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Original Contribution

Hemodynamics of mesenteric traction syndrome measured by FloTrac sensor☆

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Abstract

Background: Mesenteric traction syndrome (MTS) develops in the early phase of laparotomy, which is triggered by pulling of the mesentery. We attempted to analyze the circulatory dynamics of MTS by using the FloTrac sensor.

Methods: Prospective randomized control study, the MTS trial, was conducted with or without prophylactic administration of flurbiprofen axetil in order to control MTS development in 57 elective open colorectal surgeries. None of the Flurbipurofen group patients (n = 23) develop MTS and were allocated to the non-MTS group. Among the non-flurbiprofen group, 28 patients (82%) developed MTS and were categorized into the MTS group. For these patients, in addition to blood pressure, stroke volume variation (SVV) and systemic vascular resistance index (SVRI) were measured by FloTrac sensor.

Results: The lowest blood pressure was noted within 30 minutes from the beginning of the intra-abdominal examination; in the non-MTS group, the mean blood pressure decreased by 16.7%, and in the MTS group, it decreased by 34.2% ($P < .01$). SVV of the 28 MTS patients was as follows: <9% in 10 patients (35.7%), >9% and <13% in 8 patients (28.6%), and >13% in 10 patients (35.7%). SVRI rose in the non-MTS group by 5.1%, whereas it fell in the MTS group by 15.1% ($P < .01$), indicating the close relationship between MTS and SVRI.

Conclusions: The SVV results indicate that fluid loading is not that optimal treatment against hypotension of MTS and that it is also important to consider the use of a vasoconstrictor. FloTrac is therefore useful for making an appropriate decision on the treatment strategy for MTS.

1. Introduction

One of the factors leading to hypotension in the early phase of laparotomy is mesenteric traction syndrome (MTS). It occurs when the mesentery is pulled during the procedure [1–3]. Its incidence rate is 30% to 85% and reportedly increases with remifentanyl use [4,5]. It is believed that pulling of the mesentery results in prostacyclin release, and the patients exhibit symptoms of hemodynamic changes such as hypotension, tachycardia, and a flushed face. Recently, our group as well as another research group demonstrated that inhibiting the synthesis of prostacyclin by using nonsteroidal anti-inflammatory drugs, such as flurbipurofen axetil, could prevent MTS [5,6]. Thus, MTS seems to be prevented by administration of nonsteroidal anti-inflammatory drugs; however, its hemodynamics has not been revealed yet.

☆ Disclosures: None of the authors have any conflicts of interest to declare.

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Intraoperative hypotension lasting for more than 10 minutes in longer-than-2-hour operations results in longer postoperative hospital stay and higher morbidity [7]. In order to minimize the risk of complications, hypotension must be immediately taken care of in MTS patients. However, treatment of hypotension caused by MTS has not been sufficiently examined. Although fluid resuscitation has been recommended as the treatment of MTS, it is difficult to judge whether it is appropriate, because the hemodynamic changes that occur during MTS have not been clarified yet.

Recently, the FloTrac sensor with the Vigileo monitoring system has become clinically available for examining hemodynamic changes; it is based on arterial pulse contour analysis conducted using an arterial line indwelled in a radial artery (Edwards Lifesciences, Irvine, CA). Stroke volume (SV) and SV variation (SVV) can be continuously monitored with this system. SVV is the percentage change in SV caused by respiratory changes in arterial pulse pressure, and it functions as a parameter for fluid responsiveness. When it is higher than 13%, in arrhythmia-free patients under mechanical ventilation, it is highly likely that cardiac output (CO) will increase in response to fluid administration [8–10].

Although FloTrac is often used in major abdominal surgery, probable cases of MTS, no study has so far reported the hemodynamic changes during MTS, as observed using FloTrac. Our objectives were to analyze the circulatory dynamics, such as SVV, SV index (SVI), and systemic vascular resistance index (SVRI), during MTS and to determine the usefulness of FloTrac for deciding the best treatment strategy for MTS.

2. Materials and methods

This study was approved by the institutional review board (IRB) of Tokyo Metropolitan Bokutoh Hospital (IRB code: 15-Heisei23). Written informed consent was obtained from all patients who participated. This study was registered in UMIN-CTR (UMIN0000091111). After obtaining IRB approval and written informed consent, patients who received elective surgery of colorectal cancer at our hospital were enrolled in this prospective, randomized clinical trial, named the MTS trial. A prospective randomized control study was conducted at our hospital. Patients younger than 20 years and those who had renal dysfunction, hepatic failure, peptic ulcer, aspirin-induced asthma, or arrhythmia were excluded.

The course of the surgical procedure included peritoneal incision, opening of the abdomen, liver palpation (abdominal examination), and unfolding of the colon; the same surgical team performed all the operations.

In our study, a total of 57 patients were randomly divided into 2 groups (Fig. 1): one group of patients was pretreated with flurbiprofen axetil (1 mg/kg; maximum, 50 mg; flurbiprofen group, n = 23), and the other group of patients was not given flurbiprofen pretreatment (non-flurbiprofen group, n = 34). As none of the 23 flurbipurofen group patients developed MTS, all of them (100%) were allocated to the non-MTS group in our study. Among the 34 non-flurbiprofen patients, 28 (82%) developed MTS and they were categorized into the MTS group. Six patients who did not develop MTS in non-flurbiprofen group were excluded from our study.

All patients in both groups received general anesthesia in combination with epidural anesthesia. After admission into the operating room, an epidural catheter was inserted. Anesthesia was induced with propofol (1.5-2 mg · kg^{-1}), rocuronium (0.6 mg · kg^{-1}), sevoflurane (1%-3%), remifentanyl (0.25-0.5 μg · kg^{-1} · min^{-1}), and ephedrine and dopamine when needed. After intubation, anesthesia was maintained with oxygen, air, sevoflurane (1.%2-1.4%), and remifentanil (0.1-0.25 μg · kg^{-1} · min^{-1}). Then the radial artery was cannulated for continuous measurement of arterial pulse

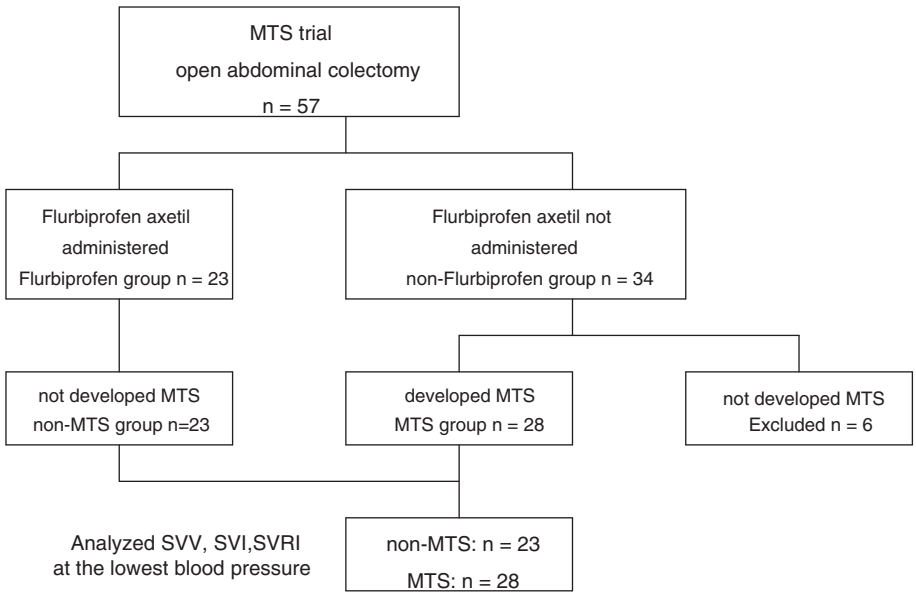

Fig. 1 Flowchart depicting the study population and subgroup distribution.