Left-colon antegrade enema (LACE): Long-term experience with the Macedo-Malone approach

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Left-Colon Antegrade Enema (LACE): Long-Term Experience With the Macedo–Malone Approach

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Aims: We evaluated the long-term results with a left antegrade continence enema (LACE) approach: “Macedo–Malone (MM) procedure” to define parameters such as clinical durability of the technique and patients’ compliance with the method. Methods: We reviewed the medical records of all patients that underwent the MM procedure in our institution since 2001 and conducted a telephonic interview to investigate the use of the enema and satisfaction with the procedure. Results: Thirty-five MM procedures were performed, but eight patients lost to follow-up were excluded. Fifteen patients (55%) were female. Myelomeningocele was the clinical diagnoses in 25 (93%). Mean age at surgery was 9 years (3–27 years) and mean follow-up was 75 months (median: 56 months). The indication for LACE was clinically intractable constipation with fecal leakage. Most patients still used the stoma regularly to do the enema. Overall reoperation rate was 25.8% and fecal continence was 89%. There were no reports of leakage through the stoma. Among patients who still used the stoma, 74% were satisfied with the procedure and would strongly recommend the procedure to another patient. Conclusions: The MM procedure is a straightforward procedure, which can be performed in 15–20 min, avoids additional enteron–enteroanastomosis, precludes the use of the appendix, and has shown comparable results to either “classical” MACE or other LACE variants. Neurourol. Urodynam. © 2015 Wiley Periodicals, Inc.

Key words: fecal incontinence and constipation; left antegrade continent enema; neurogenic bladder

INTRODUCTION

Fecal incontinence and intractable constipation are frequently associated with spinal cord abnormalities such as myelomeningocele, anorectal malformations, and sacral agenesis. Conservative management of fecal incontinence and intractable constipation includes stool softeners, bulking agents, digital rectal stimulation, suppositories, enemas, and biofeedback, which are considered first-line approach for those individuals.

When a patient is considered refractory to conservative management, an antegrade continence enema (ACE) procedure begins by isolating a 3-cm transverse flap in a tenia on the left colon (Fig. 1A). A 12-Fr silicone Foley catheter is placed on the mucosal surface of the flap to allow tubularization of the plate with running polyglycolic acid 3-0 sutures (Fig. 1B), creating an effenter tubular conduit (Fig. 1C). The continence valve mechanism is produced by embedding the tube over a serous lined extramural tunnel created by interrupted 3-0 polypropylene sutures (Fig. 1D). The distal end of the tube is anastomosed into a V shape to the skin flap to avoid stoma stenosis. A catheter is left indwelling in the conduit for 3 weeks, through which enema administration begins 7–10 days postoperatively.

We retrospectively reviewed the medical records of all patients who underwent the MM procedure in our institution since 2001. Demographics, indication for surgery, postoperative complications, follow-up time, and stool continence rate, stoma

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healing, and cosmetic appearance were reviewed. In addition, we conducted a telephonic interview with patients and families, using a questionnaire to investigate the use of the enema and satisfaction with the procedure (Appendix 1).

RESULTS

Thirty-five MM procedures were performed in the period studied. Eight patients were lost to follow-up and were excluded from the study. Of the 27 remaining patients, 15 (55%) were females and 12 (45%) were males. Clinical diagnoses were myelomeningocele in 25 (93%) and anorectal malformations in two (7%). Mean age at surgery was 9 years old (3–27 years). The indication for LACE was clinically intractable constipation with fecal leakage. Mean follow-up was 75 months.

One patient presented cutaneous fistulae and peristoma infection in the short-term postoperative time which resolved with antibiotics and leaving a Foley tube indwelling for 2 months. No other relevant acute complications were noted. Most patients still used the stoma regularly to do the enema (74%). One patient stopped using the conduit because their bowel habits improved satisfactorily. Another patient lost the channel due to inappropriate use by their parents. Two patients lost the conduit due to excessive weight gain and obesity and consequent misuse of the channel. Of these two patients, one currently performs enema through the rectum and the other had his MM procedure converted into a classic MACE procedure using the cecal appendix. Another three patients used the stoma only sporadically because they reported improvement of their bowel habits after nutritional changes. In summary, only three patients had channel complications that impacted MM use, whereas the other four stopped using it regularly either because they did not need it anymore (one patient) or because it would be helpful just occasionally.

Fig. 1. Operative steps of the surgery.
The main irrigation solution used was tap water, except by two patients who used saline solution and another patient who used glycerin solution 12%. Mean washout time of the enema was 27 min (2–90 min). The average volume used was 735 ml (range 300–3,000 ml). Among the patients who still use the conduct, the frequency of use varied from daily enema (10/20; 0%), every 2 days (9/20; 45%), and every 3 days (1/20; 5%). The catheter diameter used in most cases was 12 Fr (8–12 Fr). All subjects did the washing by gavage as oriented by the specialist nurse, except one patient who used syringe infusion.

Five patients experienced mild sporadic pain by the passage of the catheter, which did not prevent continuous use. The revision rate due to stenosis was 22.2% (6/27) and all patients underwent suprafascial revision after a mean time of 18 months after surgery. We performed one classical MACE by infrrafascial approach as a salvage procedure. Overall reoperation rate was 25.8%. There were no reports of leakage through the stoma. All patients or parents who performed the enema considered it easy to catheterize the conduit. Among the patients who still used the stoma, 88.89% reported fecal continence and most of them were satisfied with surgery (74%) and would strongly recommend the procedure to another patient with the same disease (74%). We have been using the ACE-stopper device as a way to avoid stoma strictures in recent patients (Fig 2). The clinical results are summarized in the Table I.

**DISCUSSION**

In 1990 Malone et al.\(^\text{11}\) described the antegrade continence enema (ACE) conduit via an appendicocecostomy. The original procedure combined the principle of an antegrade colonic enema for colonic washouts, with the Mitrofanoff technique for forming a continent, non refluxing conduit that can be easily catheterized via the abdominal wall. The goal of the procedure was to prevent soiling in children with fecal incontinence and clinically intractable constipation. The MACE procedure has also been performed laparoscopically with good results with or without plication of the appendix over a serous-lined tunnel.\(^\text{2}\)

Difficulty catheterizing the Malone antegrade continence enema (MACE) channel is the most frequently observed

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**TABLE I. Summary of Clinical Data: Epidemiology, Complications, and Enema Details**

<table>
<thead>
<tr>
<th>Epidemiology</th>
<th>12 (45%): 15 (55%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex, male: female</td>
<td>MMC: 25 (93%); ARM: 2 (7%)</td>
</tr>
<tr>
<td>Age at procedure (years)</td>
<td>Mean: 75; Median: 56 (5–164)</td>
</tr>
<tr>
<td>Indication of LACE(^a)</td>
<td>5 (18.5%)</td>
</tr>
<tr>
<td>Length of follow-up (months)</td>
<td>Partially continent 3 (11.1%)</td>
</tr>
<tr>
<td>Incidence of complications</td>
<td>None</td>
</tr>
<tr>
<td>Mild pain during catheterization or enema</td>
<td>6 (22.2%)</td>
</tr>
<tr>
<td>Incontinence</td>
<td>1 (3.7%)</td>
</tr>
<tr>
<td>Stomal leakage</td>
<td>7 (25.9%)</td>
</tr>
<tr>
<td>Stomal revision by stenosis</td>
<td></td>
</tr>
<tr>
<td>Fistulae</td>
<td></td>
</tr>
<tr>
<td>Redo MACE</td>
<td></td>
</tr>
<tr>
<td>Nonuse/infrequent use/stomal lost</td>
<td></td>
</tr>
<tr>
<td>Summary of enema details</td>
<td></td>
</tr>
<tr>
<td>Content</td>
<td></td>
</tr>
<tr>
<td>Volume (cc)</td>
<td>Water 17 (63%), glycerin 1 (3.7%), saline 2 (7.4%)</td>
</tr>
<tr>
<td>Wash out time (min)</td>
<td>735 (300–3,000)</td>
</tr>
<tr>
<td>Frequency(^b)</td>
<td>27 (2–90)</td>
</tr>
<tr>
<td>Easy catheterization</td>
<td>D (50%), 2D (45%), 3D (5%)</td>
</tr>
<tr>
<td>Infusion, gavage: syringe</td>
<td>20 (74%)</td>
</tr>
<tr>
<td></td>
<td>19 (70.3%): 1 (3.8%)</td>
</tr>
</tbody>
</table>

\(^a\)According to the disease responsible for changes in evacuation: MMC, meningomyelocele; ARM, anorectal malformation.

\(^b\)Frequency of enemas: D, Daily; 2D, every 2 days; 3D, every 3 days.
complication with reports ranging from 5% to 36%. It can occur either at the skin level from stoma stenosis or intra-abdominal obstruction due to obliteration, angulation, and/or false passage of the channel. Stoma leakage is a highly distressing complication to the patient with published reports ranging from 3% to 6%. VanderBrinck et al. reported that from a total of 282 patients who underwent creation of a MACE, 49 patients (17%) required 68 surgical revision procedures. Mean time from MACE creation to revision was 19 months. Skin level or endoscopic procedures accounted for 52/67 (78%) procedures. Sixteen patients (33%) required more than one revision and three patients (6%) required more than two procedures. This critical review of an expressive series outlines that almost one in five cases will require a surgical revision.

Irrespective of stoma complications, which can occur with any colonic stoma, LACE appears more physiological than right colonic antegrade colonic enema enemas because the enema is less likely to impair water absorption, which occurs predominantly in the ascending colon. Moreover, delivery of enemas into the descending colon targets the stool where it is hardest, benefits from gravity, and results in timely and effective bowel evacuation. In our series, mean washout time was 27 min and a review of the literature summarized in Table II showed comparable results. Mean LACE washout duration was 28.8 min in five papers that included average washout time (listed in Table II).

Ellison et al. reviewed experience with the Malone antegrade colonic enema procedure and investigated functional outcomes and complications of proximal (cecal) MACE in 48 cases and distal (sigmoid colon) LACE in 55. Location did not affect the overall efficiency of fecal continence. Flush time was shorter for distal than for proximal MACE stomas (37.2 vs. 61.2 min, P < 0.003). Fifteen patients underwent a total of 20 complete MACE revisions, including 12 proximal and six distal MACES. As a channel, the appendix was associated with a higher but not statistically significant stoma complication rate compared to the colon (42% vs. 25%). Chang et al. also reported on a long-term outcome of left-sided versus right-sided ACE. They compared left-sided ACE in 25 patients (group 1) and right-sided in 26 patients (group 2) and found that nonuse or infrequent use of ACE was more common in group 1 than in group 2 (11/25 [44.0%] vs. 0/26 [0%]) and higher patient satisfaction in group 2 (P = 0.0015).

We found that seven patients (25.9%) reported either nonuse or infrequent use of the MM procedure that were either associated with stoma loss (3/7) or because of improvement in bowel habits (4/7). This information outlines the importance of early recognition of inappropriate ACE use in order to minimize and avoid complications. As previously stated, stenosis of the stoma was assessed by six cases (22.2%) and remains the main complication in our series.

We confirmed significant changes in social status in our population. It is well accepted that ACE procedures improve quality of life issues and other social parameters reported by patients. Har et al. asked patients’ parents/guardians to complete the PedsQL(TM) Generic Core Scales QOL survey prior to the operation, 6 months after, and 12 months after the procedure. A total of 15 consecutive patients underwent MACE procedure at a mean age of 9.8 years (range 7.0–11.1 years). The mean QOL score pre-MACE was 64.1. At 6-months post-MACE, the mean overall QOL score was 90.2, and it was 92.0 at 12 months. All 15 patients at the 6-month follow-up had significant improvement in their QOL (P = 1.9 × 10(−7)) and all subcategories of their QOL were significantly improved as well. We did not complete QOL surveys, but 89% of our patients reported fecal continence and 74% were satisfied with surgery and would strongly recommend the LACE procedure to another patient with the same disease.

We acknowledge that from the initial 35 patients, follow-up was possible in only 27 patients and important data could have been missed. We assume that this can be explained in terms of patients who came from distant places to our tertiary center deciding to visit local care for follow-up after stabilizing their clinical condition. This assumption is, however, minimized by a long-term analysis of a procedure that was started 14 years ago and proves that results are sustained. We also acknowledge that exchange of experiences with other centers allowed us to include new measures for follow-up, such as the incorporation of the ACE-stopper device to reduce stoma stenosis occurrence. We also

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**TABLE II. Review of Left Antegrade Colonic Enema (LACE)**

<table>
<thead>
<tr>
<th>Author</th>
<th>Technique</th>
<th>N</th>
<th>Follow-up (months)</th>
<th>Volume (ml)</th>
<th>Washout time (min)</th>
<th>Stomal leakage</th>
<th>Continence</th>
<th>Pain</th>
<th>Stenosis</th>
<th>Stomal revision</th>
<th>Satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kelly et al., 2002</td>
<td>Sigmoid flap</td>
<td>2</td>
<td>6 and 17</td>
<td>X</td>
<td>20</td>
<td>0</td>
<td>100%</td>
<td>X</td>
<td>X</td>
<td>0</td>
<td>X</td>
</tr>
<tr>
<td>Liloku et al., 2002</td>
<td>Tubularized</td>
<td>7</td>
<td>1.5–18</td>
<td>200–500</td>
<td>10–30</td>
<td>X</td>
<td>85%</td>
<td>X</td>
<td>14.2%</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Churchill et al., 2003</td>
<td>Monti–Malone</td>
<td>18</td>
<td>24</td>
<td>360 (50–850)</td>
<td>18 (5–60)</td>
<td>10%</td>
<td>90%</td>
<td>0</td>
<td>33.3%</td>
<td>X</td>
<td>88%</td>
</tr>
<tr>
<td>Ahn et al., 2004</td>
<td>Monti–Malone</td>
<td>10</td>
<td>5.5 (1–14)</td>
<td>250</td>
<td>10–30</td>
<td>10%</td>
<td>90%</td>
<td>0</td>
<td>33.3%</td>
<td>0</td>
<td>X</td>
</tr>
<tr>
<td>Calado et al., 2005</td>
<td>Macedo–Malone</td>
<td>9</td>
<td>20.7 (8–33)</td>
<td>450</td>
<td>30–60</td>
<td>11.1%</td>
<td>100%</td>
<td>X</td>
<td>44.4%</td>
<td>33.3%</td>
<td>88%</td>
</tr>
<tr>
<td>Kim SM et al., 2006</td>
<td>Monti–Malone</td>
<td>19</td>
<td>3–37</td>
<td>600 (250–800)</td>
<td>30 (15–60)</td>
<td>10.5%</td>
<td>73.7%</td>
<td>21.1%</td>
<td>X</td>
<td>10.5%</td>
<td>X</td>
</tr>
<tr>
<td>Meyer et al., 2008</td>
<td>Macedo–Malone</td>
<td>9</td>
<td>25 (3–83)</td>
<td>13.35 (250–1,500)</td>
<td>49.2 (15–90)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>11%</td>
<td>92%</td>
<td></td>
</tr>
<tr>
<td>Kim H et al., 2009</td>
<td>Macedo–Malone</td>
<td>6</td>
<td>4–84</td>
<td>X</td>
<td>X</td>
<td>16%</td>
<td>X</td>
<td>67%</td>
<td>X</td>
<td>66.7%</td>
<td>95.8%</td>
</tr>
<tr>
<td>Chang et al., 2012</td>
<td>Monti–Malone</td>
<td>25</td>
<td>64.5</td>
<td>1,092</td>
<td>34</td>
<td>52%</td>
<td>68%</td>
<td>28%</td>
<td>12%</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Current series</td>
<td>Macedo–Malone</td>
<td>27</td>
<td>75 (5–164)</td>
<td>735 (300–3,000)</td>
<td>27 (2–90)</td>
<td>0</td>
<td>90%*</td>
<td>18.5%</td>
<td>X</td>
<td>22.2%</td>
<td>74%</td>
</tr>
</tbody>
</table>

*This mark calculation that involves only patients whose stoma still works, X means non-informed.

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anticipate future analysis of other well-established scoring systems to judge patients’ satisfaction with the procedure. We consider that the MM procedure has advantages compared to classical MACE: shorter OP-time, can be done irrespectively of appendix availability, provides shorter washout times, and spares the appendix for a Mitrofanoff procedure. In summary, we present the long-term data of an original procedure described by the authors that passed the “test of time”, being evaluated here at a mean follow-up of 75 months. We stress that this is a straightforward procedure; it can be performed in 15–20 min, avoids additional entero–entero anastomosis, precludes the use of the appendix, and has shown comparable results to either “classical” MACE or other LACE variants. We acknowledge that the controversy between right-sided versus left-sided stomas is ongoing and to our knowledge, no paper has so far managed to prove clear superiority of one strategy over the other. Shorter transit time seems to be one of the most apparent advantages of the MM procedure and LACE procedures over classical MACE.

CONCLUSIONS

The MM procedure produces a high rate of fecal continence (89%) and one-fourth of cases will need a surgical revision after a mean follow-up of 75 months. Three in four cases still use it regularly and consider it a great improvement in their social habits and daily life.

REFERENCES


APPENDIX TABLE I. Questionnaire for Patients Who Performed Macedo–Malone Surgery

<table>
<thead>
<tr>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
</tr>
<tr>
<td>DN</td>
</tr>
<tr>
<td>Date of surgery</td>
</tr>
<tr>
<td>Registration Contact</td>
</tr>
</tbody>
</table>

1. Do you do enema (washing) every day? How many times a day?
2. How much time do you spend to perform the enema (to leave the stool)?
3. What solution (liquid type) you use to do the enema?
4. What is the volume of liquid in each wash?
5. How do you do the wash? Use syringe or vial to fall by gravity?
6. Since you began performing enemas, you are:
   a. Fully continent (without losing feces)
   b. Partly continent
   c. Incontinent (losing feces)
7. What is the number of probe you use to catheterize the gut?
8. In your opinion, do enemas (washes) are easy or difficult?
9. Do you have struggled to catheterize your stoma (insert the tube in the gut’s hole)?
10. Have you had a leak in your stoma?
11. Have you had significant pain? If so, the pain is:
   a. In the introduction of the catheter (tube)?
   b. During the administration of the enema solution?
   c. When passing stools?
12. Are you satisfied with the surgery? Why?
13. Do you still use your stoma? If not, why?
14. Would you recommend this procedure to another person/patient?
15. Did You need to do some reoperation or revision surgery?
16. Do you sleep with the catheter (tube)?