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Retrospective study of dystocia in mares at a referral hospital

J. LYNCH NORTON[†], B. L. DALLAP[#], J. K. JOHNSTON[#], J. E. PALMER[†#], P. L. SERTICH[§], R. BOSTON[‡] and **P. A. WILKINS*[†#]**

Department of Clinical Studies, Sections of [†]Large Animal Medicine, [‡]Biostatistics, [§]Reproduction, and [#]Emergency, Critical Care and Anesthesia, University of Pennsylvania, School of Veterinary Medicine, George D. Widener Hospital for Large Animals, New Bolton Center, Kennett Square, Pennsylvania, USA.

Keywords: horse; dystocia; fetal outcome; management protocol

Summary

Reasons for performing study: **The period between the onset of dystocia and its resolution has an important bearing on fetal outcome. There are few published data on which to base decisions regarding optimum management of cases in practice.**

Objectives: **To evaluate and compare the effects of a coordinated dystocia management protocol (CDMP) with that of a previous protocol of random management on time to resolution and outcome in both an emergency dystocia referral population of mares (referred emergency cases: EM) and in a population of mares residing in hospital due to high risk pregnancy (HRP) concerns that then experience dystocia at parturition.**

Methods: **Retrospective study performed at a university hospital referral centre of cases presenting from 1991–2004 divided into *Group 1* (pre-CDMP) and *Group 2* (CDMP).**

Results: **Medical records of 71 cases with dystocia were retrieved and data recorded. For referred emergency cases (EM), time from hospital presentation to resolution decreased significantly by 32 min (P = 0.03) after institution of CDMP. Survival rate of mares at discharge was 86%. Survival of EM foals was low, with 10% in *Group 1* and 13% in *Group 2*, surviving to discharge. For EM foals delivered alive, survival to discharge was 30% and 43% in *Groups 1* and *2*, respectively. Median Stage II was significantly (P<0.001) different at 71 and 282 min for EM foals delivered alive vs. those not alive at delivery, respectively. Median duration of Stage II was also significantly (P<0.001) different between EM foals surviving and not surviving to discharge, at 44 and 249 min, respectively. Survival of HRP dystocia foals to discharge was 79%.**

Conclusions: **Although CDMP reduced the time from presentation at the hospital to resolution significantly for EM, total duration of Stage II for EM was unchanged, as was foal outcome.**

Potential relevance: **Very early referral of mares with dystocia to referral centres with dystocia management protocols may improve fetal outcome as increased duration of Stage II in the horse affects fetal outcome negatively.**

Introduction

Equine dystocia is a true emergency and threatens survival of both fetus and dam (Giles *et al.* 1993; Embertsen 1996; Haas *et al.* 1996; Freeman *et al.* 1999). A period from onset of Stage II parturition to delivery and time from presentation at a referral hospital to delivery have important effects on outcome for mare and foal (Embertson 1999; Byron *et al.* 2003). Factors involved include a well coordinated dystocia team and defined protocol used in order to minimise the period spent nonproductively.

A coordinated dystocia management protocol (CDMP) was instituted at University of Pennsylvania, Widener Hospital in 1997 as a guideline for decision-making in an effort to decrease the period from hospital presentation to dystocia resolution for emergency dystocia cases. The purpose of the present study aimed to evaluate the effects of this CDMP within the years 1997–2005 inclusive (*Group 2*) compared with having no specific protocol in place during 1991–1996 inclusive (*Group 1*).

Materials and methods

Case selection and case populations

Case records of mares with a complaint of dystocia, defined as Stage II of >30 min, between the years 1991 and 2004 were retrieved and data recorded. Mares involved in pre-CDMP (n = 16; 1991–1996) were designated as *Group 1* and those involved in CDMP (n = 55; 1997–2005) were designated as *Group 2*.

Definitions: 1) Referred emergency cases (EM) were mares presented to the hospital on an emergency basis with dystocia as their presenting complaint. 2) High risk pregnancy cases (HRP), in which dystocia occurred in mares already hospitalised and enrolled in a programme designed for managing mares with either historical problems or current pregnancies considered to be 'high risk'. Enrolment in the HRP included previous history of abnormal foals (e.g. neonatal isoerythrolysis or encephalopathy, sepsis, placentitis) and all critical illness in the dam. Evaluation of fetal presentation was generally performed and/or assistance provided prior to the 30 min mark, but the delivery was not termed 'dystocia' unless >30 min passed before delivery of the fetus.

*Author to whom correspondence should be addressed. Present address: 382 West Street Road, Kennett Square, Pennsylvania 19348, USA.

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Data recorded

Data recorded included: year of presentation; EM or HRP; an estimate of the time Stage II began for EM cases (determined from history or from time of initial contact with emergency clinician on call if owner estimate was not available from history); recorded Stage II initiation in HRP mares; time of hospital arrival for EM mares; time of resolution for all cases; if the fetus was delivered alive; survival of foals delivered alive; survival of mares; method of dystocia resolution and reasons for death/euthanasia in nonsurviving foals delivered alive.

Dystocia management protocols

Group 1: Management was random, except in HRP cases where a parturition protocol was developed for hospitalised mares based on the histories and clinical problems. For emergency cases, dystocia could continue for hours or the case referred immediately for caesarean section (CS), depending on the judgement of the admitting clinician.

Group 2: the CDMP is represented in Figure 1. Briefly, the dystocia team consisted of members of the emergency service, neonatal intensive care unit, obstetricians, surgeons and anaesthetists, together with personnel such as nurses, residents, students and clinical laboratory technicians. Once these individuals had been notified, each proceeded to their designated area and became prepared. A designated 'dystocia cart' containing equipment needed by the obstetricians and an 'emergency cart' containing equipment needed for mare treatment/stabilisation were available. Designated timekeeper and record keeper were identified. For HRP mares, because of their intensive management, much was already in place prior to the onset of Stage II and ready for immediate action should dystocia occur. For EM, all preparations were generally accomplished by the time the case arrived.

On arrival, the mare was taken immediately to the dystocia management stall. The timekeeper began calling out 'time passed' at one min intervals. A 2 min period was allowed for initial assessment, during which electrodes for determination of fetal ECG and an i.v. catheter placed in position. Intranasal oxygen insufflation (INO_2) was provided to the mare at 15 l/min and a rough clip of the abdomen began. Following the initial assessment a 2 min period was allowed to intubate nasotracheally the fetus. The decision tree then progressed through assisted vaginal delivery (AVD) while the mare was standing, to controlled vaginal delivery (CVD) with the mare in dorsal recumbency while anaesthetised and, finally, to fetotomy, CS or euthanasia. The rough clip of the abdomen was completed during CVD in addition to gross and final surgical preparation of the ventral abdomen in anticipation of CS. Limited time frames were allowed for each technique before the next was attempted. The lead senior clinician might choose to move to the next technique more rapidly than the maximum period allowed or to omit a technique altogether. Assisted and controlled vaginal delivery might be prolonged at owners' request or at the lead clinician's decision, if the fetus was

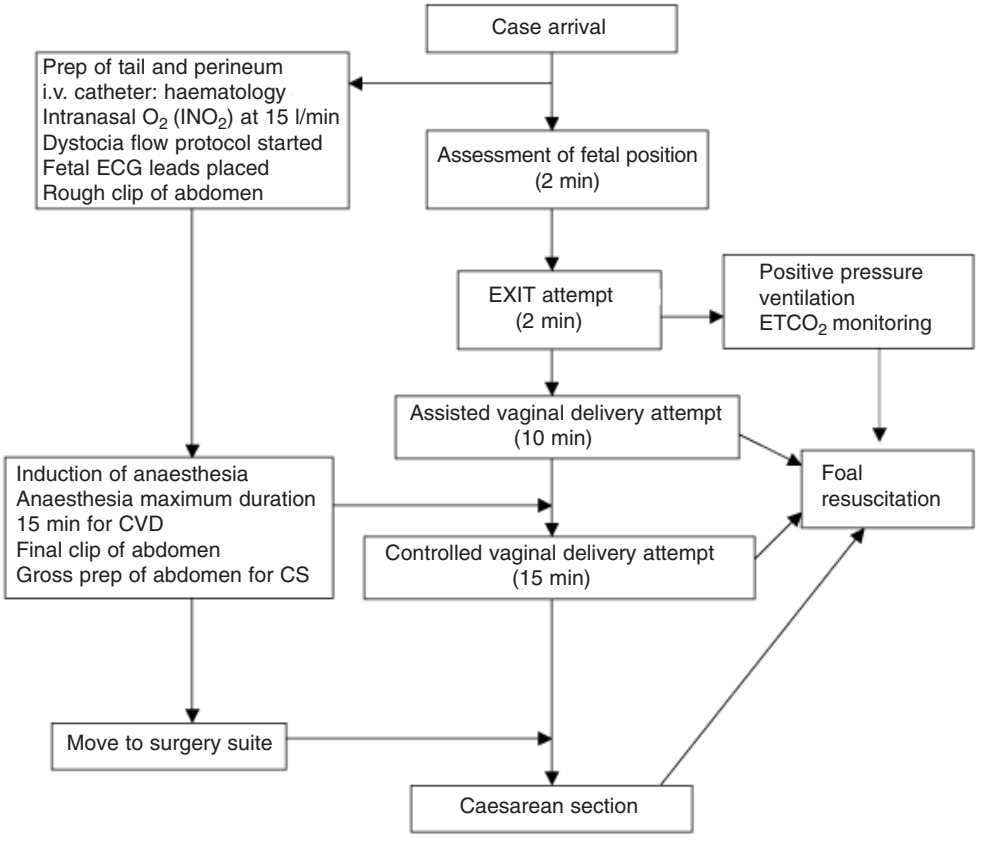

Fig 1: Coordinated dystocia management protocol (CDMP). Fetotomy and euthanasia decisions may have been made by the owner and are not depicted in the flow chart. For detailed description see Materials and methods. EXIT = ex utero *intrapartum treatment; $ETCO_2$ = end tidal CO_2.*

diagnosed as dead or because of severe financial limits imposed. Medications used for fetal resuscitation (e.g. epinephrine) were administered via an endotracheal tube.

Nasotracheal intubation of a fetus (EXIT) (Bouchard *et al.* 2002; Palmer and Wilkins 2005) during Stage II was performed in 11 cases subsequent to 1996.

Travel distance/time estimates

For EM cases, an estimate of distance and time required for travel was obtained by the use of an internet based mapping site[2]. For this purpose, the point of departure was entered as the address of the farm of origin, if available, or the address of the referring veterinarian if the farm of origin could not be determined from the medical record. These estimates were used to assess referral radius and partition period prior to hospital arrival only and were not part of the calculation for total duration of Stage II.

Statistical analysis

Tests of association of categorical variables were performed using Fishers' exact test, tests of differences between ordinal arrangements of interval variates between outcome classes were performed using the Kruskal Wallis test; and survival analysis, involving periods to events (e.g. hospitalisation period, coinciding with hospital departure) were performed using Cox regression, as well as the log rank test. For evaluation of differences from time of hospital arrival to resolution for EM cases with regards to foals born alive and/or discharged alive, *t* testing was performed on log transformed times in addition to Kruskal Wallis.

Logistic regression to examine the association between foal outcome measures (respectively, born alive and alive at discharge) and total duration of State II, distance of mare from the hospital and estimated travel time to the hospital. Units of association were percent change on the odds of the outcome per extra unit of time taken, or extra mile travelled.

Additionally, tabulation facilities and box plots were used to create tables and graphics. The software, Stata 8.2[3], was used for all statistical analysis, and a $P<0.05$ was used routinely to separate differences due to chance from differences due to test variables. Trends were identified at a P value of <0.10.

TABLE 1: Time (min) from hospital arrival for referred emergency cases (EM) or after HRP mare has been diagnosed as dystocia, to dystocia resolution by technique used. Data presented as total number, median (25th–75th percentile: range)

Technique	Mares with dystocia (n = 71)			
	HRP (n = 14)		EM (n = 57)	
	Pre-CDMP (n = 6)	CDMP (n = 8)	Pre-CDMP (n = 10)	CDMP (n = 47)
AVD	50 min (25–70:25–70) (n = 4)	26 min (18–43:15–55) (n = 3)	50 min (20–80:20–80) (n = 2)	17[a] min (10–39:10–39) (n = 5)
CVD	60 min (N/A) (n = 1)	29 min (15–43:15–43) (n = 2)	(n = 0)	45 min (30–73:16–106) (n = 16)
CS	100 min (N/A) (n = 1)	60 min (50–160:50–160) (n = 3)	93 min (90–136:78–251) (n = 5)	64[a] min (50–75:28–300) (n = 20)
Fetotomy	(n = 0)	(n = 0)	167 min (150–182:150–182) (n = 3)	90[a] min (81–91:66–153) (n = 5)
Euthanasia	(n = 0)	(n = 0)	(n = 0)	36 min (N/A) (n = 1)

a = Significantly different from pre-CDMP. N/A = not applicable. AVD = assisted vaginal delivery; CVD = controlled vaginal delivery; CS = caesarean section.

Results

A total of 71 medical records were identified with sufficient information for inclusion in the study. 1) Dystocia in HRP (n = 14), 6 prior to (*Group 1*) and 8 in 1997 and after (*Group 2*). 2) Mares admitted with presenting complaint of dystocia (n = 57), 47 presenting after the implementation of CDMP (Table 1) (*Group 2*).

Options for method of dystocia resolution included AVD, CVD, CS, fetotomy or euthanasia of the mare. Time from admission of the mare with dystocia or dystocia determination in HRP mares, to dystocia resolution and number of each technique resulting in dystocia resolution are presented in Table 1. Prior to the initiation of CDMP most dystocias were resolved using AVD or CS. Following CDMP initiation, 33% (18/55) were resolved successfully by CVD and CS was required in 42% (23/55). For all methods, time from presentation (EM), or reaching 30 min Stage II (HRP), to resolution decreased following implementation of CDMP (*Group 2*). Cases where dystocia was resolved by AVD had the shortest period to delivery, followed by CVD and CS (Table 1). Periods for CS were 19 and 31 min longer than CVD in EM and HRP cases, respectively.

In EM mares, median time from arrival to dystocia resolution was significantly ($P = 0.03$) decreased by ~32 min after implementation of CDMP (Table 2). However, total duration of Stage II for EM mares was not different after CDMP, despite the significant decrease in time to resolution following arrival at the referral hospital (Table 2). Median estimated travel distance for EM cases, 1997 and after, increased significantly ($P<0.001$) from 12.5 (9–24: 9–53) miles (median, 25th–75th percentile: range) to 48 (22–65: 5–129) miles post CDMP implementation. Correspondingly, median estimated time for travel significantly increased ($P = 0.008$) with CDMP from 22 (17– 43:17–82) min to 77 (38–95:11–153) min, accounting for 31.0% of total Stage II duration in *Group 2* compared to 12.6% in *Group 1*. For HRP mares, no significant change in either duration of Stage II or time to resolution was present.

No significant difference was observed in survival rate of mares to discharge after the implementation of CDMP (81% vs. 87%) and population type (HRP vs. EM) had no association with mare outcome.

TABLE 2: Median (25th–75th percentile: range) total duration of Stage II duration of Stage II prior to hospital arrival and time from admission to dystocia resolution for referred emergency cases

	Total duration stage II (min)	Stage II prior to arrival (min)	Time from arrival to resolution (min)
Group 1 n = 10	229 (120–270:120–602)	126 (60–310: 45–420)	92 (80–167: 20–251)
Group 2 n = 47	250 (140–360: 25–783)	182 (180–240:15–720)	60[a] (39–80:10–300)

[a]Significantly different from *Group 1*.

Overall, in 31/71 (44%) cases the fetus was delivered alive, of which 15 (48%) were subsequently discharged alive, overall survival 21% (15/71: Table 3) There was no difference in fetal survival for either HRP or EM in *Group 2*, compared to *Group 1*. For EM the longest Stage II delivery of a live foal was 346 min for a foal that was assisted with *ex utero* intrapartum treatment, but died shortly after delivery. The longest Stage II in an EM foal surviving to discharge was 162 min, which was delivered by CS due to a posterior presentation and did not have apparent cord compression or placental separation. Median (25th–75th percentile: range) duration of total Stage II was significantly different (P<0.001) at 71 (45–138:15–346) min and 282 (151–390:30–783 min) for foals delivered alive vs. those not alive at delivery, respectively. Total duration of Stage II was 44 (30–80:30–162) min for foals surviving to discharge, significantly different (P<0.001) from foals not surviving to discharge at 249 (120–338:30–783 min), with a difference of 181 min (Fig 2). For each 10 min increase in Stage II above 30 min there was a 10% increased risk of the fetus being dead at delivery (P<0.001) and a 16% increased risk of the fetus not surviving to discharge (P = 0.003).

For EM cases, there was an insufficient number of foals either born alive or surviving to discharge to examine differences between *Groups 1* and *2* regarding period in hospital and foal outcome. For total EM cases the duration between hospital arrival and dystocia resolution was significantly (P = 0.03) less for foals born alive v.s. those not delivered alive. This difference was not maintained when examining foals discharged alive vs. those not discharged alive. For EM cases there was a trend for an association between decreased distance travelled and assumed time required for travel, with fetuses being delivered alive (P = 0.10; P = 0.07, respectively) and foals surviving to discharge (P = 0.09; P = 0.06), respectively).

A larger proportion of foals delivered alive by AVD (P = 0.043) survived to discharge than did CS foals, with AVD having the shortest total duration of Stage II (Table 1, Fig 3). Only one foal was delivered by CVD prior to CDMP and, therefore, no statistical comparisons could be made with respect to outcome.

Overall, 10 foals delivered alive were subsequently subjected to euthanasia; 6 suffered from moderate to severe flexural deformities in addition to other important medical problems. Six foals delivered alive died after delivery, all severely compromised at delivery and lived for only a short period despite aggressive resuscitation attempts.

TABLE 3: Summary data for fetal outcome in mares with dystocia

Category	Total	Delivered alive	Dead on arrival died/euthanasia	Discharged* (All/DA)
All	71	31 (44%)	56 (79%)	15 (21%/48%)
Group 1: Total	16	9 (56%)	10 (63%)	6 (37%/67%)
High risk pregnancy cases	6	6 (100%)	1 (17%)	5 (83%/83%)
Referred emergency cases	10	3 (30%)	9 (90%)	1 (10%/30%)
Group 2: Total	55	22 (40%)	46 (84%)	9 (16%/41%)
High risk pregnancy cases	8	7 (88%)	2 (25%)	6 (75%/86%)
Referred emergency cases	47	14 (30%)	41 (87%)	6 (13%/43%)

*Expressed as % overall and as % from delivered alive (DA). CDMP = controlled dystocia management protocol

Discussion

Institution of CDMP greatly decreased the time from presentation to resolution for EM mares with dystocia, regardless of technique (Tables 1, 2). There was no difference in time to resolution for dystocia in HRP mares, nor was this expected as in this population of mares, management might be considered ideal, requiring neither referral nor transport. The predicted time to resolution, based on CDMP was shorter than that observed in EM mares and the protocol must be considered as only a guide for the decision-making process. The guideline was introduced with the purpose of improving fetal outcome; the small number of cases and dissimilar case number between *Groups 1* and *2*, limited the statistical power to recognise a small improvement. However, a more reasonable explanation for a lack of improvement in fetal outcome resides in the continued prolonged period to presentation from onset of Stage II, before and after CDMP was instituted, offsetting time gained by use of CDMP. As a retrospective study, these data are potentially flawed as the time of actual onset of Stage II may not have been recorded in EM cases, or observed or remembered accurately by the individual providing the history; however, these

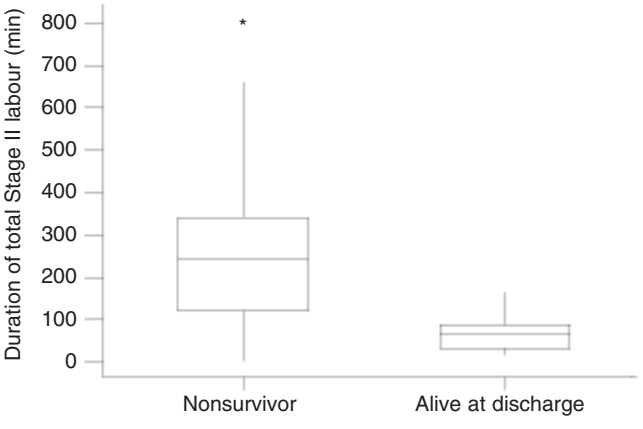

Fig 2: Boxplot illustrating difference between total Stage II duration for nonsurviving v.s. surviving foals delivered from dystocia.

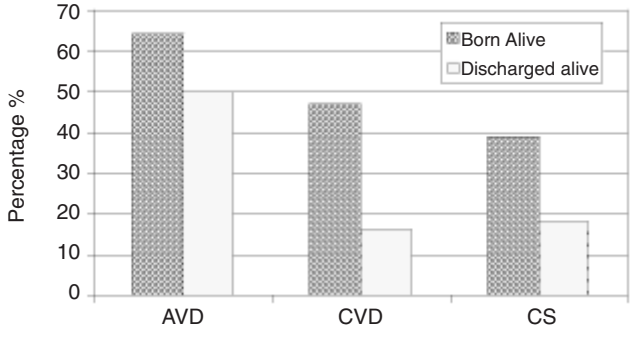

Fig 3: Percentage of foals delivered alive and surviving to discharge for 3 methods of delivery: Assisted vaginal delivery (AVD); Controlled vaginal delivery (CVD) and caesarean section (CS).

data indicate a long period prior to hospital arrival, for most cases, that did not change with CDMP.

While much of the delay, prior to arrival, can be accounted for by travel distance and travel time, delaying the decision for referral, arranging transportation and familiarity or lack thereof, of the route to the referral centre, may also play a role and could not be evaluated in this study. Using the travel estimates for EM from *Group 1*, 59% (126 min) of Stage II for EM was accounted for by time spent during transport (23 min) and at the farm or in other ways (103 min) (Table 2). In *Group 2* 73% (182 min) of total Stage II was spent prior to referral with ~42% (77 min) of that explained by travel, leaving 105 min (58%) accounted for by time spent at the farm or in other ways. Mares with dystocia appeared to be sent to the referral practice in Kentucky earlier than observed in our study, frequently without being seen by a referring veterinarian (Byron *et al.* 2003; R. Embertson, personal communication 2004). Earlier referral should result in improved outcome for the fetus, although the distance travelled by many of the EM cases in the present study had increased in *Group 2*. The observation that fetal/foal survival did not decrease in *Group 2* suggests that CDMP ameliorated some of the deleterious effects of the prolonged period either to referral or to arrival at the referral hospital associated with the increased referral radius. It is important to note that mare outcome was good to excellent in our study and that mare survival may dictate referral, even if fetal survival is unlikely, and may have accounted for some of the enlarged referral radius for dystocia cases in *Group 2*. The Kentucky report demonstrated that many mares returned to reproductive service, with many bred the same season as the dystocia and carrying that subsequent foal to term (Byron *et al.* 2003).

Our management protocol also introduced the use of CVD as a technique for resolution of dystocia when part of an established protocol (Byron *et al.* 2003). Method of resolution was associated with time to resolution due to the organisation of the CDMP. Unlike the Kentucky report, attempts at AVD were made in many cases; 20% of cases were resolved by AVD. Before CDMP was instituted, CVD was rarely performed at our institution, but is now common (Table 1). Caesarean section was the most frequent final resolution technique in CDMP (Table 1). Despite the period required to attempt CVD, time to resolution by CS decreased after CDMP, demonstrating an improved efficiency in dystocia management associated with CDMP.

The overall fetal survival rate from dystocia reported here compares well with data from the Kentucky study (Byron *et al.* 2003). It is important to recognise, however, that our overall data were influenced by dystocia occurring within mares enrolled in the high-risk pregnancy programme (HRP), where fetal survival was 83% *Group 2* and 86% *Group 1*, with 100% and 88% of foals delivered alive, respectively. This programme represents an idealised parturition management situation with close monitoring for onset of Stage II and rapid medical response for any problems. The HRP results sharply contrast with those of EM mares where fetal survival was only 10% in *Group 1* and 13% in *Group 2*, less than the 23% survival reported from Kentucky (Byron *et al.* 2003). In the Kentucky study, 70% of 104 foals delivered alive survived to discharge, compared to the HRP population in the present study in which 83–86% survived. The percentages of EM foals delivered alive that survived to discharge were 30% and 43% in *Groups 1* and *2* respectively. The difference in EM live foal delivery percentage between our study and the Kentucky report may be explained by differences in total Stage II duration, as may the difference in percentage of foals delivered alive that survived to discharge. The Kentucky group also reported that only total duration of Stage II was associated with final outcome for the fetus (Byron *et al.* 2003). The Kentucky data, and that of the HRP data from the present study, clearly demonstrate that rapid dystocia resolution corresponds to improved fetal outcome. Duration of Stage II directly impacts fetal survival, with an increased risk of nonsurvival for each 10 min increase in Stage II duration beyond 30 min.

Significantly fewer foals, delivered by either CVD or CS, were alive or survived to discharge when compared to AVD, again associated with shorter Stage II for AVD (Fig 3). However, survival of foals delivered by either CVD or CS was increased compared to the results from Freeman *et al.* (1999), where only 11% of dystocia foals were alive at delivery by CVD or CS; and only 5% survived to discharge. In the Freeman study, median total duration of Stage II was prolonged (300–360 min), underscoring the importance of rapid resolution if fetal survival is to be achieved.

In conclusion, the institution of CDMP significantly decreased time from hospital arrival to dystocia resolution for referred emergency cases. However, despite decreased dystocia duration improving fetal survival, the duration prior to hospital arrival in the present study remained prolonged and potentially counteracted any potential benefit CDMP may have had on fetal survival. Dystocia remains an emergency condition of the mare and prompt relief or referral, once dystocia is recognised as being not readily and rapidly correctable, should result in improved fetal survival. However, referral at any point usually results in survival of the mare.

Manufacturers' addresses

[1]Ambu Inc, Glen Burnie, Maryland, USA.
[2]MapQuest, http://www.mapquest.com/
[3]Stata Corp., College Station, Texas, USA.

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