

# Use of dexmedetomidine as an adjunct in the treatment of paradoxical hypertension after surgical repair of coarctation of the aorta in infants

Manoj K. Sahu, Vinod Kumar Manikala<sup>1</sup>, Sarvesh Pal Singh, A. K. Bisoi<sup>1</sup>, Ujjwal Kumar Chowdhury<sup>1</sup>

Departments of Intensive Care for CTVS and <sup>1</sup>Cardiothoracic and Vascular Surgery, All India Institute of Medical Sciences, New Delhi, India

## ABSTRACT

Severe persistent hypertension is seen infrequently in newborns and infants, but we came across two infants who developed severe paradoxical hypertension after successful coarctation repair. Treatment of systemic hypertension following repair of coarctation of the aorta is always challenging particularly in infants. Dexmedetomidine was used successfully as an adjunct to the established anti-hypertensive drugs in the immediate postoperative period in our cases to treat postoperative paradoxical hypertension.

Received: 19-12-14  
Accepted: 03-04-15

**Key words:** Coarctation of the aorta; Dexmedetomidine; Paradoxical hypertension

## INTRODUCTION

Early postoperative hypertension is a common complication, seen in 56–100% cases after surgical correction of coarctation of the aorta.<sup>[1]</sup> Severe uncontrolled hypertension may complicate the postoperative course in these patients. The etiology is multifactorial, like altered baroreceptor reflex, the activation of sympathetic and renin-angiotensin system and expansion of extracellular volume.<sup>[2]</sup> Immediate and effective treatment is mandatory as hypertension imparts severe strain on the new anastomosis and increases afterload on the left ventricle. Traditionally, short and fast-acting intravenous (iv) vasodilators like sodium nitroprusside (SNP), nitroglycerine (NTG) have been used independently or in combination with beta blockers and angiotensin-converting enzyme (ACE) inhibitors to achieve good control of the paradoxical hypertension in the immediate postoperative period.

Dexmedetomidine (DEX), a new alpha-2 agonist shows promise in controlling hypertension when used as an adjunct to other anti-hypertensive agents.

## CASE REPORTS

### Case 1

A 4-month old male child weighing 6.2 kg presented with tachypnea and feeding difficulty since 1-month of age. On evaluation, the child was found to be suffering from infantile coarctation of aorta. His blood pressure (BP) in right upper limb was 130/90 mmHg and in right lower limb was 70/50 mmHg. His femoral pulses were feeble. Color Doppler echocardiography confirmed the presence of coarctation of aorta with a gradient of 60 mmHg, bicuspid aortic valve and severe biventricular dysfunction. Elective surgery was done, the child underwent resection of coarctation segment and end to end anastomosis of descending thoracic aorta and isthmus. Aortic cross clamp time

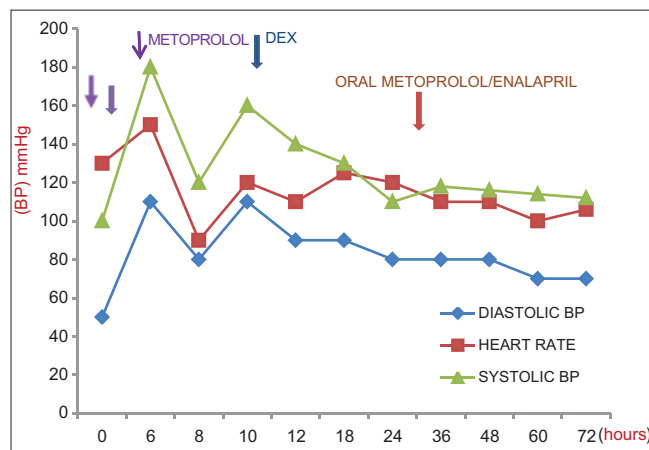
Access this article online
Website: <a href="http://www.annals.in">www.annals.in</a>
DOI: 10.4103/0971-9784.159826
Quick Response Code:


**Address for correspondence:** Dr. Manoj K. Sahu, Department of Cardiothoracic and Vascular Surgery, CTVS Office, 7<sup>th</sup> Floor, CN Centre, All India Institute of Medical Sciences, New Delhi - 110 029, India. E-mail: [drmanojksahu@gmail.com](mailto:drmanojksahu@gmail.com)

was 25 min. Following repair, the child was shifted to Intensive Care Unit (ICU) on SNP infusion at 1 mcg/kg/min and with direct right radial artery pressure of 100/50 mmHg. In about 6 h time, the BP increased up to 160/90–180/110 mmHg [Figure 1]. Iv fentanyl at 2 mcg/kg and midazolam 0.15 mg/kg were given as boluses intermittently for analgesia and sedation respectively. The SNP infusion was increased up to 3 mcg/kg/min. But the BP was not adequately controlled. An iv infusion of NTG was started at 0.5 mcg/kg/min and increased gradually up to 3 mcg/kg/min. As the response was transient and the BP resurged again, iv metoprolol was given at 0.6 mg (0.1 mg/kg) increments up to 2 mg. The response in decreasing the BP was short-lasting and heart rate (HR) decreased up to 80/min and hence could not be continued further. At this stage, DEX infusion was started at 0.5 mcg/kg/h. Additional analgesia was given as paracetamol suppositories (10 mg/kg)/8 hourly and no further fentanyl/midazolam were administered. Soon the BP started to decrease and remained steady at around 110/80 mmHg. The child was extubated after 24 h when the BP was maintained at a steady state of around 110 mmHg systolic and the ventricular function improved. Oral metoprolol 2 mg and enalapril 0.5 mg twice daily were started after confirmation of bowel sounds. SNP and NTG infusions were tapered off but DEX was continued till 48 h and stopped when the BP was stable at around 110 mmHg. The patient was discharged on 8<sup>th</sup> postoperative day on oral metoprolol and enalapril.

## Case 2

A 1-month-old male child weighing 3.5 kg was diagnosed to have coarctation of aorta, presented with symptoms of failure to thrive. Echocardiography detected severe infantile coarctation with a gradient of 50 mmHg

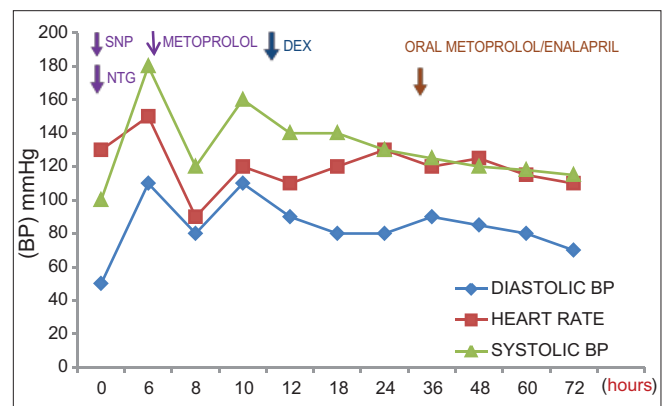


**Figure 1:** The effect of different drugs and the control of blood pressure and heart rate in the postoperative period in the 1<sup>st</sup> child (case 1)

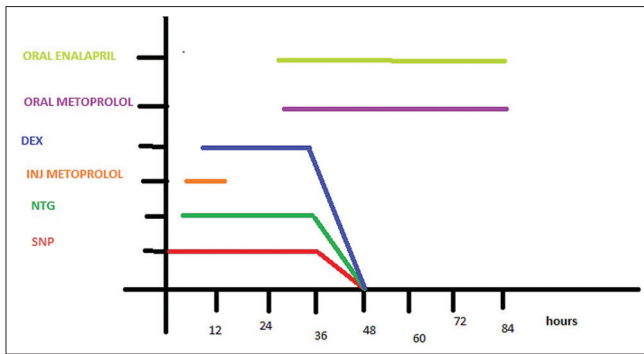
without any associated intra-cardiac defects and severe left ventricular (LV) dysfunction. Clinically, there was upper limb hypertension (110/90 mmHg measured in right arm) and lower limb BP of 60/40 mmHg. The child underwent coarctation repair with resection and end to end anastomosis. Aortic cross clamp time was 27 min. He was shifted to ICU on SNP infusion at 1 mcg/kg/min and with a direct right radial BP of 100/60 mmHg. In next few hours, the BP started to rise up to 150/100 mmHg [Figure 2]. Iv fentanyl at 2 mcg/kg and midazolam 0.15 mg/kg were given as boluses intermittently for analgesia and sedation, respectively. SNP infusion was increased up to 3 mcg/kg/h and NTG was added and increased up to 3 mcg/kg/min. BP started to rise intermittently in spite of high dose of SNP and NTG. Iv metoprolol was given at 0.4 mg (0.1 mg/kg) increments up to 2 mg, which showed a temporary response in controlling hypertension but the child developed bradycardia (HR decreased up to 90/min) for which it could not be continued. At this stage, DEX infusion was started at 0.5 mcg/kg/h and the BP decreased steadily up to 110/60 mmHg. Additional analgesia was given as paracetamol suppositories (10 mg/kg)/8 hourly and no further fentanyl/midazolam were administered. The child was weaned off from ventilator and extubated after 18 h of surgery. Oral metoprolol 1.5 mg and enalapril 0.5 mg twice daily were started [Figure 3]. SNP and NTG were tapered off gradually, but infusion DEX was continued for 36 h and then discontinued when BP was stabilized at 110 mmHg. The child was discharged uneventfully.

## DISCUSSION

Paradoxical hypertension is a common feature in the postoperative period after successful repair of coarctation of the aorta.<sup>[1]</sup> Though severe persistent hypertension is



**Figure 2:** The effect of different drugs and the control of blood pressure and heart rate in the postoperative period in the 2<sup>nd</sup> child (case 2)



**Figure 3:** The drugs and the duration of their administration at different times in the postoperative period to achieve control of blood pressure

seen infrequently in newborns,<sup>[1]</sup> our 2 cases developed severe paradoxical hypertension after successful repair of coarctation. Both the sympathetic and the renin-angiotensin system have been demonstrated as underlying mechanisms for the hypertension observed after repair of coarctation of the aorta.<sup>[3,4]</sup> SNP, NTG, propranolol, captopril, and reserpine, all have been utilized in the management of this complication.<sup>[1,3]</sup> When long-term anti-hypertensive therapy is required, beta-blockers alone or in combination with ACE inhibitors or angiotensin II antagonists may be added for adequate control.

Dexmedetomidine is a selective alpha-2 agonist having sedative and analgesic properties acting at locus coeruleus and spinal cord dorsal horn, respectively, does not cause respiratory depression at doses (0.2–0.7 mcg/kg/h infusion).<sup>[5]</sup> While on DEX infusion, the child remains calm, less agitated, and pain-free and can be extubated safely. The sympatholytic effect of DEX reduces the HR and BP when given by infusion only.<sup>[6]</sup> DEX can be used as an adjunct to the established anti-hypertensive drugs in early postoperative period to have a better control of paradoxical hypertension when the patient is recovering from the effects of anesthesia, weaning off ventilator at different stages.<sup>[6]</sup> The sudden, severe episodic increase in BP and HR when the patient wakes up while intubated and on ventilator are the danger moments leading to complications like bleeding from suture site or LV failure to significant increase in afterload if left unattended. In these situations, continuous infusion of DEX is helpful in keeping the child calm, pain-free, and less agitated which does not allow the sudden and repeated surge in BP and HR. DEX infusion does this because of its sedative, analgesic, and sympatholytic properties in combination.

The high BP in these two infants described above failed to respond to the conventional multidrug therapy. Controlling the hypertension during this crucial period is very vital as it can lead to complications and as a consequence the duration of ventilation, ICU stay, hospital stay prolongs leading to increased financial burden. In our experience, the combined regimen of NTG, SNP infusion with an intermittent bolus of iv metoprolol is usually adequate to control hypertension in the early postoperative period. Oral medications such as metoprolol and enalapril are given after resumption of bowel movements and then iv infusions of SNP, NTG are tapered off gradually. In these two infants, all the above combinations failed to bring BP to acceptable levels. Within a short time after starting DEX infusion, the BP and HR were controlled well without causing bradycardia in both the cases.

Dexmedetomidine can be used safely and effectively in infants and children in the perioperative period as an adjunct to other antihypertensive agents. DEX infusion can be continued safely in the extubated, spontaneously breathing patients, unlike other sedative agents.<sup>[7]</sup> It acts by (i) decreasing sympathetic tone, attenuation of neuroendocrine and hemodynamic responses to anesthesia, surgery, and pain (ii) cause sedation and analgesia, (iii) psychomotor function is preserved while the patient is calm and resting comfortably, (iv) it does not have a direct effect on heart and (v) It preserves the baroreceptor function. It decreases HR and BP by decreasing central sympathetic outflow (decreasing epinephrine and norepinephrine release). The sympatholytic, analgesic, and sedative properties are the ones making this drug as a useful adjunct in the perioperative period, and it helps in effectively controlling the hypertension.<sup>[8]</sup> Although our experience is limited, it seems that DEX may be a useful drug to be used as an adjunct in the management of severe reactive hypertension in the immediate postoperative period and can help to achieve good control of BP at lower doses of vasodilators like SNP and also it helps a smooth transition from iv medications to oral drugs to control the BP at a constant level without wide fluctuations.

## REFERENCES

1. Dittrich S, Germanakis J, Dittrich H, Daehnert I, Ewert P, Alexi-Meskishvili V, et al. Comparison of sodium nitroprusside versus esmolol for the treatment of hypertension following repair of coarctation of the aorta. *Interact Cardiovasc Thorac Surg* 2003;2:111-5.

2. Sealy WC. Paradoxical hypertension after repair of coarctation of the aorta: A review of its causes. *Ann Thorac Surg* 1990;50:323-9.
3. Farrell BG, Parker FB Jr, Poirier RA, Anderson G, Streeten DH, Blackman M. Angiotensin blockade in postoperative paradoxical hypertension of coarctation of the aorta. *Surg Forum* 1979;30:189-90.
4. Fox S, Pierce WS, Waldhausen JA. Pathogenesis of paradoxical hypertension after coarctation repair. *Ann Thorac Surg* 1980;29:135-41.
5. Guo TZ, Jiang JY, Buttermann AE, Maze M. Dexmedetomidine injection into the locus ceruleus produces antinociception. *Anesthesiology* 1996;84:873-81.
6. Hall JE, Uhrich TD, Barney JA, Arain SR, Ebert TJ. Sedative, amnestic, and analgesic properties of small-dose dexmedetomidine infusions. *Anesth Analg* 2000;90:699-705.
7. Chrysostomou C, Sanchez De Toledo J, Avolio T, Moota MV, Berry D, Morell VO, *et al.* Dexmedetomidine use in a pediatric cardiac intensive care unit: Can we use it in infants after cardiac surgery? *Pediatr Crit Care Med* 2009;10:654-60.
8. Bhana N, Goa KL, McClellan KJ. Dexmedetomidine. *Drugs* 2000;59:263-8.

**Cite this article as:** Sahu MK, Manikala VK, Singh SP, Bisoi AK, Chowdhury UK. Use of dexmedetomidine as an adjunct in the treatment of paradoxical hypertension after surgical repair of coarctation of the aorta in infants. *Ann Card Anaesth* 2015;18:437-40.

**Source of Support:** Nil, **Conflict of Interest:** None declared.