Psychosocial and cognitive consequences of major neonatal surgery

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Abstract

Purpose: To evaluate the long-term quality of life (QOL) of patients who had undergone major neonatal surgery, the psychosocial and cognitive consequences of neonatal surgical stress were assessed when the patients reached school age.

Materials and methods: Seventy-two patients who had undergone major neonatal surgery were enrolled in this study. Their primary diseases were anorectal malformation (ARM) in 27 cases, esophageal atresia (EA) in 23, and congenital diaphragmatic hernia (CDH) in 22. Intelligence tests using Wechsler Intelligence Scale for Children III (WISC-III) or a developmental test and the Child Behavior Checklist were conducted through questionnaires and interviews with clinical psychologists.

Results: Mental retardation (MR) was apparent in 25% of EA, 20% of ARM, and 18% of CDH, significantly higher than the 2% to 3% commonly found in the general population. The clinical range (CR) of the Child Behavior Checklist was seen in 35% of EA, 59% of ARM, and 38% of CDH, which is also significantly higher than the 25% typically seen in the general population. No significant differences in MR and CR were seen among the primary diseases. The most important factors influencing MR and CR remain to be identified.

Conclusions: To ensure true quality of life after neonatal surgical stress, pediatric surgeons must consider not only physical assessments but also cognitive, emotional, and psychosocial assessments.

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Pediatric surgeons sometimes notice emotional problems in patients who have undergone major surgery early in their lives, even among those who exhibit sound physical and mental development. Pediatric surgeons do not generally
recognize that their patients’ psychosocial impairment is deeply associated with the disease or surgical stress they themselves were involved in. To ensure the long-term quality of life of those patients who underwent major surgery during the neonatal period or in early infancy, pediatric surgeons should be aware of the long-term psychosocial and cognitive effects of neonatal surgical stress.

On the other hand, the clinical outcomes of neonatal surgery have been most commonly assessed by survival rate and functional achievement. Recently, more attention has been paid to the effects of neonatal surgical stress on mental and intellectual development. However, the long-term psychosocial and cognitive consequences of neonatal surgical stress have not been extensively documented [1,2], if at all, or only for certain diseases, specifically anorectal malformation (ARM) [3-6] and Hirschsprung disease [7-9].

1. Material and methods

Seventy-two pediatric patients above school age, 37 males and 35 females, all of whom had undergone major surgery during the neonatal period or in early infancy, were enrolled in this study. Their ages ranged between 6 and 17 years. The subjects of the study included the most typical neonatal surgical diseases requiring long-term follow-up: esophageal atresia (EA) in 23 cases, high and intermediate types of ARM in 27, and congenital diaphragmatic hernia (CDH) in 22. The index patients were divided into 2 groups according to hospital stay: Gr. S for a hospital stay of less than 60 days (n =37) or Gr. L for a stay of more than 60 days (n =35). They were also divided into 2 additional groups according to the number of surgeries: Gr. O for 1 surgery (n =20) or Gr. T for 2 or more (n =52).

1.1. Surgical stresses

To evaluate the surgical stress, for example, length of hospital stay, number of surgeries, exposure to life-threatening episode (LTE), and home medical treatment (HMT), pediatric surgeons reviewed the medical records. Life-threatening episode was defined as neonatal asphyxia, resuscitation with mechanical ventilation, cardiac massage, administration of nitric oxide or catecholamine. Home medical treatment after discharge included oxygen inhalation, mechanical ventilation, parenteral nutrition, enteral nutrition, and intermittent catheterization.

Table 1  Prevalence of MR

<table>
<thead>
<tr>
<th>Diseases (case no.)</th>
<th>EA (20)</th>
<th>ARM (25)</th>
<th>CDH (22)</th>
<th>Total (67)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>MR cases</td>
<td>5 (25%)</td>
<td>5 (20%)</td>
<td>4 (18%)</td>
<td>14 (21%)</td>
<td>NS</td>
</tr>
<tr>
<td>Groups (case no.)</td>
<td>Gr. S (34)</td>
<td>Gr. L (33)</td>
<td>Total (67)</td>
<td>p =</td>
<td>NS</td>
</tr>
<tr>
<td>MR cases</td>
<td>4 (12%)</td>
<td>10 (30%)</td>
<td>14 (21%)</td>
<td>p =</td>
<td>NS</td>
</tr>
<tr>
<td>Groups (case no.)</td>
<td>Gr. O (18)</td>
<td>Gr. T (49)</td>
<td>Total (67)</td>
<td>p =</td>
<td>NS</td>
</tr>
<tr>
<td>MR cases</td>
<td>2 (11%)</td>
<td>12 (24%)</td>
<td>14 (21%)</td>
<td>p =</td>
<td>NS</td>
</tr>
</tbody>
</table>

NS indicates not significant.
among the primary diseases, that in each study group was significantly higher than the 2% to 3% commonly found in the general population [10,11]. Mental retardation was recognized in 4 cases of Gr. S (34) and in 10 cases of Gr. L (33), for an incidence of 12% and 30%, respectively. The incidence of MR in Gr. L was higher than that in Gr. S; however, no statistical significance between the 2 groups was found. Mental retardation was recognized in 2 cases of Gr. O (18) and 12 cases of Gr. T (49). The incidence of MR in Gr. T was higher than that in Gr. O; however, no statistical significance between them was found.

The CR of the CBCL was seen in 32 cases in total (71); 8 cases of EA (23), 16 of ARM (27), and 8 of CDH (21) (Table 2). Although no significant difference was seen in the prevalence of the CR among the primary diseases, the prevalence in each study group was significantly higher than the 25% typically seen in the general population (\(P < .001\)) [13]. The CR was noted in 17 cases of Gr. S (36) and 15 of Gr. L (35), for a total of 27 cases (71), representing an incidence of 47% and 43%, respectively; no difference was evident between these 2 groups. The CR of CBCL was noted in 6 cases of Gr. O (20) and 26 of Gr. T (51); the prevalence of the CR in Gr. T seemed higher than that in Gr. T, and there was no significant difference between these 2 groups.

The CR was noted in 18 of the cases with LTE (41) and 6 of those without LTE (9) and in 8 of the cases with HTM (17) and 24 of those without HMT (54); consequently, no difference was evident in the prevalence of the CR between cases with and without LTE and between cases with and without HMT.

To eliminate the effect of MR on the CBCL, the prevalence of the CR in cases of an IQ exceeding 80, or cases of normal intelligence, was calculated. The CR was seen in 5 (42%) of 12 cases of EA, 8 (47%) of 17 cases of ARM, and 6 (40%) of 15 cases of CDH, which did not differ from the prevalence seen in the total of all cases.

3. Discussion

We pediatric surgeons sometimes notice that patients who have undergone major surgery during the neonatal period or in early infancy have emotional disturbances or interpersonal-relationship disorders. Unlike neurologically impaired patients, however, these conditions are not recognized as a consequence of neonatal surgical stress or as being secondary to the diseases per se, and they are not considered for treatment or handled as disorders. To determine the actual incidence of psychosocial and cognitive consequences in patients after major neonatal surgery, the authors conducted this study in cooperation with clinical psychologists.

The incidence of MR was discovered to be unexpectedly high in the study group and much higher than that found not only in the general population but also in the control group and in the extremely low birth weight patients who had undergone minor surgery. None of the subjects had an ischemic or hypoxic episode during the perinatal or perioperative periods or experienced an LTE after one or more surgeries. The kind of primary disease, length of the hospital stay, and number of surgeries were not responsible for the etiology of MR. Ludman et al [2] reported that those patients who had undergone major neonatal surgery were lagging significantly in educational attainment regardless of the type of disease. They did not identify any risk factors, except for mechanical ventilation, as being responsible for the poor educational attainment in early adolescence. Although the cause of the high incidence of MR was not identified in this study, major surgical stress during the neonatal period, subsequent persistent medical problems, or insufficient early child care might be involved in the etiology of MR. For prevention or early intervention, a more meticulous analysis of their history not only during hospital stay but also after discharge would be indispensable for identifying the real risk factors for MR.

In this study, the authors focused on the psychosocial effects of major surgical stress during the neonatal period and subsequent persistent medical problems in school-aged children. We undertook this study because even mentally healthy subjects showed almost the same incidence of emotional and psychosocial impairment regardless of the type of disease. Some reports indicate that poor fecal continence after surgically corrected ARM [4,5] and Hirschsprung disease [7,8] resulted in poor QOL and more

<table>
<thead>
<tr>
<th>Diseases (case no.)</th>
<th>EA (23)</th>
<th>ARM (27)</th>
<th>CDH (21)</th>
<th>Total (71)</th>
<th>(P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR cases</td>
<td>8 (35%)</td>
<td>16 (59%)</td>
<td>8 (38%)</td>
<td>32 (45%)</td>
<td>NS</td>
</tr>
<tr>
<td>Groups (case no.)</td>
<td>Gr. S (36)</td>
<td>Gr. L (35)</td>
<td>Total (71)</td>
<td>(P)</td>
<td></td>
</tr>
<tr>
<td>CR cases</td>
<td>17 (47%)</td>
<td>15 (43%)</td>
<td>32 (45%)</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Groups (case no/)</td>
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<td>Gr. T (51)</td>
<td>Total (71)</td>
<td>(P)</td>
<td></td>
</tr>
<tr>
<td>CR cases</td>
<td>6 (30%)</td>
<td>26 (51%)</td>
<td>32 (45%)</td>
<td>NS</td>
<td></td>
</tr>
</tbody>
</table>

NS indicates not significant.
behavioral problems in school-age patients. They supposed that continence dysfunction and anally invasive treatment were responsible for the psychosocial consequences. However, Ludman et al [9] and Ojmyr-Joelsson et al [6] reported that their patients with ARM did not experience psychosocial impairment despite significant functional problems and chronic illness. In our study, the CR was equally prevalent in different types of major surgical stress regardless of persistent medical problems, which suggests that fecal dysfunction in ARM cases affects psychosocial outcome significantly. Although the risk factors for impaired psychosocial consequences after major neonatal surgery remain to be clarified, pediatric surgeons must concern themselves with the long-term effects of neonatal surgical stress on emotional and psychosocial health to improve their patients’ long-term quality of life after neonatal surgery.

References