Intermediate Cervical Plexus Block for Carotid Endarterectomy: A Case Series of the Spread of Injectate

Mattias Casutt, Kathrin Job, Jonas Beutler, Jan Duwe, Patrick Veit and Christoph Konrad

Background: The case series illustrates the spread of local anesthetic resulting from a standardized single-injection technique of intermediate cervical plexus block before carotid endarterectomy.

Methods: 14 consecutive patients scheduled for elective carotid endarterectomy were included. Standardized intermediate cervical plexus block was performed on the level of C5/C6 at the posterior border of the sternocleidomastoid muscle. A mixture of 20ml Ropivacaine 0.75%, 20ml Prilocaine 1% and 8ml Iopromidum (iodine-concentration 300mg/ml) was injected. The direction of the injection was defined as cranial, medial and caudal behind the sternocleidomastoid muscle in a depth of 1-1.5cm. Subsequently, after 30minutes, a CT-scan of the head and neck region and upper thorax was completed to evaluate the distribution of the injectate in a three-dimensional reconstruction.

Results: The spread of the injectate ranged from the top edge of cervical vertebral body 1 to the bottom edge of thoracic vertebral body 3. The reproduced volume of 75260(5407)mm³ (SD) possessed a maximal craniocaudal spread of 125(24)mm in the sagittal plane 81(13)mm and in the coronal plane 43(13)mm. The minimal distance to the skin was 0.9(1.0)mm. The patients judged the block to be sufficient under our protocol. Therefore, no patient required conversion to general anesthesia.

Conclusion: Intermediate cervical plexus block is associated with an extensive spread of injectate that transverses the deep cervical fascia. The distribution pattern and the sensory and motor blockade level of this intermediate cervical plexus block seems to be sufficient for surgery and is of minor risk compared to the deep cervical plexus block.

Keywords: Carotid endarterectomy; Cervical plexus block; Spread of local anesthetic; Three-dimensional reconstruction

Abbreviations: CEA: Carotid Endarterectomy; CT: Computed Tomography; SD: Standard Deviation

Introduction

Possible perioperative complications of carotid surgery are myocardial or cerebrovascular infarctions. Different anesthetic procedures are performed for carotid endarterectomy (CEA) [1]. A multicenter, randomized controlled trial did not find any difference in outcome between general and regional anesthesia [2]. There are advantages and disadvantages for both kinds of anesthesia. Patients under general anesthesia have safe control of airways, no pain or anxiety during the operation, and anesthetic agents may offer a degree of neuroprotection [3]. On the other hand, patient population undergoing CEA possesses numerous comorbidities with a high incidence of severe coronary disease and intraoperative propensity for arterial hypotension [2,4]. Shunts should protect the brain from stroke during low cerebral blood flow in the carotid cross-clamping phase, but they damage the arterial wall which might result in cerebral embolism. Intraoperative neurological monitoring under general anesthesia, such as stumper pressure measurement (blood pressure measured in the internal carotid artery), EEG or somatosensory evoked potentials, reveal poor sensitivity and specificity regarding the requirement for shunt placement compared to the awake patient [5,6]. Therefore, regional anesthesia has become the favored anesthesia technique for CEA in the last years as it allows direct neurological monitoring [7] and provides effective pain relief with a higher patient satisfaction postoperatively [8].

Carotid surgery requires blockade of the cervical nerves C2-4. This may be performed by using a intermediate cervical plexus block, a deep cervical plexus block or a combination of both [9]. The deep block is technically difficult, needs one to three injections, results more frequently in conversion to general anesthesia and is associated with potentially serious complications, such as injection of the local anesthetic epidurally, subarachnoidly or into the vertebral artery [9]. In contrast, the intermediate block is technically easier and can be performed more rapidly. Clinical trials found, that the intermediate block is equally effective [7,10] or even superior [9] compared to the deep block. Additionally, anatomical studies with dye injections proved that the deep cervical fascia is a penetrable barrier [11,12].

The purpose of this case series was to show the spread of injected local anesthetic after intermediate cervical plexus blockade in a three-dimensional CT-scan. We examined in vivo whether the deep cervical fascia was traversed by the local anesthetic. According to our
knowledge, such a deep cervical fascia penetrability of local anesthetic in vivo has not yet been described.

Materials and Methods

After approval by the institutional ethics committee (Kantonale Ethik-Kommission des Kantons Luzern, protocol number 708) and written informed consent, 14 consecutive American Society of Anesthesiologists class II-III patients undergoing elective CEA were enrolled into this study (74±5yr of age and 26±4kg/m² body mass index). Exclusion criteria included known bleeding disorder, history of sepsis, acute cardiac-decompensation, severe respiratory insufficiency or known diaphragmatic motion abnormalities.

After routine monitoring of five-lead electrocardiography, noninvasive blood pressure, pulse oxymetry and peripheral insertion of a 18G intraveneous cannula, a 20G cannula was placed in the contralateral radial artery for continuous blood pressure monitoring. 2L/min oxygen was administered nasally. Regional anesthesia was performed by two senior anesthesiologists with patients in supine position and the head turned slightly away from the side of surgery. After skin disinfection, an atraumatic needle for peripheral nerve blocks (Stimuplex D 25Gx35mm, B. Braun, Melsungen, Germany) was inserted on the level of C5/C6 at the horizontal projection of the cricoid cartilage on the line tracing the posterior border of the sternocleidomastoid muscle. The direction of injection was defined as fan-shaped cranial in chn direction, medial and caudal behind the sternocleidomastoid muscle. The direction of injection was defined as fan-shaped cranial in chn direction, medial and caudal behind the sternocleidomastoid muscle.

The direction of injection was defined as fan-shaped cranial in chn direction, medial and caudal behind the sternocleidomastoid muscle.

Table 1: Demographic data of the 14 patients with radiological contrast agent spread.

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age (y)</th>
<th>BMI (kg/m²)</th>
<th>Minimal distance of the contrast agent to the skin (mm)</th>
<th>Craniocaudal spread in relation to the spine</th>
<th>Craniocaudal spread (mm)</th>
<th>Volume (mm³)</th>
<th>Maximal contrast spread in the sagittal plane (mm)</th>
<th>Maximal contrast spread in the coronal plane (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 / m</td>
<td>79</td>
<td>25</td>
<td>1</td>
<td>middle of CBV3 - lower edge of TBV3</td>
<td>102</td>
<td>70236</td>
<td>77</td>
<td>33</td>
</tr>
<tr>
<td>2 / m</td>
<td>70</td>
<td>22</td>
<td>1</td>
<td>middle of CBV2 - lower edge of TBV3</td>
<td>148</td>
<td>82560</td>
<td>79</td>
<td>25</td>
</tr>
<tr>
<td>3 / m</td>
<td>77</td>
<td>29</td>
<td>2</td>
<td>upper edge of CBV2 - lower edge of TBV3</td>
<td>101</td>
<td>73038</td>
<td>54</td>
<td>33</td>
</tr>
<tr>
<td>4 / m</td>
<td>73</td>
<td>29</td>
<td>0</td>
<td>lower edge of CBV3 - lower edge of TBV3</td>
<td>124</td>
<td>86759</td>
<td>84</td>
<td>36</td>
</tr>
<tr>
<td>5 / m</td>
<td>73</td>
<td>29</td>
<td>1</td>
<td>lower edge of CBV2 - middle of TBV2</td>
<td>133</td>
<td>79701</td>
<td>74</td>
<td>36</td>
</tr>
<tr>
<td>6 / m</td>
<td>76</td>
<td>24</td>
<td>3</td>
<td>upper edge of CBV4 - lower edge of TBV3</td>
<td>135</td>
<td>66009</td>
<td>94</td>
<td>50</td>
</tr>
<tr>
<td>7 / f</td>
<td>72</td>
<td>30</td>
<td>0</td>
<td>middle of CBV2 - lower edge of TBV2</td>
<td>128</td>
<td>70518</td>
<td>89</td>
<td>74</td>
</tr>
<tr>
<td>8 / m</td>
<td>83</td>
<td>21</td>
<td>2</td>
<td>middle of CBV2 - lower edge of TBV2</td>
<td>169</td>
<td>74025</td>
<td>86</td>
<td>56</td>
</tr>
<tr>
<td>9 / f</td>
<td>74</td>
<td>21</td>
<td>0</td>
<td>lower edge of CBV2 - middle of TBV2</td>
<td>86</td>
<td>77219</td>
<td>102</td>
<td>35</td>
</tr>
<tr>
<td>10 / m</td>
<td>78</td>
<td>26</td>
<td>0</td>
<td>lower edge of CBV1 - lower edge of TBV3</td>
<td>157</td>
<td>72248</td>
<td>79</td>
<td>44</td>
</tr>
<tr>
<td>11 / m</td>
<td>74</td>
<td>29</td>
<td>2</td>
<td>upper edge of CBV1 - lower edge of TBV3</td>
<td>138</td>
<td>75045</td>
<td>68</td>
<td>37</td>
</tr>
<tr>
<td>12 / m</td>
<td>67</td>
<td>31</td>
<td>0</td>
<td>middle of CBV2 - lower edge of TBV1</td>
<td>108</td>
<td>74438</td>
<td>72</td>
<td>41</td>
</tr>
<tr>
<td>13 / f</td>
<td>61</td>
<td>18</td>
<td>0</td>
<td>lower edge of CBV1 - lower edge of TBV2</td>
<td>123</td>
<td>79202</td>
<td>70</td>
<td>40</td>
</tr>
<tr>
<td>14 / m</td>
<td>78</td>
<td>29</td>
<td>0</td>
<td>lower edge of CBV3 - upper edge of TBV1</td>
<td>103</td>
<td>72969</td>
<td>103</td>
<td>57</td>
</tr>
<tr>
<td>mean (SD)</td>
<td>74</td>
<td>(5)</td>
<td>26</td>
<td>(4)</td>
<td>0.9</td>
<td>(1.0)</td>
<td>125</td>
<td>(24)</td>
</tr>
</tbody>
</table>

BMI = body mass index; CVB = cervical vertebral body; f = female; m = male; TVB = thoracic vertebral body

Results

The medial cranio-caudal spread of the contrast medium was averaged 125 (24)mm with a maximal cranial spread to the top edge of cervical vertebral body 1 and a maximal caudal spread to the bottom edge of thoracic vertebral body 3. In the sagittal plane there was a medium distribution of averaged 81 (13)mm and in the coronal plane of averaged 43 (13)mm. The average distribution volume in the scanographic sequential cross section was 75'260 (5407)mm³ (Figure 1 and 2). In the sample, we measured a medium distance of 0.9 (1.0)mm between injectate and skin, whereat in 7 patients (50%) the injectate adjoined the skin. In one out of the total of 14 patients there was a local anesthetic sheating of the carotis artery over a distance of 34mm. No patient required conversion to general anesthesia.
Case series was designed to show the spread of the upper margin of the thyroid cartilage on the line tracting the posterior scapula muscle with needle position in the horizontal projection of the without muscular response below a current of 0.5mA of the levator block which included 6 patients receiving 40ml local anesthetic [19].

three-dimensional scanographic reconstruction of the deep cervical

40ml of local anesthetics. In our study, we administered a total of 80ml [17] with the majority between 20ml and 40ml [7,10,14,15,18-20]. Certainly, patients with a higher dose could benefit in relation to the intermediate cervical plexus block. This has already been done in many previous investigations [7,9,10] The patients judged the block to be sufficient under our protocol. Therefore, no patient required conversion to general anesthesia.

In conclusion, we showed in vivo the permeability of the deep cervical fascia for local anesthetics after intermediate cervical plexus blockade. The intermediate cervical plexus blockade can be performed rapidly, is sufficient for surgery according to our protocol and provides an alternative approach to the deep cervical block for CEA with a lower rate of complications.

Conflict of Interest: There are no conflicts of interests.

References


