COMPARISON BETWEEN HES 130/0.4 AND MODIFIED FLUID GELATIN DURING ABDOMINAL SURGERY GUIDED BY TRANSESOPHAGEAL DOPPLER

Thesis

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ALT	Alanine aminotransferase
AST	Aspartate aminotransferase
BSE	Bovine spongiform encephalitis
CO	Cardiac output
CI	Cardiac Index
CVP	Central venous pressure
Da	Dalton
EDM	Esophageal Doppler monitor
FTc	Flow time corrected
GEL	Gelatins
GST	Glutathione serum transferase
HES	Hydroxyethyl starch
INR	International normalized ratio
HR	Heart rate
MD	Minute distance
MW	Molecular weight
PAOP	Pulmonary artery occlusion pressure
PT	Prothrombin time
PV	Peak velocity
PVE	Plasma volume expansion
RCTs	Randomized controlled trials
$SCVO_2$	Central venous oxygen saturation
SV	Stroke volume
TED	Transesophageal Doppler

TEG™	Thromboelastograph
vWF	von Willebrand factor

ABSTRACT

Intraoperative fluid management plays important role in anesthesia. Different types of fluids are used in plasma volume expansion. Modified fluid gelatin and Hydroxyethyl starches are commonly used in plasma volume expansion. The new Hydroxyethyl starch 130/0.4 is efficient plasma substitute with relatively safe profile on renal and platelet function.

Key Words: Modified fluid gelatin, Hydroxyethyl starch 130/0.4, plasma volume expansion

Plasma volume expansion is of substantial importance during major surgery. To achieve this goal, colloids may be preferred to crystalloids, as they more effectively increase blood volume and consequently, cardiac output (**1)**. A number of studies have compared the different available colloids. In almost all these studies, the outcome was either not an endpoint or was not reported **(2, 3)**. It is therefore not surprising that reasons for choosing specific products remain unclear. **(4)** Gelatins (GEL) have the advantage of their unlimited daily dose recommendation and minimal effect on hemostasis **(5).** However, they are associated with a more frequent incidence of allergic reaction **(6).** GEL are associated with more than twice the incidence as the modified fluid form **(7).**

Hydroxyethyl starches (HES) have the advantage of a higher plasma-expanding effect and an infrequent incidence of allergic reactions, but they have more pronounced effects on hemostasis **(8)**. As the HES-related effects on hemostasis appear to be related to their specifications **(9)**, a new HES with a lower *in vivo* molecular weight (HES 130/0.4) has been introduced. This new synthetic colloid appears to have fewer effects on hemostasis **(10–12)** while maintaining the same effectiveness as medium molecular weight HES **(12–14)**.

Esophageal Doppler monitoring (EDM) measures blood flow velocity in the descending thoracic aorta. When combined with a nomogram-based estimate of aortic cross sectional area, which is derived from the patient's age, height, and weight, it allows hemodynamic variables, including stroke volume, cardiac output, and index to be calculated. The monitor, however, does not provide direct measurement of pulmonary artery and pulmonary artery occlusion pressures, although changes in the corrected systolic flow time have been shown to reflect qualitative changes in pulmonary artery occlusion pressures, allowing optimization in left ventricular filling **(15)**. Several studies demonstrated the importance of the use of EDM to direct intraoperative fluid administration **(16, 17)**.

Hemodynamic optimization is one of the crucial goals of anesthesia management in ensuring adequate perioperative organ perfusion. Adequate perfusion, however, not only relies on sufficient perfusion pressure but also on systemic blood flow, i.e., cardiac output (CO), to deliver oxygen and substrates to the organs and to eliminate metabolic by-products. Although arterial blood pressure is measured perioperatively in most patients, CO is not routinely monitored.

Thermodilution techniques, requiring insertion of a pulmonary artery catheter, are considered to be the clinical standard of CO measurement **(18)**. However, major risks, high costs, and considerable additional time needed for pulmonary artery catheter insertion limit the routine assessment of CO. Intraoperative CO monitoring could, however, be useful in many patients to guide fluid administration and therapy with vasoactive and inotropic substances. Therefore, transesophageal Doppler (TED) ultrasonography of the descending aorta could be a useful monitoring device. TED allows a continuous estimation of CO and facilitates the assessment of preload, afterload, and myocardial contractility by calculating advanced hemodynamic variables **(19)**.

Various studies have demonstrated improved patient outcome and reduced length of hospital stay when hemodynamic management is guided by TED **(20, 21)**, suggesting that this technique may be a valuable supplement to the current standard hemodynamic monitoring. Early TED devices were not user friendly and were difficult to operate, which prevented widespread clinical use. In recent years, new devices have been developed, which combine the benefits of safe and continuous CO monitoring with the advantages of simple operation and straightforward display of the measured data. We review the technical basis and clinical applications including limitations, risks, and contraindications.

TECHNICAL PRINCIPLES

Doppler Sonography

The Doppler Effect describes an apparent change in the frequency of a wave noticed by an observer moving relative to the source of the wave. The frequency shift, i.e., the discrepancy between actual and noted frequency, is directly proportional to the relative velocity between the emitter and receiver. By measuring this Doppler frequency shift (Δf), which is produced when moving red blood cells are interrogated by an ultrasound beam, blood flow velocity (v) can be determined by the standard Doppler equation **(22)**

$$V = \frac{\Delta f \times c}{2fT \times \cos\theta}$$