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Non-invasive blood pressure monitoring in an anaesthetised calf - a case report

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Abstract

A six month old cross bred calf was presented with a swelling on lateral abdomen and diagnosed with lateral abdominal hernia, which underwent herniorrhaphy under general anaesthesia formed the subject of the study. The animal was administered with meloxicam @ 0.5 mg/kg body weight intravenously for pre-emptive analgesia. Thirty minutes later, xylazine @ 0.02 mg/kg and butorphanol @ 0.05 mg/kg, were administered intravenously. Upon sedation, the animal was administered with a loading dose of lignocaine @ 1 mg/kg body weight intravenously. Immediately following the loading dose of lignocaine, anaesthesia was induced using guaiphenesin @ 50 mg/kg and ketamine @ 2mg/kg intravenously. Following induction, anaesthesia was maintained using the prepared guaiphenesin-ketamine-lignocaine-butorphanol anaesthetic mixture as continuous rate infusion @ 3 ml/kg/hr. Indirect and direct blood pressure measurements were monitored and recorded. The non-invasive blood pressure values for systolic, diastolic and mean blood pressures did not differ significantly ($p > 0.05$) from those monitored invasively.

Keywords: *Anaesthesia, non-invasive blood pressure, invasive blood pressure, calf, intravenous anaesthesia*

Every anaesthetic drug causes changes in the homeostasis of the animal hence warranting constant monitoring of anaesthetised patient. Of the many parameters measured, blood pressure is the key to understand patients' cardiovascular status. Hypotension, a common

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drawback of most anaesthetic drug, if left unmonitored can lead to detrimental effects for the patient during and after surgery. Arterial blood pressure can be measured by two techniques - invasive (direct) and non-invasive (indirect) methods. Invasive blood pressure (IBP) monitoring is reported to be the most accurate method for blood pressure monitoring (Afshar *et al*, 2005). High cost of equipment, requirement of technical skill in catheterising arteries and calibrating transducers are the constraints involved in usage of IBP in field conditions. Non-invasive blood pressure (NIBP) monitoring is an alternative to invasive blood pressure monitoring. It is economical and requires minimal technical knowledge with easy applicability in field practice. But the debate on reliability of blood pressure values monitored non-invasively keeps away the field practitioner from depending on non-invasive blood pressure monitoring for routine practice. The present study plays on record a comparative evaluation of blood pressures monitored non-invasively to that monitored invasively by arterial catheterisation.

A six month old cross bred calf weighing 48.5 kg, presented to the Teaching Veterinary Clinical Complex, Pookode with a swelling on lateral abdomen and diagnosed with lateral abdominal hernia, classified as ASA class I which underwent herniorrhaphy under general anaesthesia formed the subject of the study. Following fasting, the animal was administered with meloxicam @ 0.5 mg/kg body weight intravenously for pre-emptive analgesia. Thirty minutes later, xylazine @ 0.02 mg/kg and butorphanol @ 0.05 mg/kg, were administered intravenously. Upon sedation, the animal was administered with a loading dose of lignocaine @ 1 mg/kg body weight intravenously. Immediately following the loading dose of lignocaine, guaiphenesin @ 50 mg/kg and ketamine @ 2mg/kg intravenously were used for induction of anaesthesia. Intubation using suitable size endotracheal tube was carried out and then connected to a fresh oxygen supply using a Boyle's apparatus. Following induction, anaesthesia was maintained using the prepared guaiphenesin-ketamine-lignocaine-butorphanol anaesthetic mixture as continuous rate infusion @ 3 ml/kg/hr so as to deliver guaiphenesin @ 150 mg/kg/hr, ketamine @ 6 mg/kg/hr, lignocaine @ 3 mg/kg/hr and butorphanol @ 21 mcg/kg/hr. Indirect blood pressure measurements were made using an NIBP cuff of width approximately 40 percent of the circumference of the base of the tail, wrapped around the tail base and connected to the multipara patient monitor for monitoring the non-invasive blood pressure throughout the anaesthesia. The NIBP cuff was applied over the coccygeal artery. A 22G catheter was placed into the auricular artery, following aseptic preparation of the site and was then secured using tape. The catheter was then connected to a blood pressure transducer (disposable) through a heparin saline packed tubing (Fig. 1). Care was taken to place the transducer at the same level as that of the heart. The apparatus, with respect to the local atmospheric pressure, was then zeroed. NIBP and IBP were monitored and recorded at every 15 minute till recovery.

The non-invasive mean blood pressure values after induction and every fifteen minutes thereafter till recovery ranged from 78 to 117 mmHg with a mean ± SE of 93.50 ± 5.86 mmHg, while the invasive mean blood pressure values varied from 93 to 108 mmHg with a mean ± SE of 102.83 ± 2.79 mmHg. The non-invasive diastolic blood pressure values after induction and every fifteen minutes thereafter till recovery ranged from 65 to 91mmHg with a mean ± SE of 74.3 ± 4.43 mmHg, while the invasive diastolic blood pressure values varied from 79 to 94 mmHg with a mean ± SE of 85.66± 2.53 mmHg. The non-invasive systolic blood pressure values after induction and every fifteen minutes thereafter till recovery ranged from 104 to 151 mmHg with a mean ± SE of 124.6 ± 7.33 mmHg, while the invasive systolic blood pressure values varied from 115 to 130 mmHg with a mean ± SE of 123.5± 2.70 mmHg. The non-invasive blood pressure values for systolic, diastolic and mean blood pressures - did not differ significantly ($p > 0.05$) from those monitored invasively. The co-efficient of variation for the values studied were less than 20 per cent, suggesting that the experiment was reliable.

The values obtained for invasive and non-invasive blood pressure are illustrated in Table 1.

Table 1: NIBP and IBP values obtained during anaesthesia

Time	Non-invasive blood pressure monitoring			Invasive blood pressure monitoring		
	Systolic	Diastolic	Mean	Systolic	Diastolic	Mean
After induction	151	91	117	122	82	102
15 minutes later	141	64	81	130	91	108
30	122	82	102	132	94	112
45	111	67	90	118	80	98
60	119	77	93	124	88	104
75	104	65	78	115	79	93
Mean	124.6	74.3	93.50	123.5	85.66	102.83
SE	7.33	4.43	5.86	2.70	2.53	2.79

This study compared the efficiency of invasive and non-invasive methods of blood pressure monitoring in large animals. According to Glen (1970), the NIBP cuff placement over the tail was found to be the most effective for the measurement of non-invasive blood pressure in cattle. Our findings of non-significant difference between NIBP and IBP validates the use of NIBP in farm settings as IBP requires experienced technicians. The findings are consistent with studies conducted in small animals which show that NIBP and IBP have minimal variations (Olsen *et al.* 2016). The comparative findings from the present study were in accordance with those reported by Nout *et al.* (2002) in foals. But it is in contradiction to the findings by Aarnes *et al.* (2014) where he concluded from his study on 38 cattle that NIBP is not an efficient alternative to IBP and this could be attributed to the tight fit of NIBP cuff around the tail used for the present study.

Fig. 1: Ear cannulation for IBP measurement

Blood pressure measurement is crucial for monitoring in animals. Invasive blood pressure monitoring is the gold standard for monitoring blood pressure but lack of expert technicians and equipment can hinder it's usage in the field conditions. Non-invasive blood pressure measurement can be taken as an alternative to invasive blood pressure measurement and can be utilised to monitor changes in a healthy animal undergoing surgery. It should be noted that NIBP is a reliable alternative which do not differ significantly from IBP and could be used for routine practice.

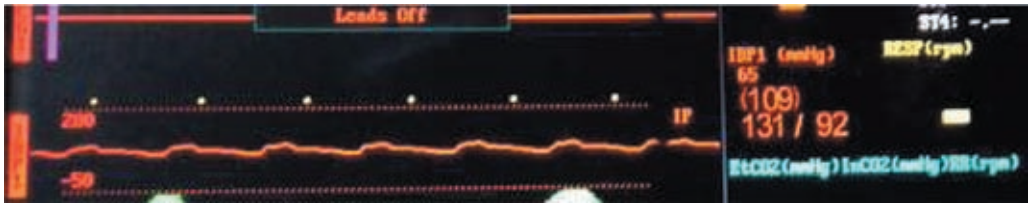

Fig. 2: IBP reading

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