Dedicated staff for patient education improves bowel preparation quality and reduces the cecal intubation time of colonoscopy
A single institution retrospective study

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Abstract
Adequate bowel preparation is an essential part of a high-quality colonoscopy. Recent studies showed that the small-volume bowel cleansing agent Bowklean performs better in terms of tolerability and acceptability. However, its split-dose regimen is sometimes confusing to the patient. To promote Bowklean in Fu Jen Catholic University Hospital, dedicated staff for patient education on bowel preparation were provided by Universal Integrated Corporation (Taiwan), but not in every period because of the clinic room availability and manpower capacity. This provided us an opportunity to compare the quality of colonoscopy between those with and without the dedicated patient education. This study aimed to compare various quality indices between the two groups. We set bowel preparation quality as the primary endpoint, assessed by modified Aronchick scale, and other quality indices including procedure time and adenoma detection rate as the secondary endpoints. We performed a single institution retrospective study. All patients who received colonoscopy from an outpatient setting with Bowklean as the bowel cleansing agent from October 2020 to November 2020 were reviewed. Primary and secondary endpoints were then compared between the conventional group and the dedicated staff group, with StataSE 14 by Wilcoxon rank sum test or logistic regression. Four hundred ten patients were recruited, including 217 patients with dedicated patient education and 193 without. The proportion of bowel preparation quality “Excellent + Good + Fair” was significantly higher in dedicated staff group than conventional group (97.7% vs 93.3%, \( P = .03 \); logistic regression coefficient = 1.12). The cecal intubation time was significantly shorter in the dedicated staff group (3.68 ± 2.02 minutes vs 4.52 ± 3.25 minutes, \( P < .01 \)). After excluding those with polypectomy or biopsy, the total procedure time tended to be shorter in the dedicated staff group (10.2 ± 3.35 minutes vs 9.40 ± 2.43 minutes, \( P = .06 \)). There was no significant difference regarding adenoma detection rate between the two groups. Our study shows that patient education by dedicated staff can improve bowel preparation quality and has the potential to decrease procedure time. Further large-scale prospective trials are still needed to evaluate if it can also achieve a better adenoma detection rate.

Abbreviations: ADR = adenoma detection rate, CRC = colorectal cancer, FJUH = Fu Jen Catholic University Hospital.

Keywords: colonoscopy, quality improvement

1. Introduction
Colorectal cancer (CRC) is the leading cause of death worldwide.[1] Colorectal cancer screening is an essential part of CRC early detection.[2] Adequate bowel preparation improves the detection of colorectal lesions and is essential for successful colonoscopy screening.[3] Nevertheless, nearly one-quarter of colonoscopies are associated with inadequate bowel preparation.[4] Recent research and previous studies indicated that a split-dose regimen with smaller volumes and a more pleasant taste provided a more tolerable experience, and hence significantly improved the efficacy of bowel cleansing.[5] Currently, there are several high-quality formulas available, including Bowklean (sodium picosulfate/magnesium citrate preparation). Bowklean was demonstrated to beat traditional large-volume formula out in terms of tolerability and acceptability.[5] However, our clinical experience had shown that its split-dose regimen was sometimes confusing. Besides, low-residue diet and how to use bowel-cleansing agents, for an average of
Table 1
Comparison of the patient education between conventional group and dedicated staff group.

|                      | Conventional group | Dedicated staff group |
|----------------------|--------------------|----------------------|
| The health staff     | Doctor and nurse   | A dedicated staff provided by Universal Integrated Corporation, Taiwan |
| Equipment            | Two-page diagrammatic leaflets about the restriction of low-residue diet and how to use bowel-cleansing agents. A one-page diagrammatic leaflet describing how the stool looks like under good/poor bowel preparation | Yes | Yes |
| Consuming time       | 3–5 min            | 5–10 min             |

Table 2
Modified Aronchick scale.

| Score   | Description                                                                 |
|---------|-----------------------------------------------------------------------------|
| Excellent | Small volume of clear liquid, or greater than 95% of surface seen          |
| Good    | Large volume of clear liquid covering 5–25% of the surface but greater than 90% of surface seen |
| Fair    | Presence of some semi-solid stool that could be suctioned or washed away but greater than 90% of surface seen |
| Poor    | Semi-solid stool that could not be suctioned or washed away and less than 90% of surface seen |

510 patients receiving colonoscopy with Bowklean during Oct. to Nov. 2020.

Total 410 patients were recruited

217 patients with patient education by dedicated staff

193 patients with patient education by doctor and nurse

100 patients were excluded
- 8 patients were referred from local medical doctor for polyp management
- 1 patient didn’t complete the colonoscopy owing to intolerance
- 2 patients’ colonoscopy were not performed by experienced colonoscopist
- 24 patients had colorectal cancer regardless of being treated or not
- 65 patients had previous colonoscopy within three years in FJUH

Figure 1. The flowchart of patient recruitment.
Table 3
Basic characteristics.

|                      | Conventional group | Dedicated staff group | p* |
|----------------------|--------------------|-----------------------|----|
| **Age (yrs), mean ± SD** | 48.3 ± 13.8        | 53.6 ± 14.0           | <.01 |
| Male, n (%)          | 109 (52.3)         | 109 (50.2)            | .67 |
| Intravenous anesthesia, n (%) | 123 (63.7)          | 142 (65.4)            | .72 |
| Performed by operator with experience > 5 years, n (%) | 102 (52.8)            | 86 (39.6)             | <.01 |

Table 4
Comparison of bowel preparation quality, procedure time, and adenoma detection rate between conventional group and dedicated staff group.

|                      | Conventional group (n = 193) | Dedicated staff group (n = 217) | p* |
|----------------------|------------------------------|---------------------------------|----|
| Colon preparation quality† |                               |                                 |    |
| Good preparation, n (%) | 140 (72.5%)                   | 156 (71.9%)                     | 0.88 |
| Adequate preparation, n (%) | 180 (93.3%)                   | 212 (97.7%)                     | 0.03 |
| Procedure time |                                |                                 |    |
| Cecal intubation time (min), mean ± SD | 4.52 ± 3.25                | 3.68 ± 2.02                     | <0.01 |
| Withdrawal time‡ (min), mean ± SD | 5.90 ± 1.58                | 5.82 ± 1.60                     | 0.38 |
| Total procedure time‡ (min), mean ± SD | 10.2 ± 3.35               | 9.40 ± 2.43                     | 0.06 |
| Adenoma detection, n (%) |                                |                                 |    |
| All patients | 49 (25.4%)                   | 61 (28.1%)                      | 0.53 |
| FIT+§ | 12 (38.7%)                  | 12 (57.5%)                      |    |

FIT = fecal immunochemical test.
*Statistics by Wilcoxon rank sum test (procedure time)/logistic regression (colon preparation quality, adenoma detection rate).
†“Good preparation” was defined as modified Aronchick scale “Excellent” or “Good”. “Adequate preparation” was defined as modified Aronchick scale “Excellent”, “Good”, or “Fair”.
‡For withdrawal time and total procedure time, only those without polypectomy or biopsy were recruited (n = 126/129, respectively).
§The number of patients with positive FIT was 31/32 in the two groups, respectively.
adequate preparation, which accounted for 93.3% (180 in 193) in the conventional group and 97.7% (212 in 217) in the dedicated staff group ($P = .03$; coefficient = 1.12) (Table 3). We also treated these data as ordinal ones (excellent = 4, Good = 3, and so on) and analyzed them with Wilcoxon rank sum test, while there was no significance ($P = .65$; not shown in the table).

Regarding procedure time, cecal intubation time was significantly shorter in the dedicated staff group (3.68 ± 2.02 minutes vs 4.52 ± 3.25 minutes, $P < .01$) (Table 4, Fig. 2); the difference remained significant after excluding patients with the longest three in each group (3.56 ± 1.77 minutes vs 4.27 ± 2.64 minutes, $P < .01$; not shown in the table). As for the withdrawal time and total procedure time, there was no significant difference between the two groups (withdrawal time: 8.11 ± 4.86 minutes vs 8.37 ± 5.75 minutes, $P = .95$; total procedure time: 12.63 ± 6.48 minutes vs 12.05 ± 6.17 minutes, $P = .28$; not shown in the table). Because great variability existed regarding the degree of difficulty and time of polyp management, the two indices were analyzed again after excluding those with polypectomy or biopsy. One hundred twenty six in the conventional group and 129 in the dedicated staff group were left. Still, no significant difference was noted in withdrawal time (5.90 ± 1.58 minutes vs 5.82 ± 1.60 minutes, $P = .38$), while the total procedure time tended to be shorter in the dedicated staff group (10.2 ± 3.35 minutes vs 9.40 ± 2.43 minutes, $P = .06$) (Table 4, Fig. 2).

ADR was calculated after correlation with pathology report, while no significant difference was noted in the two groups (49 adenoma detection in 193 vs 61 adenoma detection in 217, $P = .53$). The same statistical analysis was done in those with positive fecal immunochemical test, and there was still no significant difference (12 in 32 vs 13 in 31, $P = .92$).

4. Discussion and Conclusions

Adequate bowel preparation is one of the most important quality indicators of screening colonoscopy, which is vital for complete mucosal inspection.[13] Poor colon preparation decreases ADR significantly, and the screening colonoscopy is suggested to be repeated under the condition of inadequate bowel preparation.[14] Bowel-cleansing formulas play an important role in bowel preparation, and recent studies indicated that split-dose formulas were superior to the traditional single-dose large-volume ones.[5,6,15] However, the split-dose regimen is more complicated, so patient education matters. The importance of patient education as an essential part of successful bowel preparation had been addressed in previous studies. Questionnaire after regular instructions, dietician-designed recipe, cell phone message reminding, education through multimedia, and personalized patient education were reported to enhance the effect of bowel preparation and decrease the rate of poor colon preparation.[11,12,6,17] Our study, on the other hand, showed that dedicated staff not only improved the quality but also decreased the procedure time, an issue which had not been fully investigated in previous studies. We postulated that it was because better bowel preparation quality led to decreased time consuming on fecal material cleansing. Since the shortcut of colonoscopist manpower became an issue after the implementation of mass-screening programs for colorectal cancer,[18,19] the shortened procedure time may aid in the relief of this situation.

There were some advantages of our study compared with previous ones. First of all, the quality indicators of the conventional group were all up to standard, with the ratio of poor colon preparation below 10% and ADR higher than required by the current guideline.[10] This fact strengthened the credibility of our conclusion, since the control group was already good enough, and the dedicated staff group performed even better. Second, it’s the first study in the similar field proving that good bowel preparation has the potential to decrease procedure time. However, weakness existed in our study. Owing to its retrospective nature, there were some differences in basic characteristics between the two groups. There were no adequate data on how patients’ age affects bowel preparation, and subgroup analysis showed no difference regarding bowel preparation quality and procedure time between colonoscopists with experience $>5$ and $\leq5$ years ($P = .40$ for the ratio of adequate preparation and $P = .09$ for cecal intubation time, respectively). Second, the better bowel preparation quality in the study group failed to translate into better ADR in our work, as in previous studies.

In conclusion, our study shows that patient education by dedicated staff can improve bowel preparation quality and has the potential to decrease procedure time. Further large-scale prospective trials are still needed to evaluate if it can also achieve a better adenoma detection rate.
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