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A STUDY OF PH IN DRAIN FLUID AND POSTOPERATIVE INFECTIOUS COMPLICATIONS IN PATIENTS OF ABDOMINAL SURGERY: A STUDY FROM A TERTIARY CARE CENTRE IN CENTRAL INDIA

General Surgery

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KEYWORDS

INTRODUCTION

Abdominal pain accounts for nearly 7% of all emergency room visits and is the most common cause for abdominal surgeries. [1-2]

Pain in the back usually corresponds to retroperitoneal abdominal pain, while pain in the suprapubic region indicates pain in the bladder, distal colon and pelvic organs; periumbilical pain indicates small bowel, appendix and midgut involvement and epigastric pain indicates pain from stomach, pancreas, liver and gall bladder.[3,4]

Appendicitis, gastroesophageal reflux disease (GERD), pancreatitis, gallbladder disease, diverticulitis, and small bowel obstruction are some of the common causes of abdominal pain.

Following an abdominal surgery, patients complain of infectious complications, which are difficult to diagnose as these infections are obscure. In such conditions, the diagnosis is made on the basis of presence of bacteria in the peritoneal fluid. The polymorphonuclear cell count was suggested as diagnostic criteria for infectious complications, while the clinical and laboratory signs such as leukocytosis, fever, local tenderness, erythema, elevated erythrocyte sedimentation rate and C-reactive protein, considered to diagnose infectious complications have been found to be non-specific.

The bacteria can be identified directly using Gram stain or culture, but results take long and requires a standard laboratory setup. So, there was a need for fast, easy to perform test, which has a high sensitivity and specificity.

It was Simmen et al in 1994, who reported that in patients with intra-abdominal infection, there was low pH (<7.1) and pO_2 (<6.5 kPa) and a high pCO_2 (>8 kPa) of peritoneal fluid. These three parameters showed improvement with the clinical improvement in these patients and they concluded that the assessment of these parameters is simple, cost-effective, rapid and helps in early detection of infectious complications.

Not much work has been followed after the preliminary published works of Simmen et al. There is only 1 study done by an Indian author[5] who reiterated the findings putforth by Simmens.

The present study was conducted to find out the effectiveness of pH level in predicting the postoperative infectious complications following abdominal surgery.

MATERIAL AND METHODS

This prospective, observational study was conducted in the Department of Surgery, Sri Aurobindo Medical College and P.G. Institute, Indore (M.P.) from November 2019 to May 2021 on patients undergoing abdominal surgeries.

Patient of age more than 18 years, undergoing abdominal surgery, requiring drain placement and willing to provide voluntary written informed consent to participate in the study were included. While similar patients not requiring drain placement and those not willing to provide voluntary written informed consent to participate in the study were excluded from the study.

The study was approved by the Institutional Ethics Committee and prior to enrolling any patient into the study, an informed voluntary written consent was obtained.

All these patients underwent thorough clinical and physical examination prior to the surgery. Preoperative investigations and preoperative anesthetic checkup were done prior to taking the patient into the operation theatre.

The patients underwent abdominal surgery under appropriate anesthesia. All the patients in whom drain placement was done were visited and after consenting the drain samples were collected and sent for analysis. These samples were collected on Day-1, Day-3 and Day-5.

The Cobas-b 121 analyzer was used for analyzing the drain samples.

The data obtained was analyzed using online statistical software GraphPad. The mean comparison of means within the group was done using paired 't' test. Association between two non-parametric variables was done using Pearson Chi-square test. A p value of <0.05 was taken as statistically significant.

RESULTS

- We included 50 patients undergoing abdominal surgery and requiring drain placement.
- 16 (32%) were in the age group 21-40 years, 27 (54%) were in the age group 41-60 years and 7 (14%) were in the age group >60 years.
- 14 (28%) were females and 36 (72%) were males.
- 13 (26%) underwent elective surgery and 37 (74%) underwent emergency surgery.
- The most common site of drain placement was pelvic cavity (74%), followed by above mesh drain and Morrison drain.

Table : Distribution according to drain site

Drain Site	Number	Percentage
Pelvic cavity	37	74.0
Above mesh drain	5	10.0
Morrison drain	4	8.0
Morrison & Pelvic cavity	3	6.0
Paracolic & Pelvic	1	2.0
Total	50	100.0

- The mean drain pH was comparable between day-1 and day-3 (P=0.967) and the mean drain pH at Day-5 was significantly lower than mean drain pH at day-3 (P=0.020). (Table…)

Table: Comparison of drain pH at different time intervals (Drain 1)

pH	No.	Mean ± SD	't' value	P value
Day-1	50	7.07 ± 1.49	-0.041, df=49	0.967, NS
Day-3	50	7.08 ± 1.48		
Day-3	50	7.08 ± 1.48	2.415, df=49	0.020*
Day-5	50	5.87 ± 2.98		

- The mean drain pO2 was comparable between day-1 and day-3 (P=0.407) and the mean drain pO2 was significantly lower on Day-5 compared to Day-3 (P=0.008).
- The mean drain pCO2 was comparable between day-1 and day-3 (P=0.260) and between Day-3 and Day-5 (P=0.103), showing a comparable mean drain pCO2 at all the time intervals.
- The mean drain pH on Day-3 was significantly higher than on Day-1 (P=0.039) and was comparable between Day-3 and Day-5 (P=0.564). (Table …)

Table : Comparison of drain pH at different time intervals (Drain 2)

pH	No.	Mean ± SD	't' value	P value
Day-1	4	7.17 ± 0.48	-3.526, df=3	0.039*
Day-3	4	7.42 ± 0.39		
Day-3	3	7.38 ± 0.48	-0.686, df=2	0.564, NS
Day-5	3	7.52 ± 0.13		

- The mean drain pO2 was comparable between day-1 and day-3 (P=0.388) and between Day-3 and Day-5 (P=0.449), showing a comparable mean drain pO2 at all the time intervals.
- The mean drain pCO2 was comparable between day-1 and day-3 (P=0.324) and between Day-3 and Day-5 (P=0.050), showing a comparable mean drain pCO2 at all the time intervals.
- In elective surgery patients, the mean drain pH was comparable between day-1 and day-3 (P=0.183) and between Day-3 and Day-5 (P=0.999), showing a comparable mean drain pH at all the time intervals. (Table…)

Table : Comparison of drain pH in relation to type of surgery (Elective)

Drain pH	No.	Mean ± SD	't' value	P value
Day-1	13	7.49 ± 0.27	1.413, df=12	0.183, NS
Day-3	13	6.36 ± 2.83		
Day-3	13	6.36 ± 2.83	0.001, df=12	0.999, NS
Day-5	13	6.35 ± 2.83		

- In emergency patients, the mean drain pH was comparable between day-1 and day-3 (P=0.134) and the mean drain pH at Day-5 was significantly lower than mean drain pH at day-3 (P=0.003) (Table …)

Table: Comparison of drain pH in relation to type of surgery (Emergency)

Drain pH	No.	Mean ± SD	't' value	P value
Day-1	37	6.91 ± 1.70	-1.532, df=36	0.134, NS
Day-3	37	7.33 ± 0.23		
Day-3	37	7.33 ± 0.23	3.210, df=36	0.003*
Day-5	37	5.70 ± 3.04		

- In infective patients, the mean drain pH on Day-1 7.25 ± 0.37, on Day-3 was 7.25 ± 0.27 and on Day-5 was 5.84 ± 2.91. The mean drain pH was comparable between day-1 and day-3 (P=0.920) and between day-3 and day-5 (P=0.071).
- In non-infective patients, the mean drain pH on Day-1 6.98 ± 1.79, on Day-3 was 6.99 ±1.79 and on Day-5 was 5.89 ± 3.05. The mean drain pH was comparable between day-1 and day-3 (P=0.974) and between day-3 and day-5 (P=0.100).
- In 5 (10%) had mild serous discharge, 6 (12%) had purulent discharge, 2 (4%) had serohemrrhagic discharge, 4 (8%) seropurulent discharge and wound dehiscence with fecal discharge in 1 (2%).
- Pus culture was not done in 26 (52%) patients. No growth was seen in 8 (16%) patients. E. coli was seen in 6 (12%) patients, Klebsiella pneumonia was seen in 3 (6%) patients, acinobacter baumanii complex in 2 (4%) patients, coagulase negative staphylococcus in 2 (4%) patients, gram negative bacilli in 2 (4%) and MRSA in 1 (2%) patient.
- Suture line healthy with no discharge was seen in 35 (70%) patients, wound dehiscence with purulent discharge was seen in 6 (12%) patients, wound dehiscence in 5 (10%) patients, serous discharge in 2 (4%) patients, burst abdomen in 1 (2%) patients and mild serous discharge in 1 (2%) patients.
- At discharge, 36 (72%) patients were discharged successfully, 7 (14%) underwent secondary closure of wounds, 4 (8%) underwent burst abdomen repair, 2 (4%) underwent reexploration and 1 (2%) had expired.

DISCUSSION

We included 50 patients of age more than 50 years, who underwent abdominal surgery during the study period.

After the surgery, the drain fluid was collected in these patients and they were analyzed for pH, pO2 and pCO2 to predict the presence of infectious complications.

Of the 50 patients included in the study, 68% were of age more than 41 years. 72% of the patients were males and 28% were females.

74% patients underwent emergency abdominal surgeries, while 26% patients underwent elective abdominal surgeries.

74% of the drains were placed in the pelvic cavity, 10% were above mesh drains, 8% were Morrison's drain, 6% were Morrison and Pelvic cavity drains and 2% were paracolic and pelvic cavity drain. Pelvic cavity being the most common drain placed in our study.

The drain fluid was collected on day-1, day-3 and day-5 postoperatively and analysis done. The mean drain pH day-3 was found to be higher than the day-1 pH level, which decreased by day-5 postoperatively. The mean drain pH on day-1 and day-3 were comparable (P=0.967), while the mean drain pH on day-5 was significantly lower than day-5 pH (P=0.020).

In elective surgery patients (n=13), there was non-significant decrease in the mean pH level from day-1 to day-5 (P>0.05), while in emergency patients (n=37), the mean pH level non-significantly increased on day-3 compared to day-1 (P>0.05), but then decreased significantly on day-5 compared to day-3 (P<0.05).

In infective patients (n=16), the mean drain pH remained stable from day-1 to day-3 and then decreased non-significantly on day-5 compared to day-3 (P>0.05), while in non-infective patients (n=34), there was a slight non-significant increase in the mean pH on day-3 compared to day-1 and then a non-significant decrease on day-5 compared to day-3 (P>0.05).

The third parameter, pO2 was found to be high on postoperative day-1, which persistently reduced till day-5 postoperatively. The mean pO2 was comparable between day-1 and day-3 (P=0.407), while the mean pO2 was significantly lower on day-5 compared to day-3 (P=0.008).

The second parameter, pCO2 was found to be high on postoperative day-1, which persistently reduced till day-5 postoperatively. The mean pCO2 was comparable between day-1, day-3 and day-5 (P>0.05), though we found a reduction in the pCO2 level over the time, but the difference was not found to be statistically significant (P>0.05).

In few of the patients, we had placed the second drain also. In these patients, we found that the mean pH increased from day-1 postoperatively to day-5 postoperatively. The increase in mean pH in drain-2 was found to be significantly higher on day-3 compared to day-1 (P=0.039), but the increase in drain pH from day-3 to day-5 was found to be statistically not significant (P=0.564).

The mean pO2 of drain-2 also showed a persistent decrease from Day-1 to Day-5, but this decrease was statistically not significant (P>0.05), similarly the mean pCO2 of drain-2 showed a persistent decrease, but again this decrease was statistically not significant (P>0.05).

The residual complications were seen in 36% patients in our study. Purulent and mild serous discharge were the most common residual complications encountered, while less prevalent residual complications seen were seropurulent and serohemorrhagic discharge and wound dehiscence with fecal discharge.

Pus culture / sensitivity was performed in only 24 patients. 16% showed no growth. E. coli was seen in 12%, Klebsiella pneumoniae in 6%, acinobacter baumanii complex in 4%, coagulase negative staphylococcus in 4%, gram negative bacilli in 4% and MRSA in 2% patients.

In 70% the suture line was healthy, 12% had wound dehiscence with purulent discharge, wound dehiscence was seen in 10%, serous discharge in 4%, burst abdomen in 2% and mild serous discharge in 2% patients.

At discharge majority of the patients were discharged healthy, 14% required secondary closure of wound, 8% underwent burst abdomen repair, 4% underwent re-exploration and there was 1 death.

On this topic not much literature is available on the internet. In all we found only 4 articles related to this topic. Three of these are done by **Simmen et al**[6,7,8] in various years and one Indian study done by **Yadav et al.**[5]

Initial study was done by **Simmens et al.**[6] and they had arrived at the cut-off of pH, pO2 and pCO2 values. According to them, a pH <7.1, pO2 < 6.5 kPa and pCO2 > 8 kPa, which were monitored by them immediately after surgery, is suggestive of infective complications. The results of the study done by Simmens have been supported by the study done by **Yadav et al.**[5]

But unlikely in our study we did not find any such relationship between the drain pH level and the development of infection. The pH levels were found to be similar between infective and non-infective patients.

The limitations of our study were that there are only 4 articles which relate to topic are published online. There was no additional contradictory or supporting articles to substantiate the claims. There is a need for more studies to be done on this topic and to reach at a conclusion.

CONCLUSION

Evaluation of drain pH for the identification and management of obscure infectious complications did not lead to any conclusive results in our study. The cut-off of pH (< 7.1), pO2 (<6.5 kPa) and pCO2 (>8.0 kPa) which are suggestive of infectious complications, could not be established in the present study. Not much of literature is available on this topic, and which are available are written by same author, and substantiated by one Indian study. With such lacunae in the literature, it is difficult to reach any proper conclusion. Hence, we recommend for further studies to be conducted.