | |
|---|---|---|---|---|---|---|---|---|---|
| | % | No. of patient | Out of total patient | % | No. of patient | Out of total patient | % | No. of patie-nt | Out of total EM +EL patient |
| On post operative day – 2 | 44.2 | 34 | 77 | 95.3 | 41 | 43 | 62.5 | 75 | 120 |
| On post operative day – 4 | 79.2 | 61 | 77 | 97.7 | 42 | 43 | 85.8 | 103 | 120 |
| On post operative day – 7 | 96.1 | 74 | 77 | 97.7 | 42 | 43 | 96.7 | 116 | 120 |

**Table 8. Hospital stay in Elective and Emergency cases**

| Type of cases | Total No. of patient | Mean Hospital stay |
|---|---|---|
| Elective patients (EL) | 67 | 8.86 |
| Emergency patients (EM) | 53 | 9.32 |
| Both Emergency + Elective | 120 | 8.95 |




mean hospital stay
9.4
9.3
9.2
9.1
9
8.9
8.8
8.7
8.6
8.86
9.32
8.95
elective
emergency
both EM+EL
mean hospital stay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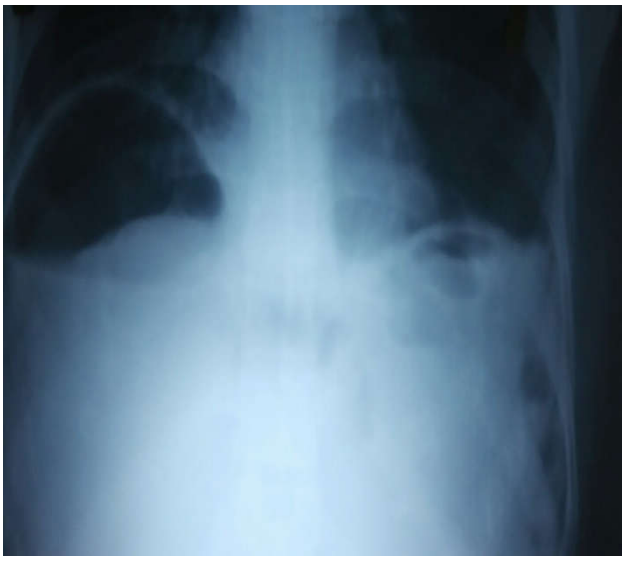


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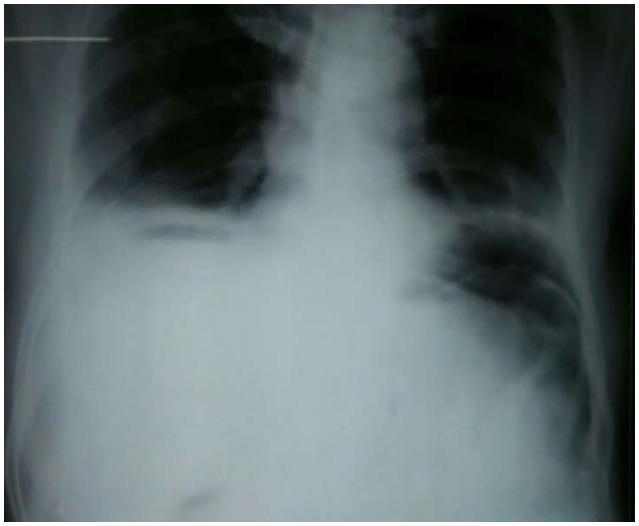


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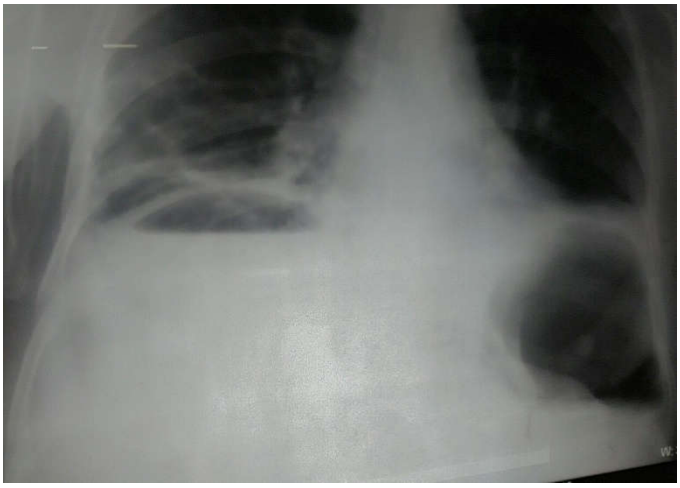

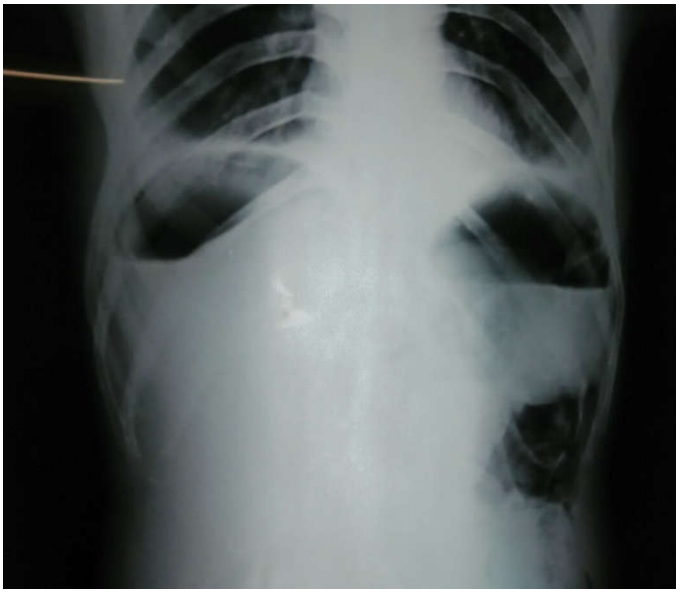


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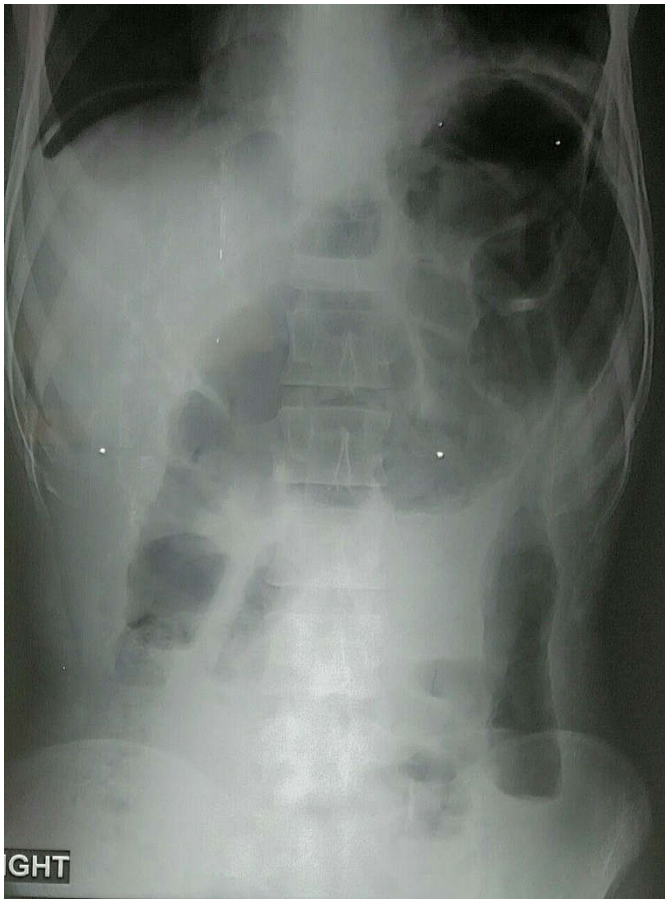
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## DISCUSSION

X-Ray erect abdomen is good tool to study pneumoperitoneum and its course overtime along with CECT abdomen, USG abdomen, X-ray left lateral decubitus. CECT is regarded as criterion standard for detection of pneumoperitoneum, but it is expensive in terms of both radiation burden and cost. Due to change in abdominal and thoracic pressure (2:1), air in the peritoneal cavity moves to subphrenic space even in recumbent position. (Earls *et al*., 1993; Stapakis and Thickman, 1992) USG abdomen is operator dependent. Radiologist may not available at rural centre particularly in developing countries like India. So x-ray erect abdomen involving both dome of diaphragm is a reliable option for detection of pneumoperitoneum/POPP. In compare to chest x-ray and x-ray left lateral decubitus, x-ray erect abdomen also detect lower abdomen, bowel dilatation, collection. So for over all to detect resolution of pneumoperitoneum, erect x-ray of abdomen may got edge over chest x-ray and x-ray left lateral decubitus. Resolution of post operative pneumoperitoneum depends on many factors like,

- Preoperative condition patients (emergency/elective)
- Size of incision
- Amount of dissection done
- Lean pt. Vs fatty patient
- Intraperitoneal infections
- Early mobilisation of patients
- Division of falciform ligament during laparotomy

In studies selected type of patients (elective/emergency), type of operation performed, size of incision given, measures to control post operative infection, steps taken for early mobilisation, all make it so heterogenous group to analyse the outcome. Estimation of absolute amount of air present in peritoneal cavity is difficult.

**Grades of pneumoperitoneum: (Josef EFisher *et al*., 1961)**

Grade 1-upto 100 ml
Grade 2-100ml to 500 ml
Grade 3-500ml to 1000ml
Grade 4->1000ml

A very approximate guide in patient of average built to calculate amount of gas in peritoneal cavity, a layer of air under diaphragm (cm) can help like: (Josef EFisher *et al*., 1961)

1.3 cm- approx. 500ml
2.5 cm- approx.1000ml

Mean hospital stay of patients is 8.95days, in elective group mean hospital stay is 8.86days and in emergency group mean hospital stay is 9.32day. Probably no much difference in hospital stay is due to, In this hospital we discharge the patients after removal of stitches, as this request is made by most of the patient. In this study. 62.5% patients do not show gas under diaphragm on POD2 x-ray, means in 62.5% patients post operative pneumoperitoneum (POPP) resolve before 48 hours of laparotomy. 88.8% of patients do not show gas under diaphragm on POD4 x ray, means 88.8% of patients POPP resolve before 4$^{th}$ post operative day. 96.7% of patients do not show gas under diaphragm on POD7 x-ray, means 96.7% of patients POPP resolve before post operative day7. In this study, >95% of patients shows resolution of POPP before 7$^{th}$ POD and >85% of patients show resolution of POPP before 4$^{th}$ POD. On POD2 x-ray, 67.2% of elective patients shows no pneumoperitoneum while 56.6% of emergency shows no pneumoperitoneum. On the basis of POD4 and POD7 x-ray no significant difference in resolution of POPP is observed among elective and emergency patients. Effect of drain placed in peritoneal cavity is also evaluated. On POD2 x-ray, 42.2% patient with drain shows resolution of POPP while 95.3% of patients without drain shows resolution of POPP. On POD4 x-ray, 79.2% of patients with drain shows resolution of POPP

while 97.7% of patients without drain shows resolution of POPP. In prior studies, there was found no difference with the relation of drain placement on resolution of POPP but this study there is significant difference on the basis of POD2 and POD4 x-ray. At this hospital we generally uses open abdominal drain.

Also abdominal drain generally placed where dissection is more, prior infection is there, faecal contamination is there. This difference is observed due combination of use of open abdominal drain and drain placed where more dissection done, peritoneal infection/contamination is there. No significant difference in resolution of POPP is obtained on the basis of POD7 x-ray. Four patient show pneumoperitoneum on POD7 x-ray erect abdomen. Two out of four went for second laparotomy due anastomosis leak in one and other was due to leak from duodenal perforation repair. Other two patients was managed conservatively, One was ileostomy due to vagino-ileal fistula with incomplete veginal vault repair, other was of ca rectum and APR was done and also perineal wound gets infected. Out of four patients, two patients gets operated second time, other two do not show pneumoperitoneum on POD10 x-ray erect abdomen. It was interesting to note that two case (which operated second time) shows gradually increasing amount of POPP and in both cases it's thickness was more than 1cm and other two cases showed POPP which was decreasing over time and on POD7, it was just visible.

**Summary and Conclusion**

This study shows 62.5% shows resolution of POPP before 48 hours, 85.8% of post laparotomy shows resolution of POPP before 4th post operative day and 96.7%of cases shows resolution of POPP before 7th post operative day. In elective patients without pre-op peritonitis show early resolution of pneumoperitoneum compare to emergency cases who generally present with pre-op peritonitis.

Open drain delay resolution of POPP.

Increasing amount of POPP shows post operative disruption of continuity of bowel. Prolonged POPP is due to persistence of intraperitoneal infections/collection.

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