Automatic and voluntary respiration failure induced by unilateral lateral-medullary infarction

K. Noda 1, J. Nonami 1, E. Iwasawa 2, N. Sato 2, T. Kanazawa 1, H. Tanaka 1, T. Yokota 2 Y Yokohama City Minato Red Cross Hospital, Department of Neurology, Yokohama, Japan 2 Tokyo Medical and Dental University, Department of Neurology and Neurological Science, Tokyo, Japan

Background

Central hypoventilation induced by unilateral lateral-medullary infarction (ULMI) is rare but critical complication and its incidence is still unclear. The respiratory center is located in bilateral ventral part of the medulla oblongata, named ventral respiratory group (VRG) (Figure 1). Previous reports suggest that an infarct expanded to the ventral part of the medulla affecting enough unilateral and ipsilateral VRG is associated with failure of automatic respiration during sleep, known as Ondine’s curse.6

Objective

To reveal the incidence and to confirm anatomical association of hypoventilation in ULMI.

Patients and Methods

Medical records are reviewed and spatial distribution of infarcts in MRI of serial ULMI cases are analyzed. Contours of each slice of T1-weighted image were traced to make 3D models for each case are traced. The contours are placed together in pile to reveal the rostro-caudal extension of the infarcts.

Result

Incidence 8.6%

Thirty-five patients with ULMI were admitted to our regional emergency hospital during 8 years since 2009 to 2016, and 3 (8.6%) of them presented with respiratory failure requiring tracheal intubation without any airway obstruction. Characteristics of respiratory failure in our cases are compared to those in previous reports (Table 1). Spatial distribution of infarcts including VRG of the three cases in MRI (DWI) on admission is shown in Figure 2.

Discussion

No previous report refers to the relationship between rostro-caudally distribution of the infarcts and the type of respiratory failure in ULMI. VRG is divided into four parts and the function of each part of VRG in animal experiments (Mendoza et al. 2013) suggest Botzinger complex which controls inspiration is located in a part of medulla rostral to Pre-Botzinger Complex which controls automatic respiration. Case 1 with only automatic respiratory failure resembles the cases in previous reports. In contrast, however, the lesions of patient 2 and 3 who have dyspnea and tidal volume reduction, respectively, i.e. voluntary respiratory failure, are extended to the caudal part of pons, and that is consistent with Mendoza’s suggestion.

Conclusion

Involvement of the ventral part of medulla is responsible for hypoventilation as previously reported. Rostrally long extension of the infaracts may be associated with failure of voluntary ventilation in addition to automatic one.

Reference


Table 1 A summary of our cases and previous reports of ULMI with respiratory failure

<table>
<thead>
<tr>
<th>Cases</th>
<th>Sex</th>
<th>Dyspnea</th>
<th>Tidal Volume Reduction</th>
<th>Ventilator withdrawal</th>
<th>Ventilator dependence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case1</td>
<td>M</td>
<td>-</td>
<td>76%</td>
<td>60%</td>
<td>100%</td>
</tr>
<tr>
<td>Case2</td>
<td>M</td>
<td>-</td>
<td>76%</td>
<td>60%</td>
<td>100%</td>
</tr>
<tr>
<td>Case3</td>
<td>M</td>
<td>-</td>
<td>76%</td>
<td>60%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Figure 1 Brainstem area for respiration (Mendoza et al. 2013).7

Figure 2 Three cases of ULMI with respiratory failure

Case 1: 66 yo M  Case 2: 52 yo M  Case 3: 48 yo M

Profile: Axial MRI, Coronal MRI, Trace

All lesions extended to the ventral part of medulla, including VRG (Figure 2 a, b, c). Patient of Case 1 with automatic respiratory failure had a longitudinally short lesion at the level of inferior olivary nucleus (Figure 2 d, g), consistent with previous reports. On the other hand, patients of Case 2 and Case 3 presented with voluntary respiratory failure and had rostro-caudally long lesions located from the level of inferior cerebellar peduncle to the caudal part of pons (Figure 2 e, f, h, i).