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ORIGINAL RESEARCH

Development of a classification system for equine postoperative complications and its application in a cohort of 190 horses undergoing emergency laparotomy

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Abstract

Background: Accurate reporting of postoperative complications is paramount to understanding procedural outcomes, comparing procedures and assuring quality improvement. Standardising definitions of complications in equine surgeries will improve the evidence of their outcomes. To this end, we proposed a classification for postoperative complications and applied it to a cohort of 190 horses undergoing emergency laparotomy.

Methods: A classification system for postoperative complications in equine surgery was developed. Medical records of horses that underwent equine emergency laparotomy and recovered from anaesthesia were analysed. Reported complications pre-discharge were classified as per the new classification system, and the cost and days of hospitalisation were correlated with the equine postoperative complication score (EPOCS).

Results: Of the 190 horses that underwent emergency laparotomy, 14 (7.4%) did not survive to discharge (class 6 complications), and 47 (24.7%) did not develop complications. The remaining horses were classified as follows: 43 (22.6%) had class 1 complications, 30 (15.8%) had class 2, 42 (22%) had class 3, 11 (5.8%) had class 4; and three (1.5%) had class 5. The proposed classification system and EPOCS correlated with the cost and length of hospitalisation.

Limitations: This was a single-centre study and the definition of scores was arbitrary.

Conclusions: Reporting and grading all complications will help surgeons better understand the patients' postoperative course, thereby reducing subjective interpretation.

KEYWORDS
adverse event, classification system, colic surgery, complications, horse

INTRODUCTION

Postoperative complications in equine colic surgery remain a great challenge, despite improvements in pre-, intra- and postoperative care.[1,2] Moreover, studies on these complications have reported contradictory results.[2] Accurate reporting of such adverse events is paramount to understanding the outcome of a procedure, comparing procedures and assuring quality improvement. However, the lack of a standard method for reporting equine surgical complications makes it impossible to consistently evaluate surgical performance.

Mortality is often used as an outcome measure in emergency surgeries and is non-controversial. However, the evaluation of surgical performance based on postoperative complications is affected by factors such as differences in the definition of complications, non-reporting of complications and failing to consider that one complication may lead to a series of events.

In human surgery, after a reduction in postoperative mortality, morbidity due to surgical procedures emerged as the main parameter in defining procedural safety and quality. The ability to classify, grade, risk adjust and compare adverse surgical outcomes in a

standardised and reproducible manner is necessary for quality improvement.[3]

The first classification system for postoperative complications in human surgery was proposed by Clavien et al.[4] In this classification system, complications are graded by severity and the intervention required. Although this system has been widely accepted, other classifications have been proposed in the subsequent years for improving the existing classification system,[5,6] adapting it to different types of surgeries, and quantifying the overall morbidity of the procedure.[7–9]

In veterinary medicine, such classification systems have not been widely accepted,[10] although there have been attempts to classify and report complications.[9–14] A recent scoping review[15] reported that, in equine colic surgery, there is a lack of uniformity in reporting and defining complications, thereby making it difficult to classify them. Consequently, it is impossible to compare results from studies at different centres or conducted during different periods because of the paucity of good-quality evidence. Thus, standardising the definitions of complications and introducing a classification system may expand the available evidence on the outcomes in equine surgery and facilitate quality improvement.

The principal aim of this study was to propose a classification system for postoperative complications in equine surgery. The secondary aim was to assess the clinical utility of this classification system using a series of colic surgery cases.

MATERIALS AND METHODS

Definition of complications

In the first phase of the study, we developed a classification system derived from the original Clavien–Dindo classification[4] and its subsequent modifications.[5] For this purpose, we accepted the following definition of a complication as reported by Dindo et al.[5]: 'any deviation from the ideal postoperative course'. The method of classifying the complications was based on the therapy used for the complication. Subsequently, for the purpose of classification in this study, we adopted the following definition of a complication: 'a complication is any deviation from the ideal postoperative course requiring treatment or impairing function of one or multiple organs'. Furthermore, we differentiated between complications that could be resolved during hospitalisation and those that were likely to produce derangement in the post-discharge period. As for the Common Terminology Criteria for Adverse Events (CTCAE) classification system,[13] we introduced the concept of 'proposed treatment' as a discriminant to account for the decision made by the owners.

Based on this concept, the treatment that can be proposed for each complication (medical, medical intensive, surgical) and the effect on the animal (systemic/non-systemic diseases, life-threatening/non-life-threatening, causing death or euthanasia), we defined six classes.

The definition '… impairing function of an organ' was adopted for events that have no available treatment options in horses (such as abortion, facial nerve paralysis) or ones leading to death.

This approach led to the development of the classification system reported in Table 1, into which complications reported in the scoping review15 were fitted in each class.

Definition of a quantitative score for complications

Furthermore, an arbitrary value, the equine postoperative complication score (EPOCS), was applied for each class to allow for quantification of the total morbidity due to the procedure. To define the EPOCS, we assumed that multiple minor complications would be considered a better outcome than a single major complication. Thus, we assigned a value to each class such that if multiplied several times (i.e., because more than one complication of a class occurred in the same horse), it would still give a total that is less than a single value of the following class. For example, a horse that undergoes two laparotomies but survives will have a score of 8, which is less than the score of a horse that is euthanased (EPOCS = 10).

Application of the classification system in equine emergency laparotomies

In the second phase, the medical records of horses admitted to the Turin veterinary teaching hospital between January 2018 and August 2021 that underwent colic surgery and recovered from anaesthesia were considered. Data on survival to discharge, reported complications before discharge, cost of the entire hospital stay and days of hospitalisation were retrieved and analysed. We considered the postoperative period as the time from when the horse was standing in the recovery box to when they were discharged from the hospital. In this study, we aimed to compare complication costs that would be applicable to a wide range of complications and to a wide range of horse sizes and weights. For this purpose, we considered cost as the total amount paid by the owner for drugs and treatments but not for professional fees for diagnostics or treatment, since the latter are not related to the horse's weight. Since expenses for surgery, anaesthesia and hospitalisation are not related to the postoperative course, we subtracted these costs from the entire amount.

To account for differences in the cost of drugs due to differences in the dimensions and breed of the animal, we associated the cost with the weight of the patient using the following formula: cost/100 kg (Euros) = [(total amount – standardised costs)/weight

TABLE 1 Proposal of a classification for postoperative complications in equine surgery with examples reported for colic surgery.

EPOCS	Class	Definition	List of complications reported pre-discharge in a recent scoping review[15]	List of complications reported post-discharge in a recent scoping review[15]
0.1	1	Any deviation from the ideal postoperative course and resolved medically with symptomatic treatment (local treatment, antipyretics, adsorbents)	Diarrhoea (non-infectious)	Diarrhoea (non-infectious)
			Fever	
			Gastric ulceration	
			Hypoproteinaemia, mild	
			Inappetence/anorexia	
			Mild anaemia/melena	
			Skin reaction at the injection site	
			Tachycardia	
			Thrombophlebitis	Thrombophlebitis
			Weight loss	Weight loss
0.5	2	Any deviation from the ideal postoperative course, resolved medically, potentially leading to further complications		Endometritis
			Keratitis	
			Incisional drainage	
			Incisional infection	Incisional infection
			Partial dehiscence (skin and subcutis)	Partial dehiscence (skin and subcutis)
			Subcutaneous abscess	Subcutaneous abscess
				Hernia (without herniorrhaphy)
1	3	Non-systemic disease requiring treatment other than those allowed for class 1 and 2 complications. Any non-life-threatening organ failure	Abortion	
			Diaphragmatic flutter	
			Haematoma in body wall	
			Haemoabdomen/haemorrhage from enterotomy/anastomosis not requiring transfusion	
			Hyperazotaemia	
			Hyperlipidaemia	
			Hypocalcaemia	
			Hypoproteinaemia, severe	
			Laminitis	Laminitis
			Myopathy	
			Paraphimosis	
			POC	POC
			POR	
			Radial /facial nerve paralysis	
			Rectal tears (grade I–II)	
			Respiratory distress	
4	4	Any deviation from the normal postoperative course, requiring a second surgery	Acute hernia	Hernia requiring herniorrhaphy
			Complete dehiscence (linea alba)	Complete dehiscence (linea alba)
			Haemoabdomen/haemorrhage from enterotomy/anastomosis not responding to medical treatment	
			Paraphimosis unresponsive to medical treatment	
			POC unresponsive to medical treatment	
			POR unresponsive to medical treatment	
			Rectal tears (grade II–III)/ retroperitoneal abscess	

(Continues)

TABLE 1 (Continued)

EPOCS	Class	Definition	List of complications reported pre-discharge in a recent scoping review[15]	List of complications reported post-discharge in a recent scoping review[15]
8	5	Systemic disease requiring intensive care	Colitis (infectious diarrhoea) salmonellosis/clostridiosis/enteritis	
			Disseminated intravascular coagulation/purpura haemorrhagica	
			Grass sickness	
			Hepatic/renal failure	Hepatic/renal failure
			Hyperlipaemia	
			Peritonitis/septicaemia	
			Pneumonia/pleuropneumonia/pulmonary oedema	
			Severe anaemia/haemoabdomen/haemorrhage from enterotomy/anastomosis and requiring transfusion	
			Systemic inflammatory response syndrome/endotoxaemia	
			Multiple organ dysfunction syndrome	
10	6	Class 6a—complications requiring euthanasia on humane grounds or because of life-threatening organ failure	Declining clinical condition	
			Evisceration	
			Laminitis not responding to treatment	Laminitis not responding to treatment
			Peritonitis not responding to medical treatment/visceral rupture	
			Rectal tears (grade IV)	
		Class 6b—spontaneous death of the patient	Shock, collapse/cardiovascular compromise, haemorrhagic shock	

Abbreviations: EPOCS, equine postoperative complications score; POC, postoperative colic; POR, postoperative reflux

in kg × 100]. This would give a more precise indication of the cost sustained by the owner for treating the complications without a horse breed or size bias. The length of hospital stay was counted until the postoperative day on which the horse was considered ready for discharge, thus avoiding biases introduced by the owners' decision to collect their horses after a formal discharge recommendation.[16] Horses for whom relaparotomy was offered but whose owners declined it were assigned to class 4 (complications needing a second surgery) because the complication could have potentially been resolved by the second surgery. Nevertheless, these horses have been excluded from the cost and length of hospital stay analysis. We also excluded horses assigned to class 6 (death or euthanasia on humane grounds) complications from the cost and length of stay analysis. To assess the correlation between a complication and the cost or length of hospital stay, the most severe complication was registered for horses with more than one complication. For each complication reported for each animal, a score was assigned according to the EPOCS system (Table 1). The total score was considered as the total EPOCS for each case. The correlations between the EPOCS and complication class, total cost and length of hospital stay were analysed using the Spearman correlation test. Values are expressed as median (range).

RESULTS

Complete records were available for 190 horses. Of these, 14 (7.4%) did not survive until discharge (class 6 complication) and 47 (24.7%) did not develop any complications. The remaining horses were assigned to the following classes based on their postoperative complications: 43 (22.6%) were in class 1, 29 (15.3%) were in class 2, 43 (22.6%) were in class 3, 11 (5.8%) were in class 4 and three (1.5%) were in class 5. The number and percentage of horses in the hospital population having each complication are reported in Table 2, while the number and percentage of horses having more than one complication are reported in Table 3.

Among the 11 horses in class 4, data on cost and length of hospital stay were available for only seven, as four were subjected to euthanasia due to financial constraints. The latter cases were assigned to the class of proposed treatment but with reduced cost and length of hospital stay because of the choice of the owners and were thus excluded from the correlation analyses. Cost and length of hospital stay were compared for each class of complication, except class 6, owing to its natural variability (euthanasia or death could have occurred from day 1 to several days postoperatively and with or without expensive treatment for complications).

TABLE 2 Number and percentage of horses in the hospital population having each complication.

Class	Complication	Number of cases	Percentage of cases
1	Diarrhoea (non-infectious)	7	3.7
	Fever	86	45.3
	Mild anaemia/melena	4	2.1
	Thrombophlebitis	11	5.8
2	Keratitis	1	0.5
	Incisional drainage/infection	45	23.7
	Partial dehiscence (skin and subcutis)	13	6.8
3	Abortion	1	0.5
	Haemoabdomen/haemorrhage from enterotomy/anastomosis not requiring transfusion	1	0.5
	Hyperlipidaemia	7	3.7
	Laminitis	11	5.8
	Myopathy	7	3.7
	POC	34	17.9
	POR	28	14.7
4	Complete dehiscence (linea alba)	1	0.5
	POC unresponsive to medical treatment	4	2.1
	POR unresponsive to medical treatment	4	2.1
5	Systemic inflammatory response syndrome/endotoxaemia	5	2.6
6	Declining clinical condition	7	3.7
	Evisceration	1	0.5
	Peritonitis not responding to medical treatment/viscera rupture	2	1.1
	Shock, collapse/cardiovascular compromise, haemorrhagic shock	6	3.2

Abbreviations: POC, postoperative colic; POR, postoperative reflux.

TABLE 3 Number and percentage of horses in the hospital population having more than one complication.

Number of complications per horse	Number of horses	Percentage of horses
0	47	24.7
1	49	25.8
2	38	20.0
3	25	13.2
4	22	11.6
5	9	4.7

A total of 169 horses were available for the cost and length of hospital stay analyses. The median (range) cost per 100 kg and days of hospitalisation are reported in Table 4. There was a moderate correlation between the class of complication and cost ($r = 0.641$, confidence interval [CI] 0.538–0.726, $p < 0.0001$) and length of hospital stay ($r = 0.513$, CI 0.389–0.618, $p < 0.0001$). Similar results were obtained for the EPOCS, which positively correlated with the class ($r = 0.978$, CI 0.97–0.984, $p < 0.0002$), cost ($r = 0.558$, CI 0.4385–0.6581, $p < 0.0001$) and days of hospitalisation ($r = 0.488$, CI 0.362–0.597, $p < 0.0001$).

DISCUSSION

In this paper, we propose a classification system for postoperative complications in equine surgery that summarises the entire postoperative experience of horses with respect to complications. We combined all complications according to the treatment required for resolution. Furthermore, we propose a score for each class of complications that could be useful to quantify the morbidity due to a surgical procedure. We applied the classification system and the EPOCS in a cohort of 190 horses that underwent emergency laparotomy. Both the class of complication and EPOCS were positively correlated with the cost and length of hospitalisation. All complications registered in our hospital for colic cases fit in the classification system.

All the complications reported in the scoping review[15] were initially accommodated into the classifications proposed in human and veterinary literature. However, these classifications could not fit due to the variety of complications, and most importantly, the treatment needed to resolve those encountered after colic surgery. Furthermore, in some cases, complications reported as minor could have led to other severe complications (e.g., hernia needing surgical repair after mild incisional infection).

TABLE 4 Length of hospital stay, costs and equine postoperative complications score (EPOCS) for each class of complication in the hospital population.

		Highest class of complication						
	Total	**0**	**1**	**2**	**3**	**4**	**5**	**6**
Number of horses	190	47	43	29	41	7	3	14
Length of hospital stay (days)	172	9 (7–14)	10 (6–16)	11 (8–21)	10 (8–18)	14 (13–19)	18 (17–22)	NA
Cost of postoperative treatment (Euros per 100 kg)	172	343 (168–399)	428 (270–741)	454 (279–833)	464 (350–829)	800 (637–1075)	650 (540–730)	NA
EPOCS	190	0 (0–0)	0.1 (0.1–0.5)	0.6 (0.5–2.6)	1.3 (1–3.1)	5 (4.1–5.5)	8.6 (8–11)	10 (10–12.6)

Note: Median EPOCS (range) of the entire hospital population was 0.6 (0–12.6), while the median (range) complication class was 2 (0–6). Values are expressed as median (range).

In the scoping review,[15] three types of complications were identified: complications that resolved medically, those that required relaparotomy, and those that led to death or euthanasia. These complications were generally reported in two periods: during and after hospitalisation. Complications that could be resolved with medical treatment included a variety of diseases ranging from mild fever to multiple organ dysfunction syndrome. Furthermore, certain complications that required medical treatment for resolution could lead to long-standing diseases or require a second surgery in the future. Consequently, the same basic principle of classifying the complications according to the treatment needed was followed, similar to most classification systems in human and veterinary surgery. We also classified the complications according to their impact on single or multiple organs and on possible consequences such as being life-threatening or causing further disease once resolved. In addition, we introduced in the definition the fact that a complication may not necessitate a treatment but may impair the function of one or multiple organs. Examples include abortion, cases of facial or radial nerve paralysis, or other conditions that do not require a medical or surgical treatment but alter the ideal postoperative course. Nevertheless, some of these may be considered a complication of anaesthesia rather than of surgery (facial nerve paralysis, myeloencephalomalacia and so on), and their inclusion in this classification may be reconsidered.

If we assume that a complication is any deviation from the ideal postoperative course requiring a treatment or impairing the function of one or multiple organs, we can identify the criteria and definition of every complication, either for those already reported or for those that may arise in future reports. With this definition, it will be easy to define any complication, that is, if it changes the postoperative course, it is a complication, and if it impairs the function of an organ, it is a complication. This resolves the problem of having a plethora of different definitions for each complication[15] and makes it easier to compare studies, procedures and progression of treatment.

Such an approach narrows the room for subjective interpretation of the severity of any given complication and any tendency to down-rate a complication. Besides, this classification is helpful in retrospective analyses, in which complications may not be described in detail but documentation of proposed and applied diagnostic tests and treatment is generally available.

Contrary to what is proposed in human medicine, an important aspect to consider in veterinary medicine is the possibility of the influence of owners on medical and surgical decisions for both economic and personal reasons. As proposed in the CTCAE classification,[13] in equine surgery, the complications should be reported according to the 'proposed' treatment instead of the 'applied' treatment. This is necessary to account for treatment that is proposed but denied by the owner owing to financial constraints that could ultimately lead to death or euthanasia of the animal.

Some complications may be evaluated differently by surgeons and owners; to assess the outcome of the procedure, the opinion of the patient (in human surgery) or the owner (in veterinary surgery) is paramount. This can be obtained via questionnaires and interviews. While this was not the objective of this study, it is warranted in the future. One of the outcome measures after colic surgery is survival. Survival is certainly the most important outcome; however, the complications experienced by the horses are equally important, which may influence the owners' decisions. Occasionally, owners prefer euthanasia rather than complex operations that could result in a long hospital stay or a high risk of postoperative complications. An important example is the decision to continue surgery if resection and anastomosis are needed. However, if only survival is considered, many important aspects related to colic surgery would be disregarded. If the owner prefers euthanasia over surgery, the outcome would be negative (death of the animal), whereas if surgery is performed and the horse survives, the outcome may be positive. However, all the complications that might have occurred after the surgery were not considered. The proposed treatment for complications, instead of survival/non-survival potential, gives a wider view of the burden of a procedure. In this cohort, six horses were euthanased based on the owners' decision when a second laparotomy was offered to further investigate and potentially treat postoperative colic (POC) or postoperative reflux (POR). Reporting the survival rate would have led to the exclusion of these

six cases, while reporting the complication and proposed treatment would allow the researcher to include them in the outcome assessment. Thus, defining the outcome of a procedure by the occurrence of all its complications may help increase the sample size.[9]

We suggest that at least two periods (before/after discharge) should be used to report complications in studies, and the classification should be applied separately in each period. Moreover, the classification should be applied separately for each further division of the 'after discharge' period (mid-term follow-up or long-term follow-up) chosen by the researcher, although the longer the period of follow-up, the more difficult it is to relate the complications to the surgical procedure. A wide consensus to define which period is the most useful to assess postoperative complications is needed.

It is also important to clearly distinguish between complications and their causes. For example, postoperative intestinal adhesions may not be a complication but a cause of complications, such as POC or POR. An attempt to distinguish complications from events that cause complications was made by Freeman[17] in reference to the development of POR. POR is a complication but can also be caused by various events, both functional (such as postoperative ileus) and mechanical (adhesions, anastomotic impaction, recurrence of intestinal dislocation, anastomotic technique).[17]

Surgical outcome data are generally reported as raw morbidity and mortality, which do not necessarily reflect the quality of surgical care. Reporting all complications of each case and grading them will provide surgeons with a wider view of the postoperative period of the patient. The advantages of the classification of postoperative complications are increased uniformity in reporting results, ability to compare results from two distinct time periods at a single centre, ability to compare the results of surgery between different centres and ability to perform adequate meta-analysis.[4] Classifying complications according to the treatment needed, duration and burden on the owner and patient is beneficial. First, this may help the scientific community to identify the complications that need more comprehensive attention to reduce their incidence. For example, endotoxaemia and POR have been the focus of research in equine colic postoperative treatments with very expensive drugs and very little success. These are among the most severe complications; however, in the complete picture of the postoperative period, their treatment may not justify the costs incurred by the owners. Endotoxaemia could be considered a progression of disease (having likely started before surgery) rather than a complication and is thus difficult to stop or counteract, while POR may have different causes not treatable with prokinetics. Second, appropriate classification of complications could lead to an understanding that research and treatment should be focused on complications that may seem minor for the surgeon but have a great impact on the owner, or help the owner consider a complete picture of the condition rather than focusing on some complications. Fear of their horse developing POR and POC may lead an owner to refuse resection and anastomosis and request euthanasia during surgery. However, after considering and classifying all the complications, owners might realise that resection and anastomosis reduce the overall burden of complications and increase survival. Third, most studies on the identification of preoperative markers to determine prognosis in equine colic surgery have focused on survival. However, classifying, reporting and quantifying complications may complete the definition of prognosis in such studies, giving the surgeon and owner a better idea of the long-term prognosis. Finally, because postoperative complications are the strongest indicators of in-hospital costs, their classification may help in defining their impact on the overall cost of a procedure and direct efforts towards a significant saving capacity.

In most classification systems, including the one proposed in this paper, for each subject having more than one complication, only the most severe (e.g., higher degree) complication is reported.[3] However, focusing only on the most severe or on a single complication fails to represent the true overall 'morbidity burden' of a procedure. Besides the adoption of standard definitions and use of published schemes to classify adverse events, investigators should attempt to quantify complications and other events whenever possible rather than reporting them as qualitative results.[7–9] To make the occurrence of multiple complications comparable, quantification of classification systems has been proposed.[7–9] We did the same for equine postoperative complications by introducing the EPOCS. A numerical score (such as the EPOCS) may offer a more precise tool in clinical trials, databases or registries, and owner experience audits because it summarises the details related to the overall patient morbidity burden. On the contrary, in view of their simplicity and categorical nature, ordinal scales (such as the classification system described in this manuscript) may represent a practical tool to allow clinicians to describe individual patients or to evaluate the impact of specific types of complications after a procedure. Because both scoring systems are closely related, their simultaneous recording is recommended for clinical groups.[8]

This study has some limitations. First, it is a proposal and, as of now, the class definition and EPOCS have only been designed for postoperative complications associated with emergency laparotomy. They need to be validated on a larger scale in different types of surgeries. Second, the EPOCS, used as an example of classification, is arbitrary; thus, a survey of surgeons and owners may provide a different perception of both the score and classification. Furthermore, the classification system has been applied only in one hospital; thus, the results must be interpreted with caution. Different hospitals with different costs, owners or patients

should be included in further studies. Finally, this classification included only postoperative complications, and events that occurred during surgery were not considered.

CONCLUSIONS

Reporting all complications of each case and grading them will provide surgeons with a wider view of the postoperative course of the patient, narrowing the room for subjective interpretation of the severity of a given complication and any tendency to down-rate a complication. Furthermore, accurate reporting and grading of all complications may help in communication with clients and ultimately lead to a better outcome for equine emergency laparotomies. The broad implementation of this classification system in equine surgical literature may facilitate the evaluation and comparison of surgical outcomes among different surgeons, centres and therapies. We hope that this classification will be a starting point to provide better evidence in this field. Nevertheless, there is a need for wider validation and consideration of the opinion of horse owners in the definition of complications and a Delphi approach to achieve complete consensus.

AUTHOR CONTRIBUTIONS

Marco Gandini and Gessica Giusto equally contributed to study development, data analysis, and the writing and reviewing of the manuscript.

CONFLICT OF INTEREST STATEMENT

The authors declare that there are no conflicts of interest.

FUNDING INFORMATION

No funding was obtained for this study.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

ETHICS STATEMENT

This work involved the use of non-experimental animals only (including owned animals and retrospectively). Internationally established and recognised high standards of individual veterinary care were followed. Ethical approval from a committee was, therefore, not specifically required for publication.

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REFERENCES

1. Freeman DE. Fifty years of colic surgery. Equine Vet J. 2018;50:423–35.
2. Salem SE, Proudman CJ, Archer DC. Prevention of postoperative complications following surgical treatment of equine colic: current evidence. Equine Vet J. 2016;48:143–51.
3. Balvardi S, St-Louis E, Yousef Y, Toobaie A, Guadagno E, Baird R, et al. Systematic review of grading systems for adverse surgical outcomes. Can J Surg. 2021;64:E196–204.
4. Clavien PA, Sanabria JR, Strasberg SM. Proposed classification of complications of surgery with examples of utility in cholecystectomy. Surgery. 1992;111:518–26.
5. Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg. 2004;240:205–13.
6. Strasberg SM, Linehan DC, Hawkins WG. The accordion severity grading system of surgical complications. Ann Surg. 2009;250:177–86.
7. Strasberg SM, Hall BL. Postoperative morbidity index: a quantitative measure of severity of postoperative complications. J Am Coll Surg. 2011;213:616–26.
8. Slankamenac K, Graf R, Barkun J, Puhan MA, Clavien PA. The comprehensive complication index: a novel continuous scale to measure surgical morbidity. Ann Surg. 2013;258:1–7.
9. Slankamenac K, Nederlof N, Pessaux P, de Jonge J, Wijnhoven BPL, Breitenstein S, et al. The comprehensive complication index: a novel and more sensitive endpoint for assessing outcome and reducing sample size in randomized controlled trials. Ann Surg. 2014;260:757–63.
10. Follette CM, Giuffrida MA, Balsa IM, Culp WTN, Mayhew PD, Oblak ML, et al. A systematic review of criteria used to report complications in soft tissue and oncologic surgical clinical research studies in dogs and cats. Vet Surg. 2020;49:61–9.
11. Belshaw Z, Asher L, Dean RS. Systematic review of outcome measures reported in clinical canine osteoarthritis research. Vet Surg. 2016;45:480–7.
12. Cook JL, Evans R, Conzemius MG, Lascelles BDX, McIlwraith CW, Pozzi A, et al. Proposed definitions and criteria for reporting time frame, outcome, and complications for clinical orthopedic studies in veterinary medicine. Vet Surg. 2010;39:905–8.
13. Veterinary cooperative oncology group—common terminology criteria for adverse events (VCOG-CTCAE) following chemotherapy or biological antineoplastic therapy in dogs and cats v1.1. Vet Comp Oncol. 2016;14:417–46.
14. Giuffrida MA. A systematic review of adverse event reporting in companion animal clinical trials evaluating cancer treatment. J Am Vet Med Assoc. 2016;249:1079–87.
15. Giusto G, Cerullo A, Gandini M. Scoping review: occurrence and definitions of postoperative complications in equine colic surgery. Equine Vet J. 2022. https://doi.org/10.1111/evj.13881
16. Giusto G, Vercelli C, Gandini M. Comparison of liberal and goal-directed fluid therapy after small intestinal surgery for strangulating lesions in horses. Vet Rec. 2021;188:e5.
17. Freeman D. Post-operative reflux—a surgeon's perspective. Equine Vet Educ. 2018;30:671–80.

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