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Original Research Article

VALIDATION OF DUTCH LEAKAGE (DULK) SCORE AS A PREDICTOR OF ANASTOMOTIC LEAK FOLLOWING INTESTINAL SURGERY

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ABSTRACT

Background: Dehiscence is a common and grave complication following an intestinal anastomosis. It has a wide spectrum of presentations from minimal abdominal discomfort to florid sepsis with multisystem organ dysfunction and even mortality. A number of scoring systems have been proposed to diagnose anastomotic leak (AL) clinically at an early stage, of which the scoring proposed by Dulk and collaborators incorporating certain clinical findings and laboratory parameters has been found to diagnose AL effectively at an early stage.

Materials and Methods: We conducted a prospective, observational study at two tertiary health centrs in West Bengal including 250 patients who underwent elective intestinal anastomosis for diverse causes. We calculated the DULK Score in each case to validate this scoring system for early diagnosis of AL. SPSS version 21 was used for the necessary data analyses.

Results: Dutch Leakage (DULK) Score was positive in 40 patients, of whom 22 developed AL and the score was negative in 210 patients, of whom 7 developed AL. Consequently, in our study Dutch Leakage (DULK) Score had a sensitivity of 75.86%, specificity of 91.85%, a positive predictive value of 55%, negative predictive value of 96.66% and a diagnostic accuracy of 90%.

Conclusion: Our study validated the DULK Score as an important tool for early detection of AL following intestinal surgeries. It is a versatile tool, easy to apply, and is readily available in all health care setups.

Keywords: Anastomotic leakage (AL), Dutch leakage (DULK) score, Intestinal anastomosis, Anastomotic dehiscence.

INTRODUCTION

Anastomotic leakage (AL) is a dreaded complication following intestinal surgery with a reported incidence of 5% to 19%.[1-3] The clinical manifestation of AL varies widely as it depends mostly on location and magnitude of leak. A small leak may present with vague abdominal pain and or prolonged ileus whereas a large dehiscence usually presents rapidly with features of intra-abdominal sepsis and its consequences.[4] The gravest squeal of AL is intra-abdominal sepsis which is associated with increased morbidity, prolonged hospital stay, disability, reduction in active lifespan of a patient and even mortality.[5] Once an AL is clinically overt, it is usually too late to prevent its complications and aforesaid adverse outcomes. Consequently, surgeons should diagnose and treat AL as early as possible to reduce these complications. A number of clinical findings, laboratory parameters, and scoring systems have been proposed to diagnose AL at an early stage,[6-14] so that prompt and proper management can be started without delay and overall morbidity and mortality can be reduced. Of these, the Dutch Leakage Score or the DULK score, proposed by M Den Dulk et al. has been validated prospectively for colorectal surgery and was found to diagnose AL at an early stage with reduction in mortality.[15]

Dulk and collaborators, in 2009, proposed a scoring system incorporating certain clinical findings and laboratory parameters to diagnose AL at an early stage which is mentioned below:

DULK (Dutch Leakage) Score.[15]

Variables	Score
Fever>38*C	1
Respiratory frequency>30/minute	1
Cardiac frequency>100/minute	1
Oliguria<30ml/hour OR <700ml/24 hour	1
Agitation OR lethargy	2
Clinical deterioration	2
Ileus	2
Gastric retention	2
Surgical wound dehiscence	2
Abdominal pain	2
Leukocytosis OR CRP elevation>5%	1
Creatinine elevation OR Urea>5%	1
Enteral nutrition	1
Parenteral nutrition	2

Using this score, they found that patients with a score of more than 7 were at a higher risk of developing intestinal anastomotic dehiscence. This has also been shown to reduce the delay in the diagnosis of AL from a median of 4 days to 1.5 days with a concomitant reduction in mortality from 39% to 24%.[15]

MATERIALS AND METHODS

Study population: In a study conducted by FD McDermott, the incidence of AL was up to 19%. 1 Consequently, the estimated sample size using the formula for proportions i.e., Zαpq/d2 was 236. (Here Zα= 3.84 at 95% Confidence Limit, p= Proportion of patients having AL, q= Proportion of patients not having AL, d= Relative precision taken as 5%). Considering 5% non-response and / or loss in follow up rate, which would lead to little bias the final sample size was 250.[16]

With this background we conducted a prospective, observational study with 250 patients who underwent elective intestinal anastomosis over a period of 1 year from November 2023- October 2024. Exclusion criteria were as follows: patients with stoma at the time of operation, reversal of stoma without anastomosis, pregnancy, or ongoing infection before surgery.

Post-operative protocol: Post-operative clinical examination was conducted daily including assessment of volume and nature of drain output and the DULK score was calculated in all cases. The baseline score was calculated on the day of operation (D0) and then every day, starting from post-operative day 2 (D2) to post-operative day 4 (D4) as per the original study. If the score was calculated more than once over a period of 24 hours, then the highest score was used. We did complementary investigations as and when required and imaging was done routinely to detect AL when there was clinical suspicion. We considered a Dutch Leakage (DULK) Score positive with a value more than 7.

All complications were documented according to Clavien-Dindo classification including AL.[17]

We defined AL as any deviation from standard post-operative course following intestinal anastomosis along with presence of pus or enteric fluid or colonic content or fecal matter in drain or through main surgical wound or presence of abdominal and or pelvic collection in the area of anastomosis or contrast leakage through the anastomosis on CT scan or anastomotic dehiscence found during re-exploration.

Follow up was conducted in the outpatient clinic at 2-week interval for 1 month and then monthly for up to 3 months following operation.

Outcome criteria: The primary endpoint of this study was to evaluate the efficacy of Dutch leakage (DULK) score for early detection of AL in patients who undergone elective intestinal anastomosis. The efficacy was evaluated by its sensitivity, specificity, positive predictive value and negative predictive value.

The secondary endpoints of this study were to evaluate immediate (during operation), early (during post-operative hospital stay), and late (up to 3 months post-operative) morbidity or complications and mortality assessment, need for re-exploration, duration of post-operative stay in the hospital and need for re-hospitalization for up to 3 months following operation.

Statistical analysis: We performed a descriptive analysis of the variables with measurement of sensitivity, specificity, positive predictive value, negative predictive value and accuracy of Dutch-leakage scale diagnostic test in a 2×2 table. Data recording and analysis were performed with IBM SPSS V 21 statistical software. Quantitative values are expressed as mean (s.d.) or median values, with ranges and 95 per cent C.I. Categorical data are shown with percentage frequencies. Receiver Operating Characteristic curve was created for Dutch-leakage scale and Anastomotic leak. Values of 0·7–0·8 were considered acceptable, 0·8–0·9 as excellent, and those above 0·9 as outstanding. For all statistical tests the significance level was fixed at P <0·05.

RESULTS

We conducted a prospective observational study with 250 patients who underwent elective intestinal anastomosis over a period of 1 year to assess the

validity of Dutch Leakage (DULK) Score as a predictor of AL.

From demographic point of view, of these 250 patients, 154 (61.6%) were male and 96 (38.4%) were female with a sex ratio 1.6. The mean age of these patients was 50 ± 11.06 years.

The indications for operative interventions varied; with 156 cases (62.4%) having a diagnosis of carcinoma, 42 (16.8%) cases having inflammatory bowel disease and tuberculosis, 32 (12.8%) cases were done for reversal of a previously created stoma, 8 (3.2%) had colonic diverticular disease and 12 (4.8%) were for miscellaneous causes.

Of the 250 cases, small intestinal anastomoses were performed for 65 cases (26%), and colonic anastomosis were performed for 185 cases (74%).

We performed 136 (54.4%) manual anastomoses and 114 (45.6%) anastomoses were done by surgical stapler.

In our study we found Dutch Leakage (DULK) score was positive (>7) in 40 cases (16%) and the score was negative in 210 cases (84%). Of the 250 cases, AL was present in 29 cases (11.6%) and leak was absent in remaining 221 cases (88.4%).

While corroborating with Dutch Leakage (DULK) score, we found that of the 40 cases in which the score was positive, 22 (55%) actually had AL, while in 18 (45%) score - positive cases no leakage was found.

On the reverse, out of 210 score negative cases, leak was absent in 203 (96.66%) cases while leak was present in 7 (0.33%) score - negative cases.

We confirmed AL by the presence of enteric fluid or colonic content or fecal matter in drain or through main wound in 21 (72.42%) cases, while in 8 (27.58%) cases leak was confirmed by CT scan.

As per demographic distribution anastomotic leak was present in 18 males (11.68%) and in 11 (11.45%) females.

In terms of disease pathology, we found anastomotic dehiscence in 18 carcinoma cases (11.53%), 7 (16.66%) dehiscence in inflammatory bowel disease and tuberculosis, 3 (9.37%) dehiscence in stoma reversal and 1 (12.5%) case of dehiscence in colonic diverticular disease.

In terms of anatomical position of anastomosis, small intestinal anastomosis had a leak in 9 cases (13.84%), while large intestinal anastomosis had a leak in 20 cases (10.81%).

Anastomotic dehiscence was present in 16 (11.76%) cases of manual anastomosis, while stapled group had an anastomotic dehiscence of 13 (11.45%) cases [Table 1].

In our study, the mean time to diagnose AL was on the basis of DULK Score was 3 ± 0.31 days and the same on the basis of drain output nature and or radiological findings was 5 ± 1.2 days.

Table 1: Distribution of patients according to etiology and technique of anastomosis

Criteria	AL +ve	AL –ve
Total population-250	29 (11.6%)	221 (88.4%)
DULK +ve- 40(16%)	22 (55%)	18 (45%)
DULK –ve- 210 (84%)	7 (3.33%)	203 (96.67%)
Male- 154 (61.6%)	18 (11.68%)	136 (88.32%)
Female- 96 (38.4%)	11 (11.45%)	85 (88.55%)
Carcinoma- 156 (62.4%)	18 (11.53%)	138 (88.47%)
IBD and Tuberculosis- 42 (16.8%)	7 (16.66%)	35 (83.34%)
Stoma reversal- 32 ((12.8%)	3 (9.37%)	29 (90.63%)
Colonic diverticular disease- 8 (3.2%)	1(12.5%)	7 (87.5%)
Others- 12 (4.8%)	0	12 (100%)
Hand sewn anastomosis- 136 (54.4%)	16 (11.76%)	120 (88.24%)
Stapled anastomosis- 114 (45.6%)	13 (11.4%)	101 (88.6%)

In this study, we found a morbidity in 109 (43.6%) cases, of which 80 (73.4%) belonged to Clavien Dindo grade 1 and 2, while 26 (23.85%) were in grade 3a, 3b, 4a and 3 (2.75%) were in grade 4b.

The overall mortality in our study was 7 (2.8%). Of these one patient died due to sudden cardiac arrest, another one died from pulmonary embolism and five patients died due to septicaemic shock with multisystem organ dysfunction as a result of AL. Consequently, in our study, AL has an actual mortality of 17.24%.

Of the 29 cases of AL, re operation was done in 18 cases, 7.2% of total population and leak specific reoperation was 62.06%.

The mean time of post-operative stay in hospital was 8.9 ± 4.05 days. There was no readmission for features suggestive of sepsis due to delayed leakage after the index admission.

Table 2: Positivity of parameters (%) of Dutch Leakage (DULK) Score in patients with AL

Parameter	POD 2	POD 3	POD 4
Fever>38*C	9	33	71
Respiratory frequency>30/minute	59	67	94
Cardiac frequency>100/minute	84	96	100
Oliguria<30ml/hour OR <700ml/24 hour	10	33	78
Agitation OR lethargy	4	11	18
Clinical deterioration	38	68	95
Ileus	47	71	91
Gastric retention	38	55	80
Surgical wound dehiscence	8	17	29

Abdominal pain	29	41	67
Leukocytosis OR CRP elevation>5%	57	74	95
Creatinine elevation OR Urea>5%	18	39	66

We found that clinical heart rates, respiratory rates and leukocytosis or CRP elevation were the early changes to predict a leak [Table 2].

Table 3: Median (Range) Dutch Leakage (DULK) Score in patients with AL

Baseline	POD 2	POD 3	POD 4
0 (0-2)	4 (2-8)	8 (5-11)	10 (8-16)

The median DULK score in patients with AL was highest on POD 4 (Table 3) with a negative predictive value of more than 95% demonstrating its utility in clinically ruling out a leak (Table 4).

Table 4: Performance of DULK Score in predicting AL

Dutch Leakage (DULK) Score	AL Positive	AL Negative	Total
Positive	22	18	40
Negative	7	203	210
Sensitivity (%)	75.86		
Specificity (%)	91.85		
Positive predictive value (%)	55		
Negative predictive value (%)	96.66		
Diagnostic accuracy (%)	90		

On Receiver operating characteristic curve analyses we found an area under the curve of 0.965 with a p = 0.000 suggestive of strong correlation of DULK score with AL. [Figure 1]

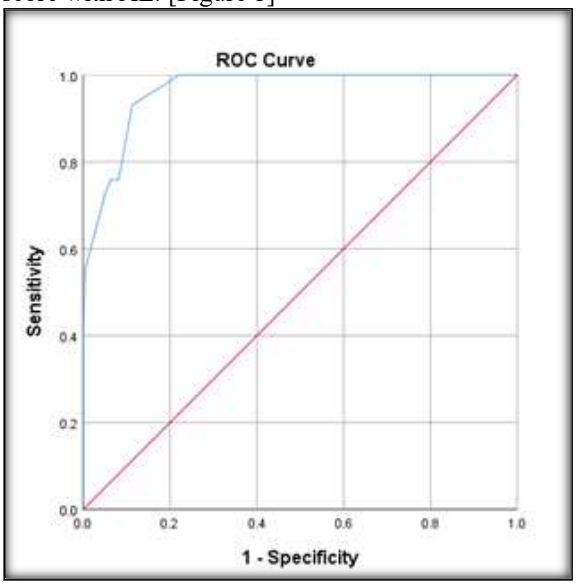

Figure 1: ROC curve showing correlation of DULK scores with Anastomotic Leak

We did not observe any statistically significant difference of anastomotic leak between male (11.68%) and female (11.45%) patients (p = 0.96), between malignant (11.53%) and non-malignant (11.70%) cases (p = 0.97) or between manual (11.76%) and stapled (11.4%) anastomosis (p=0.93).

DISCUSSION

Anastomotic dehiscence is a grave complication following intestinal surgery. Because of its varied presentation, from vague pain abdomen, prolonged paralytic ileus to septicemic shock with multi system organ dysfunction, it could be difficult to diagnose the leak at an early stage and when the leak is clinically overt it is often too late to prevent its complications and poor outcome. Despite recent advances in surgical techniques, cutting edge instruments, and provision of better post-operative care, the incidence of AL remains unchanged.[18] So it is of utmost importance to diagnose AL at an early stage to reduce the morbidity and mortality associated with AL.

Dulk and collaborators, in 2009, proposed a scoring system incorporating certain clinical findings and laboratory parameters to diagnose AL at an early stage. They enrolled 782 cases of colonic anastomoses in which 81 (10.4%) AL were documented. Their scoring system had a sensitivity of 97%, specificity of 53%, positive predictive value 16% and negative predictive value 99%. Using this score, they found that patients with a score of more than 7 were at a higher risk of developing intestinal anastomotic dehiscence. This has also been shown to reduce the delay in the diagnosis of AL from a median of 4 days to 1.5 days with a concomitant reduction in mortality from 39% to 24%. They also used a modification of the scale, incorporating clinical condition, abdominal pain not localized to the wound, C- reactive protein level and respiratory rate. With at least one parameter present, they found the overall sensitivity was 97%, overall specificity 57%, positive predictive value 17% and negative predictive value 99.5%. With at least two points, the positive predictive value was 41% and with three points the positive predictive value was increased to 57%.[19]

In our study, we got a sensitivity, specificity, positive and negative predictive values and diagnostic accuracy of 75.86%, 91.85%, 55%, 96.66% and 90% respectively which are comparable with the original research work [Table 4]. However, the difference in sensitivity, specificity and positive predictive values

could be due to lesser number of cases and socio-economic differences, difference in health seeking behaviour and clinic-demographic pattern.

Martin G et al in 2015 conducted another retrospective study to validate Dutch Leakage (DULK) Score for early diagnosis of AL in 100 patients, in which 12 patients developed AL (12%) with a leak specific mortality rate of 16.6% (2 patients). They considered a DULK Score >3 as a positive score for early diagnosis of leak with a sensitivity of 91.7%, a specificity of 55.7%, a positive predictive value of 22%, a negative predictive value of 98% and diagnosed AL 3.5 days earlier than clinical judgement alone. They concluded this scoring system is a very reliable tool for early diagnosis of AL after colorectal surgery and should be integrated into risk management health policies.[20]

Catarci M et al in 2020 conducted a multi-centre based study to evaluate the role of DULK Score, serum C-reactive protein, serum procalcitonin for early diagnosis of AL. Among 1546 patients enrolled in 19 centres, they observed that in terms of detection of AL DULK Score was better than serum C-reactive protein, serum procalcitonin on post-operative day 2 and 3. The combination of positive DULK Score, serum C-reactive protein, and serum procalcitonin values resulted in a probability of AL of 21.3% on post-operative day 2, 33.4% on post-operative day 3, and 47.1% on post-operative day 6. The combination of their negative values excluded AL in 99·0 % of cases on post-operative day 2, 99·3% on post-operative day 3, and 99·2 % on post-operative day 6. They concluded DULK Score and serum C-reactive protein level are good positive and excellent negative predictors of AL; the addition of serum procalcitonin improved the predictive value for diagnosis of AL.[21]

Albatanony A A et al in 2019 conducted a prospective study with 80 patients who undergone colorectal anastomosis to evaluate the role of DULK Score and serum level of C-reactive protein for the early diagnosis of AL. They found clinically evident AL in 12 (15%) cases and which were diagnosed postoperatively on day 6 (median value). The median interval between appearance of the initial signs of clinical deterioration and the confirmation of AL was 3 days using DULK Score. Serum level of C-reactive protein was significantly higher in patients with leakage with a cut off value of 120 mg/l on post-operative day 3. They concluded that routine application of DULK Score was able to detect AL 3 days earlier than clinical diagnosis.[22]

Antonio AB et al in 2021 conducted a study with 125 patients who underwent intestinal anastomosis to validate the DULK Score and they observed a sensitivity of 100%, a specificity of 95%, a positive predictive value of 82.7%, negative predictive value of 100% and a diagnostic accuracy of 96%. They concluded DULK Score is an inexpensive, versatile, easily applicable tool which is capable of early diagnosis of AL.[23]

Malibary N et al in 2021 conducted a study with 101 cases of elective colorectal surgery with colo-colic or colo-rectal anastomosis to evaluate retrospectively the role of DULK and modified DULK score to diagnose AL. Of the 101 cases enrolled, 8 (7.9%) had AL. DULK Score had a sensitivity of 62.5%, a specificity of 86.32%, a positive predictive value of 27.78%, negative predictive value of 96.39%. They observed modified DULK Score had a sensitivity of 75%, a specificity of 76.43%, positive predictive value of 21.43% and a negative predictive value of 97.26%. The DULK and modified DULK Scores were able to detect AL on average of 2 and 1.7 days earlier than the clinical diagnosis respectively. They concluded DULK and modified DULK Scores are excellent tool to rule out AL following colorectal surgery.[24]

In our study, we enrolled 250 cases of intestinal anastomosis where only DULK Score was used for early diagnosis of AL. We got a positive DULK score (>7) in 40 cases of whom 22 patients had clinically evident AL. Of the 210 DULK Score negative cases 7 patients had AL. The mean time to predict AL was 3 days (range 2-4 days) which was 2 days earlier for clinical detection of AL (range 4-13 days). This finding is comparable with findings of original studies by various authors where the leaks were diagnosed by DULK score by 1.5 days to 3.5 days earlier than that were clinically evident.[15,19,20,22,24]

Analysing the data of our study and comparing this data with the above mentioned studies, we can conclude that we have validated the DULK Score as a tool for early detection of AL following intestinal anastomosis. It is a versatile tool, easy to apply, available in all healthcare setups.

Limitations

The main limitation of this study is relatively small size of the study population as it was conducted in two centres only. A large, multicentre based study with varied demographic and clinical characteristics is strongly recommended to overcome this limitation.

CONCLUSION

The Dutch Leakage (DULK) Score is an excellent tool for early detection of AL following intestinal anastomosis. It helps in early re-intervention, improves survival and prognosis, and decreases hospital stay as also cost of medical care. The present study attempts to highlight the benefits of use of Dutch Leakage (DULK) Score for early diagnosis of AL and we recommend this score should routinely be utilized post-operatively following intestinal anastomosis.

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