

Table 3.1. Cardiac output (l/min/450 kg) (+/- percent change from baseline) as determined by thermodilution in three standing horses, in the baseline condition and after administration of dopamine, dobutamine, and detomidine plus butorphanol.

	<i>Subject 1a</i>		<i>Subject 1b</i>		<i>Subject 2</i>	
Baseline	40		45.6		51.6	
Dopamine	48.8	(+ 21.8%)	ND		53.7	(+ 4%)
Dobutamine	44.9	(+12.1%)	ND		56.6	(+9.7%)
Detomidine + Butorphanol	33.5	(-16.3%)	31.7	(-30.4%)	33.3	(-35.5%)

ND = not done.

Table 3.2. Cardiac output (l/min/450 kg) as determined by M-mode echocardiography in three standing horses, in the baseline condition and after administration of dopamine, dobutamine, and detomidine plus butorphanol.

	Subject 1a	Subject 1b	Subject 2
Baseline	41.6	46.4	33.2
Dopamine	36.1	ND	32.1
Dobutamine	32	ND	25.3
Detomidine + Butorphanol	34.1	34.8	27.2

ND = not done.

## Bibliography

1. Bueno, A.C., Moore, R. M., Seahorn, T. L., Cornick-Seahorn, J., and Koch, C. E. Transient weakness, ataxia, and recumbency associated with catheterization of the right side of the heart in three horses. *J Equine Vet Sci* 1999; 19(11): p. 719-722.
2. Linton, R.A., Young, L. E., Marlin, D. J., Blissitt, K. J., Brearley, J. C., Jonas, M. M., O'Brien, T. K., Linton, N. W., and D.M. Band, Hollingworth, C., and Jones, R. S. Cardiac output measured by lithium dilution, thermodilution, and transesophageal Doppler echocardiography in anesthetized horses. *Am J Vet Res* 2000; 61(7): p. 731-7.
3. Schlipf, J.W., *et al.* Lesions associated with cardiac catheterization and thermodilution cardiac output determination in horses., in *5th International Congress of Veterinary Anesthesia*. 1994;
4. Marr, C.M., Bright, J. M., Marlin, D.J., Harris, P.A., and Roberts, C.A. Pre- and post-exercise echocardiography in horses performing treadmill exercise in cool and hot/humid conditions, in *Fifth International Conference on Equine Exercise Physiology*. 1998;
5. Sampson, S.N., Tucker, R.L., and Bayly, W.M. Relationship between VO<sub>2</sub>max, heart score, and echocardiographic measurements obtained at rest and immediately following maximal exercise in Thoroughbred horses, in *Fifth International Conference on Equine Exercise Physiology*. 1998;
6. Durando, M.M., V.B. Reef, and E.K. Birks. Correlation of echocardiographic stress tests with left ventricular pressure dynamics, in *American College of Veterinary Internal Medicine, Annual Forum*. 2001;
7. Martin, B.B., *et al.* Causes of poor performance of horses during training, racing, or showing: 348 cases (1992-1996). *J Am Vet Med Assoc* 2000; 216(4): p. 554-558.
8. Durando, M.M., V.B. Reef, and E.K. Birks. Right ventricular pressure dynamics during exercise: relationship to stress echocardiography. *Equine Vet J Suppl* 2002; 34(Sept): p. 472-477.
9. Hiraga, A., *et al.* Changes in left ventricular dynamics during graded exercise, in *Fifth International Conference on equine Exercise Physiology*. 1998;
10. Pascoe, J.R., *et al.* Cardiac output measurements using sonomicrometer crystals on the left ventricle at rest and exercise, in *Fifth International Conference on Equine Exercise Physiology*. 1998;

11. Long, K.J., J.D. Bonagura, and P.G.G. Darke. Standardised imaging technique for guided M-mode and Doppler echocardiography in the horse. *Equine Vet J* 1992; 24(3): p. 226-235.
12. Slater, J.D., and Herrtage, M.E. Echocardiographic measurements of cardiac dimensions in normal ponies and horses. *Equine Vet J Suppl* 19 1995: p. 28-32.
13. Sahn, D.J., DeMaria, A., Kisslo, J., and Weyman, A. Recommendations regarding quantitation in M-mode echocardiography: results of a survey of echocardiographic measurements. *Circ* 1978; 58(6): p. 1072-83.
14. Popp, R.L. and D.C. Harrison. Ultrasonic cardiac echography for determining stroke volume and valvular regurgitation. *Circ* 1970; 41(3): p. 493-502.
15. Uehara, Y., M. Koga, and M. Takahashi. Determination of cardiac output by echocardiography. *J Vet Med Sci* 1995; 57(3): p. 401-407.
16. Kronik, G., J. Slany, and H. Mossbacher. Comparative value of eight M-mode echocardiographic formulas for determining left ventricular stroke volume. A correlative study with thermodilution and left ventricular single-plane cineangiography. *Circ* 1979; 60(6): p. 1308-1316.
17. O'Callaghan, M.W., *et al.* Comparison of echocardiographic and autopsy measurements of cardiac dimensions in the horse. *Equine Vet J* 1985; 17(5): p. 361-368.
18. Burggraf, G.W. and J.O. Barker. Left ventricular volume changes after amyle nitrite and nitroglycerine in man as measured by ultrasound. *Circ* 1974; 49: p. 136-143.
19. Tucker, R.L., *et al.* Selected echocardiographic parameters and right sided pressures of the mule, in *Fourth International Conference on Equine Exercise Physiology*. 1994;
20. Blissitt, K.J., Young, L. E., Jones, R. S., Darke, P. G., and Utting, J. Measurement of cardiac output in standing horses by Doppler echocardiography and thermodilution. *Equine Vet J* 1997; 29(1): p. 18-25.
21. Moore, D.P. *Determination of cardiac output in horses by M-mode echocardiography and thermodilution.*, in *Veterinary Medical Sciences*. Submitted 2003, Virginia Polytechnic Institute and State University: Blacksburg.

22. Schwinn, D.A. Cardiac Pharmacology. In: F.G. Estafanous, P.G. Barash, and J.G. Reeves, eds. *Cardiac Anesthesia: Principles and Clinical Practice*. Philadelphia: Lippincott Williams & Wilkins, 2002; p. 1035.
23. Plumb, D.C., *Veterinary Drug Handbook*. 4 ed. 2002, Ames: Iowa State University Press. 960.
24. Comparisons, F.a., *Drug Facts and Comparisons*. 2002, St. Louis: Facts and Comparisons. 2205.
25. MacDonald, E., and Virtanen, R. Review of the pharmacology of medetomidine and detomidine: two chemically similar alpha-2 adrenoreceptor agonists used as veterinary sedatives. In: C.E. Short, ed. *Animal Pain*. New York: Churchill Livingstone 181-200, 1992; p. 181-191, 198-199.
26. Sarazan, R.D., *et al.* Cardiovascular effects of detomidine, a new alpha 2-adrenoceptor agonist, in the conscious pony. *J Vet Pharmacol Ther* 1989; 12(4): p. 378-88.
27. Wagner, A.E., Muir, W. W., and Hinchcliff, K. W. Cardiovascular effects of xylazine and detomidine in horses. *Am J Vet Res* 1991; 52(5): p. 651-7.
28. Muir, W.W., Wagner, A.E., and Hinchcliff, K. W. Cardiorespiratory and MAC-reducing effects of alpha-2 adrenoreceptor agonists in horses. In: C.E. Short, ed. *Animal Pain*. New York: Churchill Livingstone, 1992; p. 201-212.
29. Mantin, R., and Ramsay, J.G. Cardiac output technologies. *Int Anesthesiol Clin* 1996; 34(3): p. 79-107.
30. Lee, Y.H., Clarke, K. W., Alibhai, H. I., and Song, D. Effects of dopamine, dobutamine, dopexamine, phenylephrine, and saline solution on intramuscular blood flow and other cardiopulmonary variables in halothane-anesthetized ponies. *Am J Vet Res* 1998; 59(11): p. 1463-72.
31. Gasthuys, F., de Moor, A., and Parmentier, D. Influence of dopamine and dobutamine on the cardiovascular depression during a standard halothane anaesthesia in dorsally recumbent, ventilated ponies. *Zentralbl Veterinarmed A* 1991; 38(7): p. 494-500.
32. Trim, C.M., J.N. Moore, and N.A. White. Cardiopulmonary effects of dopamine hydrochloride in anaesthetised horses. *Equine Vet J* 1985; 17(1): p. 41-44.
33. Hinchcliff, K.W., K.H. McKeever, and W.W.I. Muir. Hemodynamic effects of atropine, dobutamine, nitroprusside, phenylephrine, and propranolol in conscious horses. *J Vet Int Med* 1991; 5: p. 80-86.

34. Swanson, C.R., *et al.* Hemodynamic responses in halothane-anesthetized horses given infusions of dopamine or dobutamine. *Amer J Vet Res* 1985; 46(2): p. 365-370.
35. Robertson, J.T., W.W. Muir, and R. Sams. Cardiopulmonary effects of butorphanol tartrate in horses. *Am J Vet Res* 1981; 42(1): p. 41-4.
36. Robertson, J.T., and Muir, W. W. A new analgesic drug combination in the horse. *Am J Vet Res* 1983; 44(9): p. 1667-9.
37. Rutkowski, J.A., Eades, S. C., and Moore, J. N. Effects of xylazine butorphanol on cecal arterial blood flow, cecal mechanical activity, and systemic hemodynamics in horses. *Am J Vet Res* 1991; 52(7): p. 1153-8.