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Original Research Article

Clinical Factors Influencing Bowel Anastomotic Leak

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Abstract

Background and objectives: Anastomotic leakage is one of the most feared complications of gastrointestinal surgery. It causes considerable morbidity and mortality to the patient as well as trying the patience of the surgical team: it doubles the length of the hospital stay and increases the mortality as much as 8 to 10 fold. The objectives of this study were:
1. To study the demographic profile of patients who have anastomotic leak postoperatively.
2. To determine whether the risk factors of: hypoalbuminaemia; preoperative anaemia; emergent setting of surgery; intraoperative hypotension; body mass index; duration of surgery; post operative blood transfusions and dyselectrolytaemia contribute significantly to anastomotic leaks after resection anastomosis of bowel.
Methodology: This study was conducted on 87 patients who underwent resection-anastomosis in Victoria Hospital, either in Emergency or Elective OT between 1st December 2013 and 31st May 2015. Cases with comorbidities of uncontrolled DM, HIV/AIDS and carcinoma were excluded in this study.
Results: Serum albumin (p-value-0.01), BMI (0.05), serum potassium (0.05) and need for post operative blood transfusion (0.04) were strongly associated with bowel AL.
Conclusion: In the presence of: Serum albumin pre-operative value of 3.2g/dl or lower; Serum potassium pre-operative value of 3.8 mmol/L or lower, and Need for post-operative blood transfusion, it is important that the operating surgeon make a decision to prevent AL by either creating a diversionary stoma proximal to the site of anastomosis (for emergency patients) or pre-optimize the patient with nutritional support (for elective patients).
Keywords: Anastomotic leak; emergency; serum albumin; haemoglobin; factors influencing leak; serum potassium; blood transfusion.

1. Introduction

Anastomotic leakage is one of the most feared complications of gastrointestinal surgery. It causes considerable morbidity and mortality to the patient as well as trying the patience of the surgical team. The term anastomosis is derived from the Greek term anastomoein meaning "to furnish with a mouth".

The definition of anastomotic leakage has always been divisive. In 1991 the UK Surgical Infection Study Group offered 'a leak of luminal contents from a surgical join between two hollow viscera' [1] but this definition has rarely been referenced since. A review of 97 studies from 1993 to 1999 demonstrated 56 different definitions of anastomotic leakage after gastrointestinal surgery, illustrating the lack of uniformity and difficulties in interpreting the outcome from different studies.

A more recent attempt to standardize terminology of anastomotic leak offered the definition: "a communication between the intra- and extra-luminal compartments owing to a defect of the integrity of the intestinal wall at the anastomosis, either between small intestine and large intestine or between two ends of the intestinal wall regardless of the way this anastomosis was achieved."[2]

Having accepted these versions of an anastomosis having two ends and plenty of factors in the middle to either help it or hamper it in healing, we must endeavour to understand all perioperative variables available to us and modify them if this is found to be helpful in preventing anastomotic leak.

1.1 Aims and objectives

To study the demographic profile of patients who have anastomotic leak postoperatively.

To determine whether the risk factors of: hypoalbuminaemia; preoperative anaemia; emergent setting of surgery; intraoperative hypotension; body mass index; duration of surgery; post operative blood transfusions and

dyselectrolytaemia contribute significantly to anastomotic leaks after resection anastomosis of bowel.

2. Materials and Methods

2.1 Source of Data

Inpatient records of patients admitted to Victoria Hospital who underwent abdominal open surgery between 1st December 2013 and 31st May 2015.

2.2 Type of study

Prospective, hospital-based, time-bound study.

2.3 Sample size: 87 patients

2.4 Inclusion criteria

All the patients who are admitted to surgical wards of Victoria Hospital, Bangalore, and those willing to participate in the study, undergoing primary intestinal resection and anastomosis during study period.

2.5 Exclusion Criteria

- Pediatric patients (aged below 18 yr)
- Patients with HIV/AIDS infection
- carcinoma detected perioperatively
- uncontrolled diabetes mellitus
- active tuberculosis
- history of prolonged steroid use
- history of previous pelvic irradiation
- previous enteric diversionary procedure

2.6 Method of collection of data

When a patient was admitted to VH wards and underwent primary intestinal anastomosis, data was collected from his/her inpatient file with due consent about:

- Demographic profile of age, gender, in-patient registration number
- Indication for surgery- pre-operative diagnosis
- Blood transfusion required perioperatively- Packed red cells 350ml/unit
- Perioperative blood investigations- serum albumin (pre-operative), haemoglobin (pre-operative), serum potassium (pre- and post-operatively)
- Whether leak occurred, on which day and how it was detected (feculent matter in abdominal drain or from surgical incision site)
- Whether death occurred while in hospital for this current illness
- Whether diversionary stoma was created after leak occurred and the result of the same

2.7 Analysis of data

Using SPSS ver.7.0 all data was analysed using univariate analysis. P value of 0.05 or lower was considered significant.

2.8 Operative technique

This study was conducted on the patients who were treated by various surgeons. Therefore, there was an evident need for standardization of technique to prevent poor operative technique be the cause of confounding of results.

- All surgeons were staff in Dept. of General Surgery with experience of 5 years or more.
- All surgeries were performed through vertical midline laparotomy incisions.
- All anastomoses were end-to-end anastomosis of small bowel; no large bowel was repaired and there were no end-to-side anastomoses.
- All anastomoses were carried out in 2 layers.
- The sero-muscular layers were sutured with surgical silk No. 2-0 or No. 3-0, as per surgeon's preference.
- All through-and-through sutures were of either polyglactin 910 2.0, polyglactin 910 3-0 or polydiaxanone 3-0.
- All laparotomies received thorough peritoneal lavage with warm saline and abdomen was closed en-masse with non-absorbable suture. Skin was either sutured with nylon sutures or stapled close, based on surgeons' preferences.
- A peritoneal drain was inserted prior to closure in all cases.

3. Results

This study was conducted on 87 patients admitted to Victoria Hospital during the study period of 1st December 2013 and 31st May 2015.

Among them, 45 patients had no leak at anastomotic site post-operatively and were assigned as control group. 43 patients had clinically detectable anastomotic leak and were designated AL group. The results were computed as follows:

Table 1: Age

	Control	AL
Age for both males and females	52.5 ± 5.5	50.4 ± 9

Mean in years, as gathered from the IP records at time of admission

Figure 1: Age

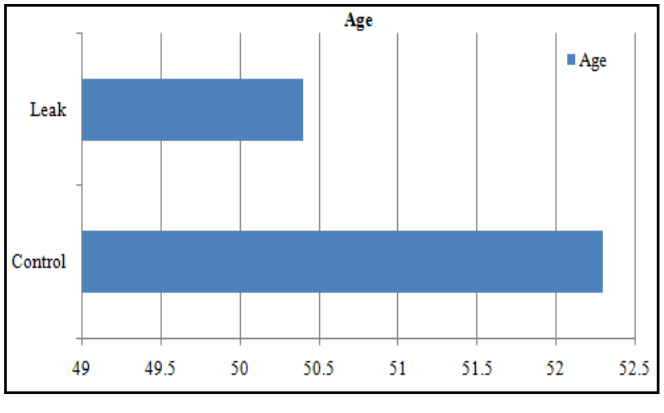

Table 2: Sex Distribution:

There were no transgenders under study and the sex distributions of both groups are as follows:

Sex	Control	AL
Male	34	35
Female	11	7

Figure 2: Graph showing Sex distribution

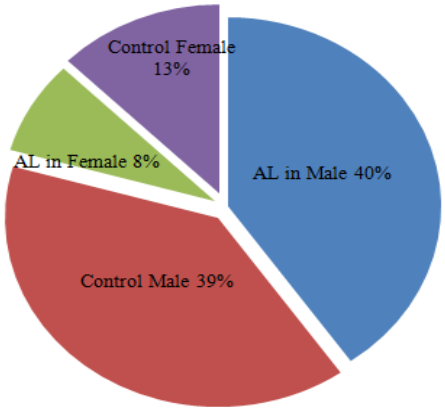

Table 3: BMI

	Control	AL
BMI	24.5 ± 0.8	23.2 ± 4.5

Body mass index of all cases under study (in mean, at time of surgery) calculated as body weight in kg divided by square of height in metres.

Figure 3: BMI

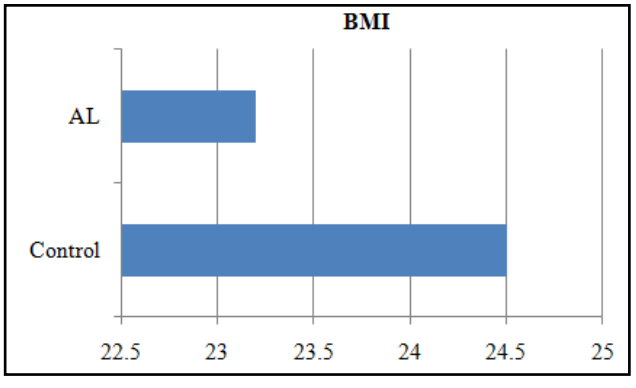

Table 4: Serum albumin

	Control	AL
Serum albumin	4.1 ± 0.5	3.2 ± 0.6

Measured in gram per decilitre preoperatively and mean of each group

Figure 4: Serum albumin

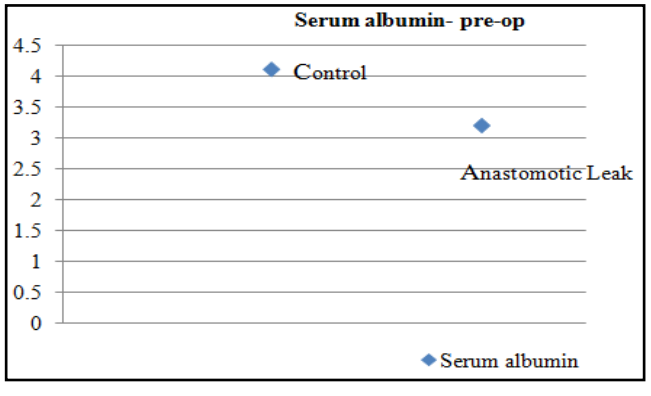

Table 5: Haemoglobin

	Control	AL
Haemoglobin	12.8 ± 0.9	11.4 ± 2.4

Measured as mean value preoperatively in grams per decilitre for all cases under study.

Figure 5: Haemoglobin

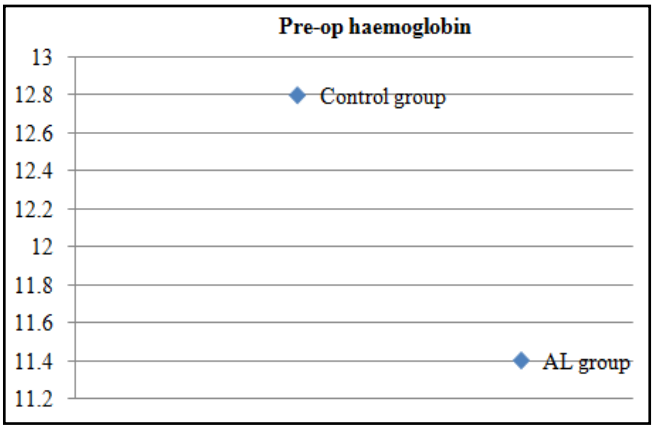

Table 6: Post operative blood transfusion

	Control	AL
No. of patients who recd. transfusion	11	24

Number of packed red cell given within the period of hospitalization in units of 350ml after due typing and cross matching

Figure 6: Post operative blood transfusion

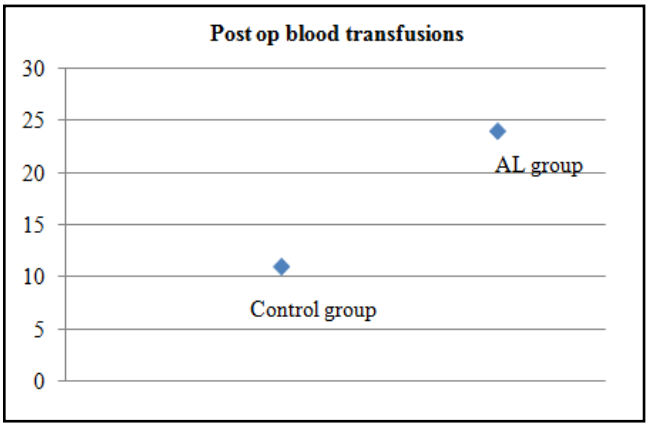

Table 7: Duration of Surgery

	Control	AL
Duration of surgery	205 ± 8	214 ± 6

Number of minutes from beginning of surgery to end as per operative records in casesheet

Figure 7: Duration of surgery

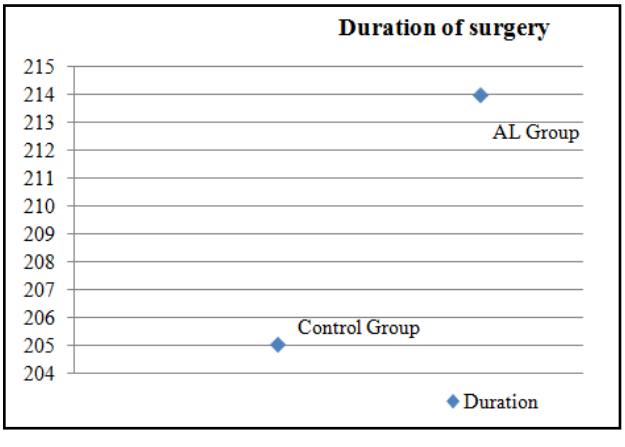

Table 8: Intraoperative hypotension

	Control	AL
Intraop. hypotension	8	11

As per anaesthesiology notes, measured as systolic blood pressure less than 90mm of mercury and diastolic blood pressure less than 60mm of mercury during the period of surgery.

Figure 8: Intraoperative hypotension

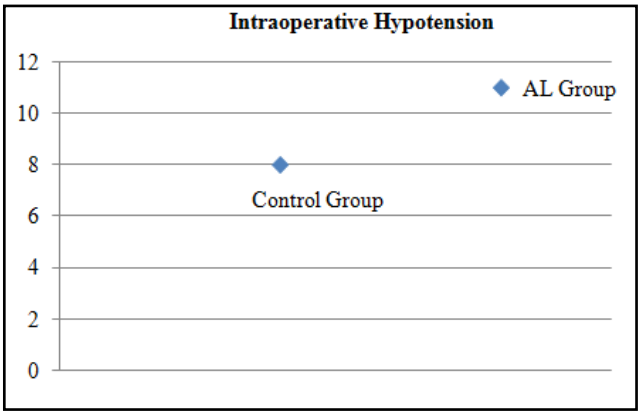

Table 9: Serum potassium

Serum potassium	Control	AL
Preoperative value	4.2 ± 0.4	3.8 ± 0.9
Postoperative value	3.6 ± 0.6	3.4 ± 0.8

Mean value of both groups measured pre- and post-operatively in millimoles per liter of serum.

Figure 9: Serum potassium

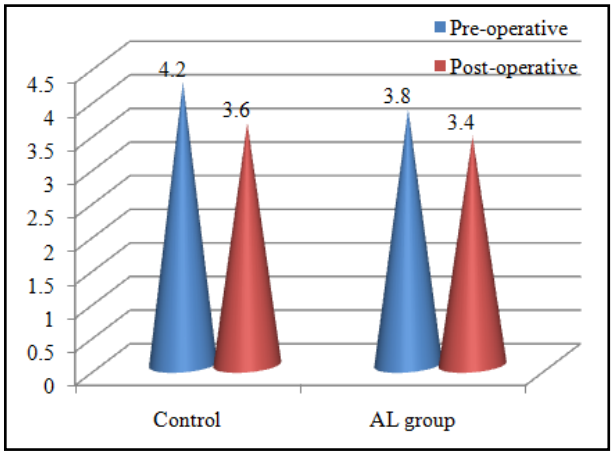

Table 10: Setting of surgery:

Setting of surgery	Control	AL
Emergency	3	4
Elective	42	38

This was decided by the Surgeon on duty, in Emergency, or by Unit Chief, in Elective cases, based on clinical condition of the patients and informed consent from the patients/ patients' attenders.

Figure 10: Setting of surgery

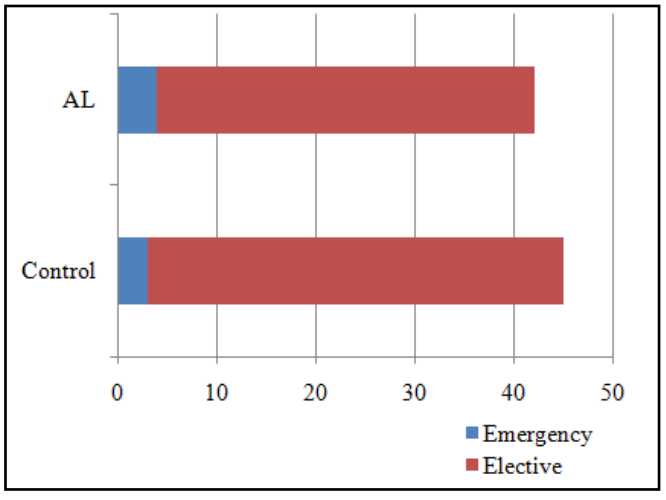

Table 11: Diversionary stoma and mortality

	AL- Stoma created	AL-Stoma not created	Control group
AL group	30	12	----------
Mortality	5	10	3

In cases of clinically detected anastomotic leak, the decision to perform a second surgery and create a stoma proximal to site of anastomosis was undertaken in 30 of 42 cases. The cases which were not re-operated were due to extreme patient debility or refusal of consent for surgery.

As can be seen, there is a 71.4% rate of stoma creation for AL, which yields a mortality rate of 16.7% for this group.

28.6% of AL patients did not get a stoma and the mortality rate for this group is 83.33%.

The control group had a mortality of 6.67%.

Figure 11: Mortality

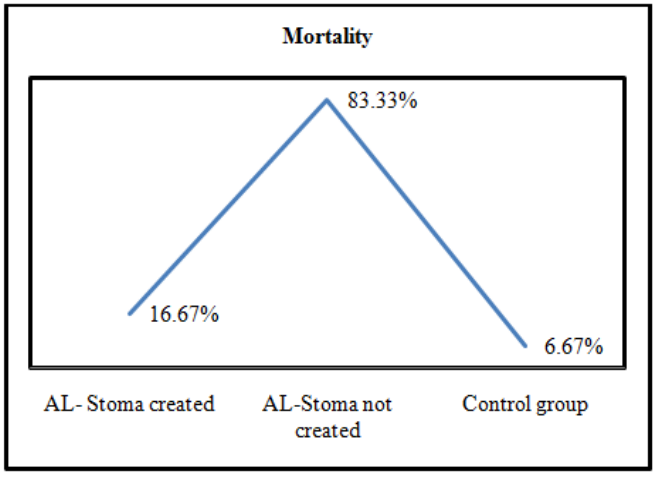

Table 12: Final computation from master chart

Sl. No.	Characteristic		Control group	Anastomotic leak group	P-value
1	Total number of patients		45	42	---------
2	Age in years		52.5 ± 5.5	50.4 ± 9	0.54
3	Sex	Male	34	35	0.71
		Female	11	7	0.82
4	BMI pre-op		24.5 ± 0.8	23.2 ± 4.5	**0.05**
5	s. albumin in g/dl		4.1 ± 0.5	3.2 ± 0.6	**0.01**
6	Haemoglobin in g/dl		12.8 ± 0.9	11.4 ± 2.4	0.45
7	Post-op blood transfusion (nos.)		11	24	**0.04**
8	Duration of surgery in mins.		205 ± 8	214 ± 6	0.42
9	Intraoperative hypotension		8	11	0.82
10	s. Ka +	Pre-op	4.2 ± 0.4	3.8 ± 0.9	**0.05**
		Post-op	3.6 ± 0.6	3.4 ± 0.8	0.72
11	Setting of surgery	Elective	3	4	0.74
		Emergency	42	38	
12	Stoma created (nos.)		nil	30	------
13	Mortality		3	Stoma present- 5	------
				Stoma absent- 10	------

4. Discussion

This set of results was obtained with thorough analysis. Its interpretation is as follows:

4.1 Age

This parameter is one of the first things which are asked to the patient. The inclusion criteria of this study excluded patients below 18 years and above 60 years, as the processes of healing and repair are markedly different in these age groups.

Most of the patients were of middle age, and all met the inclusion criteria. On ANOVA, there was no significant variation between the control group and AL group. P value was computed to be 0.54. Therefore, age is not a significant factor for AL.

4.2 Sex

In my study period, there were more men than women, as women are less likely to be brought to the hospital for medical attention in case of abdominal pain [18].

Data analysis shows probability value to be 0.71 for males and 0.82 for females when each was cross-referenced with the other, and therefore, not of any significance for this particular condition.

4.3 BMI

Body mass index was computed for both groups separately and the mean of values obtained was subjected to t-test. P value was determined to be 0.05 which is significant. It appears that overweight patients withstood surgery better and showed better healing, as compared to the AL group who had a normal BMI.

Although this is contradictory to already published material, this may be explained by the fact that patients, who are overweight, but not obese, have higher nutritional reserves.

4.4 Serum Albumin

This was measured preoperatively only and results showed that patients in the AL group had significantly low albumin (p value = 0.01).

Post-operative period is a time of negative nitrogen balance [17, 19], with even normal subjects found to have low serum albumin, and therefore, was not considered in the calculations to avoid a confounding factor.

4.5 Haemoglobin and Blood Transfusions

Patients' haemoglobin was measured in pre- and post-operative period and the pre-operative value was chosen as several patients had post-operative blood transfusions on the discretion of the treating surgeon.

Results indicate that the control group had higher haemoglobin as compared to the AL group. This has a P value of 0.45, which suggests that this is insignificant.

However, the AL group received blood transfusions twice as much as the control group and the computed P-value for this is 0.04 which is significant. It may be inferred from this that while low haemoglobin does not necessarily influence AL, the need for blood transfusions may be a risk factor for AL.

4.6 Duration of surgery, intraoperative hypotension and setting of surgery

As regards duration of surgery, presence of intra-operative hypotension and the setting of surgery (either elective or emergent), both the control group and the AL group were comparable in number. They have P values of 0.42, 0.82 and 0.74 respectively. This suggests that there may be no positive strong correlation between these factors and development of AL. These factors do influence the patients in other ways such as predisposing to DVT and other cardiovascular effects. Therefore, although there is no direct correlation found between these factors and AL, in the interest of the patients' well-being, operative time ought to be reduced by the surgeon and intraoperative hypotension should be treated promptly by the anaesthesiologists.

4.7 Serum Potassium

Patients who were under study underwent routinue pre- and post-operative assessment of all serum electrolytes, of which potassium was analysed.

Data indicates that control group tended to have normal potassium while the AL group had borderline low-levels of the same; however, the P-value of pre-operative s.Ka+ was 0.05, suggesting that even modestly lowered potassium levels may contribute to AL.

4.8 Mortality

The percentage of mortality for AL group and control group are 35.71% and 6.67% respectively.

If a diversionary stoma was created for a patient who had AL, the mortality fell to 16.7%, which is a very significant fall from 35.71%.

Results indicate a more positive outcome in cases which did not have an AL or those cases with AL which had a diversionary stoma created proximal to the site of anastomosis.

5. Conclusion

Past and recent research has shown that AL is multi-factorial, morbid and causes significant mortality. A better understanding of the factors that influence AL is essential if we are to prevent it. These factors may be modifiable (eg. haemoglobin) or non-modifiable (eg. BMI in emergency setting), and they all merit study.

Since most of the study subjects were emergent cases, it was unfeasible to optimize the patients for surgery beyond initial resuscitation. This means that none of the cases had bowel preparation or pre-operative blood transfusion to correct anaemia. Having understood this, the operating surgeon was armed with only the pre-operative investigations and the visible condition of bowel to judge what best can be done for the patients' condition.

This study aims to highlight which objectively measured factors, in the presence of standardized operative technique, are most likely to influence bowel AL, and in the case of the presence of such factors, whether it is prudent to predict likely anastomotic leak and take preventive measures regarding the same.

In the presence of-

- Serum albumin pre-operative value of 3.2g/dl or lower
- Serum potassium pre-operative value of 3.8 mmol/L or lower, and
- Need for post-operative blood transfusion,

It is important that the operating surgeon make a decision to prevent AL by either creating a diversionary stoma proximal to the site of anastomosis (for emergency patients) or pre-optimize the patient with nutritional support (for elective patients).

It is the hope of the author that these 3 objectively measurable factors be considered carefully while a resection-anastomosis is planned, especially in emergency settings, with the goal of lessening morbidity and mortality of the patients.

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