Please cite this article in press as: Koskinen L-OD et al. Severe traumatic brain injury management and clinical outcome using the Lund concept. Neuroscience (2014), http://dx.doi.org/10.1016/j.neuroscience.2014.06.039

Neuroscience xxx (2014) xxx–xxx

REVIEW

SEVERE TRAUMATIC BRAIN INJURY MANAGEMENT AND CLINICAL OUTCOME USING THE LUND CONCEPT

L.-O. D. KOSKINEN,[a*] M. OLIVECRONA[a,b] AND P.-O. GRÄNDE[c]

[a] *Department of Pharmacology and Clinical Neuroscience, Neurosurgery, Umeå University, Sweden*

[b] *Department of Anaesthesia and Intensive Care, University of Örebro, Sweden*

[c] *Department of Clinical Science in Lund, Anaesthesia and Intensive Care, Lund University, Sweden*

Abstract—This review covers the main principles of the Lund concept for treatment of severe traumatic brain injury. This is followed by a description of results of clinical studies in which this therapy or a modified version of the therapy has been used. Unlike other guidelines, which are based on meta-analytical approaches, important components of the Lund concept are based on physiological mechanisms for regulation of brain volume and brain perfusion and to reduce transcapillary plasma leakage and the need for plasma volume expanders. There have been eight non-randomized and two randomized outcome studies with the Lund concept or modified versions of the concept. The non-randomized studies indicated that the Lund concept is beneficial for outcome. The two randomized studies were small but showed better outcome in the groups of patients treated according to the modified principles of the Lund concept than in the groups given a more conventional treatment.

This article is part of a Special Issue entitled: Brain compensation. For good?. **© 2014 Published by Elsevier Ltd. on behalf of IBRO.**

Key words: severe traumatic brain injury, Lund concept, management, outcome.

Contents

INTRODUCTION

Originally, the Lund concept (LC) for treatment of severe traumatic brain injury (sTBI) was a theoretical approach mainly based on the physiological and pathophysiological principles of brain volume and brain perfusion regulation (Asgeirsson et al., 1994; Grände et al., 1997; Grände, 2006). The concept aimed at counteracting an increase in intracranial pressure (ICP) or to reduce an already raised ICP after sTBI, while improving compromised perfusion in and around the contusion areas at the same time. It can be described as an ICP- and perfusion-guided approach. The main components of the LC have found support in experimental and clinical studies, as described later in this review.

So far, no TBI guidelines have been tested in a large randomized clinical trial and from that point of view there is limited high-level clinical evidence for all TBI guidelines presented today (Muzevic and Splavski, 2013). A specific therapy therefore must be based on other types of input such as smaller clinical outcome studies including meta-analysis, experimental studies and basal physiological principles.

Even though different guidelines differ in essential aspects, the Brain Trauma Foundation's guidelines have moved closer to the LC during the past 10 years, e.g. concerning cerebral perfusion pressure (CPP) and the use of vasopressors (Bullock et al., 1996, 2000; Brain Trauma Foundation, 2007). In contrast to Brain Trauma

*Corresponding author. Tel: +46-706259701.
E-mail address: Lars-Owe.Koskinen@neuro.umu.se (L.-O.D. Koskinen).

Abbreviations: ARDS, acute respiratory distress syndrome; CPP, cerebral perfusion pressure; Hb, hemoglobin; ICP, intracranial pressure; LC, Lund concept; MAP, mean arterial pressure; PEEP, positive endexpiratory pressure; sTBI, severe traumatic brain injury; SAH, subarachnoid hemorrhage; TER, transcapillary exchange rate.

http://dx.doi.org/10.1016/j.neuroscience.2014.06.039
0306-4522/

Foundation guidelines—in which the ICP-reducing therapy should start when ICP is above 20 mmHg (Brain Trauma Foundation, 2007)—the LC recommends that the therapy should start as early as possible after arrival at the hospital, in an attempt to counteract the development of brain edema and to ensure that there is early optimization of the perfusion. To our knowledge, no clear side effects have appeared with the LC, which means that it can be given early and to all patients independent of severity of the injury and independent of the degree of autoregulation. The LC has not changed since its introduction, except that dihydroergotamin is no longer used. Dihydroergotamin, which reduces ICP via cerebral venous constriction, was used in the initial version of the concept in patients with uncontrolled increase in ICP (Asgeirsson et al., 1994). It was withdrawn because of possible side effects related to peripheral vasoconstriction in high doses. For details of the LC guidelines, see; Asgeirsson et al. (1994), Grände (2006, 2011) and Olivecrona et al. (2007, 2009a,b). A simplified schematic algorithm of the LC used in the clinical setting is shown in Fig. 1.

MEASUREMENT OF ICP AND CPP

Like in other guidelines, monitoring of ICP is an essential part of the LC, and the monitoring should be started as soon as possible after the arrival at the hospital. The method of ICP monitoring can either be by external ventricular drainage or by an intraparenchymal device. It is also crucial to monitor the arterial pressure and the mean arterial pressure (MAP).

The reference points for MAP and ICP must be identical when calculating CPP. For example, a head elevation of 15 degrees with the zero-reference point for the ICP at the external meatus and the zero-reference

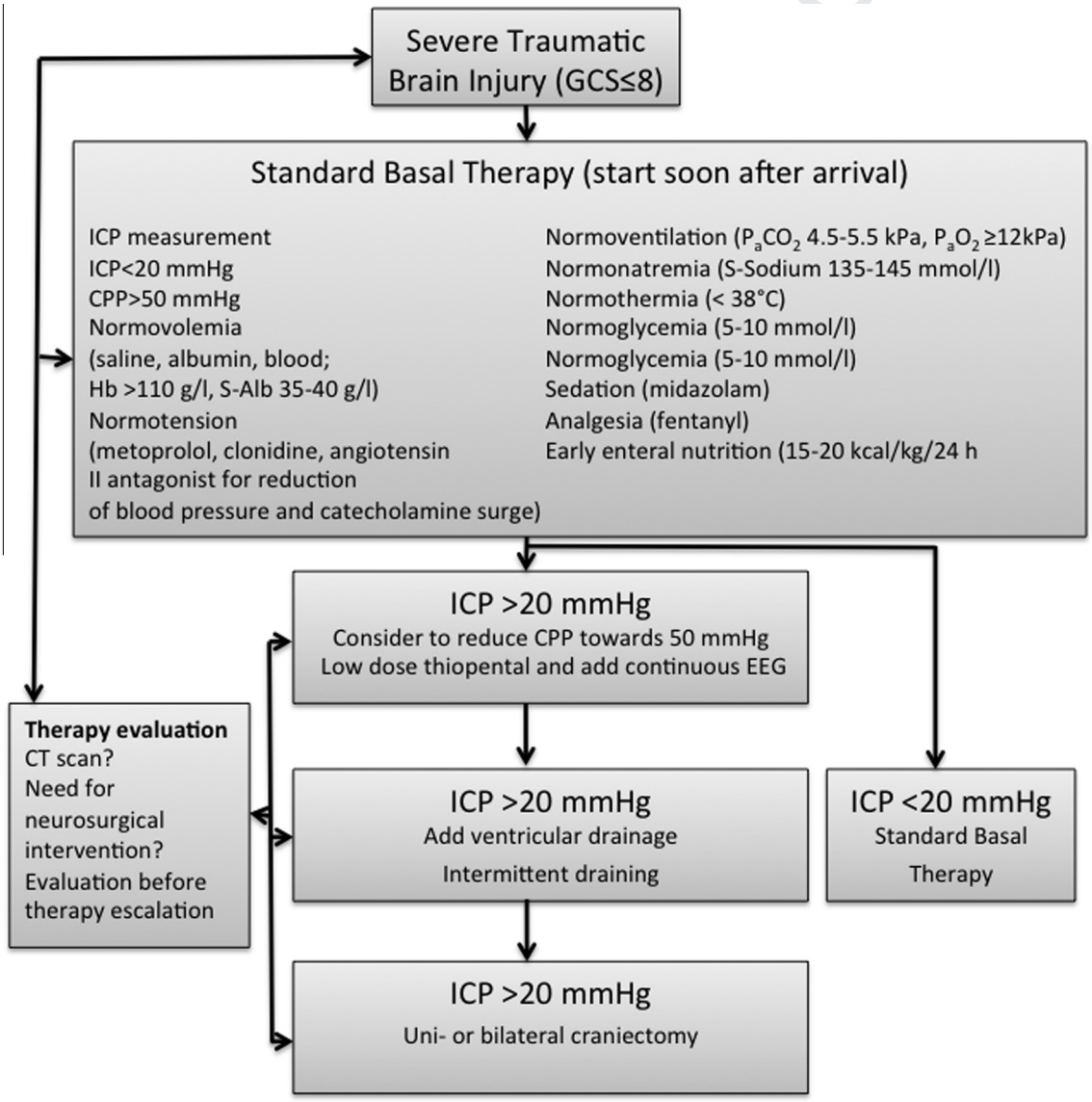

Fig. 1. A simplified schematic algorithm of the LC used in the clinical setting. For doses of the pharmacological substances used and other parameters, see Grände (2006).

Please cite this article in press as: Koskinen L-OD et al. Severe traumatic brain injury management and clinical outcome using the Lund concept. Neuroscience (2014), http://dx.doi.org/10.1016/j.neuroscience.2014.06.039