

Haemodynamic monitoring for foetal surgery: open versus foetoscopic repair of myelomeningocele

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To the Editor,

Myelomeningocele (MMC), a severe form of spina bifida, is characterised by protrusion of the meninges and spinal cord through a defect in the vertebral column [1]. MMC occurs in approximately 1 in 3,000 live births in the United States [2]. Procedure-associated maternal and foetal risks were determined for both open and foetoscopic repair of

MMC. However to date, there has been no comparison of intraoperative haemodynamic management. We have recently published the results of a conformational analysis of perioperative data during foetoscopic surgery [3]. In this case series, we aimed to evaluate the stability of haemodynamic parameters and blood gas values during open foetal surgery.

Following securing the patients' written informed consent, we analysed the data of 4 patients undergoing open foetal surgery for myelomeningocele at 26 weeks' gestation. The mean age was 33.3 ± 4.3 years. A PICCO₂ monitor was used for haemodynamic monitoring. We analysed the data before surgery, during surgery at 1st hour and immediately after the surgical procedure.

Foetal cardiac activity was monitored during foetal surgery in order to assess foetal viability and well-being, while intermittent foetal umbilical blood flow was measured. Afterwards, peak systolic (PS) and end-diastolic (ED) umbilical blood flow patterns were recorded during anaesthesia induction (T₁), foetal meningocele repair (T₂) and after the uterus had been closed (T₃). Preoperative and postoperative haemodynamic data of the patients showed no significant difference (Table 1). During anaesthesia and surgery, umbi-

Table 1. The hemodynamic variables during the perioperative period

		min-max		median	mean±sd		p*	p**	
PPV	1 st measurement	7,0	–	13,0	12,0	10,7 ± 3,2			
	2 nd measurement	10,0	–	13,0	11,0	11,3 ± 1,5	0,109	w	
	3 rd measurement	10,0	–	17,0	13,0	13,3 ± 3,5	0,109	w	0,285 w
PVPI	1 st measurement	1,4	–	2,0	2,0	1,8 ± 0,3			
	2 nd measurement	1,7	–	2,0	1,8	1,8 ± 0,2	0,655	w	
	3 rd measurement	1,4	–	2,0	1,7	1,7 ± 0,3	0,785	w	0,655 w
EVLW	1 st measurement	375,0	–	448,0	428,0	417,0 ± 37,7			
	2 nd measurement	411,0	–	428,0	428,0	422,3 ± 9,8	0,108	w	
	3 rd measurement	375,0	–	439,0	411,0	408,3 ± 32,1	0,108	w	0,109 w
SV	1 st measurement	65,0	–	81,0	65,0	70,3 ± 9,2			
	2 nd measurement	67,0	–	79,0	77,0	74,3 ± 6,4	0,109	w	
	3 rd measurement	78,0	–	81,0	79,0	79,3 ± 1,5	0,109	w	0,655 w
SVR	1 st measurement	710,0	–	920,0	810,0	813,3 ± 105,0			
	2 nd measurement	670,0	–	1000,0	710,0	793,3 ± 180,1	0,655	w	
	3 rd measurement	670,0	–	840,0	710,0	740,0 ± 88,9	0,593	w	0,655 w
SVV	1 st measurement	4,0	–	23,0	12,0	13,0 ± 9,5			
	2 nd measurement	6,0	–	11,0	9,0	8,7 ± 2,5	1,000	w	
	3 rd measurement	7,0	–	18,0	12,0	12,3 ± 5,5	1,000	w	0,180 w
CO	1 st measurement	5,9	–	7,3	6,8	6,7 ± 0,7			
	2 nd measurement	5,0	–	7,1	5,7	5,9 ± 1,1	0,285	w	
	3 rd measurement	6,4	–	7,3	6,7	6,8 ± 0,5	1,000	w	0,285 w
CVP	1 st measurement	5,0	–	15,0	10,0	10,0 ± 5,0			
	2 nd measurement	10,0	–	15,0	10,0	11,7 ± 2,9	0,317	w	
	3 rd measurement	10,0	–	15,0	15,0	13,3 ± 2,9	0,157	w	0,317 w

PPV: pulse pressure variation; PVPI: pulmonary vascular permeability index; EVLW: extravascular lung water; SV: stroke volume; SVR: systemic vascular resistance; SVV: stroke volume variation; CO: cardiac output; CVP: central venous pressure

Table 2. The umbilical flows obtained from patients:

1 st patient:
(T ₁): PS: 34.5 cm sec ⁻¹ , ED: 14.4 cm sec ⁻¹
(T ₂): PS: 28.6 cm sec ⁻¹ , ED 11.9 cm sec ⁻¹
(T ₃): PS 30.3 cm sec ⁻¹ , ED 12.2 cm sec ⁻¹
2 nd patient:
(T ₁): PS: 28.1 cm sec ⁻¹ , ED: 9.2 cm sec ⁻¹
(T ₂): PS: 20.0 cm sec ⁻¹ , ED 5.3 cm sec ⁻¹
(T ₃): PS 21.7 cm sec ⁻¹ , ED 7.5 cm sec ⁻¹
3 rd patient:
(T ₁): PS: 32.5 cm sec ⁻¹ , ED: 12.8 cm sec ⁻¹
(T ₂): PS: 25.3 cm sec ⁻¹ , ED 10.8 cm sec ⁻¹
(T ₃): PS 28.4 cm sec ⁻¹ , ED 11.7 cm sec ⁻¹
4 th patient:
(T ₁): PS: 31.2 cm sec ⁻¹ , ED: 10.4 cm sec ⁻¹
(T ₂): PS: 22.4 cm sec ⁻¹ , ED 7.8 cm sec ⁻¹
(T ₃): PS 24.4 cm sec ⁻¹ , ED 8.5 cm sec ⁻¹

linal blood flows, especially diastolic flow, may decelerate. These changes were reversible, and returned to normal after surgery (Table 2). There were no complications.

In both open and fetoscopic procedures, neither the umbilical blood flows nor the haemodynamic parameters changed significantly. Both methods have been demonstrated to improve paediatric outcomes. However there are several limitations when comparing the techniques. The small sample size is one major factor in order to estimate the long-term neurodevelopmental outcomes. Joyeux *et al.* [4] compared the results of published papers on the fetoscopic (n = 51) and open approaches (n = 71). The perinatal mortality and shunt rate at 12 months were similar. In our series, hydrocephalus and chiari type II malformation improved later in all cases while none of the patients needed ventriculoperitoneal shunt after birth. On the other hand, fetoscopic surgery required a longer operation time (223 vs. 105 min, $P < 0.001$), had a higher rate of postnatal reoperation (28% vs. 2.56%, $P < 0.001$) and a preterm prelabor membrane rupture rate (84% vs. 46%, $P < 0.001$) with an ear-

lier gestational age at birth (32.9 vs. 34.1 weeks, $P = 0.03$). In our comparison, the mean duration time for the fetoscopic and open approaches were 255 minutes and 130 minutes, respectively ($P < 0.05$). Besides the Pulse Pressure Variation Pulmonary Vascular Permeability Index, extravascular lung water or the stroke volume were valuable parameters for us to evaluate foetal well being. We supported our results with umbilical cord flow rates. Therefore, by PICCO₂ monitoring and Doppler ultrasound, goal-directed anaesthetic and surgical management provided optimal maintenance of foetal and maternal well-being.

In conclusion, although there are technical differences between minimally invasive and open procedures, both methods have similar effects in haemodynamic monitoring parameters and umbilical cord flow.

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