



In Adult Horses With Septic Peritonitis, Does Peritoneal Lavage Combined With Antibiotic Therapy Compared to Antibiotic Therapy Alone Improve Survival Rates?

A Knowledge Summary by

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Clinical bottom line

The quality of evidence in equids is insufficient to direct clinical practice aside from the following:

The use of antiseptic solution to lavage the abdomen causes inflammation and is detrimental to the patient.

For peritonitis caused by *Actinobacillus equuli*, treatment with antibiotics alone may be sufficient. A variety of antibiotics were used in the two reported studies.

Question

In adult horses with septic peritonitis, does peritoneal lavage combined with antibiotic therapy compared to antibiotic therapy alone improve survival rates?

The Evidence

There is a small quantity of evidence and the quality of the evidence is low, with comparison of the two treatment modalities in equids only performed in case series. There is a single study which performed the most robust analysis possible of a retrospective case series by using multivariate analysis to examine the effect of multiple variables on survival (Nogradi et al., 2011). Inherent to case series is the risk that case selection will have introduced significant bias into the results; peritoneal lavage maybe used more commonly in more severely affected cases or where the abdomen has been contaminated with intestinal or uterine contents. There have been no randomised trials to compare the efficacy of the treatment options discussed.

When examining the method of peritoneal lavage chosen there is a single experimental, randomised control trial comparing the use of sterile saline, saline containing potassium penicillin and neomycin, 3% or 10% povidone iodine solution for abdominal lavage in horses. The quality of evidence describing types of antibiotics used is low (case series) and there is no direct comparison of antibiotics used.

Summary of the evidence

Golland (1994)	
Population:	Horses with peritonitis attributed to <i>Actinobacillus equuli</i> at one Australian equine hospital 1982-1992 Excluded: post-operative peritonitis Peritonitis: not defined
Sample size:	15

Intervention details:	<ol style="list-style-type: none"> 1. Antibiotics: n=15 (procaine penicillin and neomycin [n=12], procaine penicillin and gentamicin [n=1], trimethoprim sulfadiazine [n=1], oxytetracycline then trimethoprim sulphadiazine [n=1]) 2. Abdominal lavage: 1/15 (3l balanced polyionic solution + 3g benzyl penicillin q 12h)
Study design:	Case series
Outcome studied:	<ul style="list-style-type: none"> • Clinical improvement after 48h of treatment • Survival rate
Main findings: (relevant to PICO question):	<p>There was a rapid response to antibiotic treatment and high survival rate of peritonitis caused by <i>A. equuli</i> infection</p> <ul style="list-style-type: none"> • Clinical improvement after 48h: 15/15 • Return to previous activity: 11/15 (7 ridden, 4 breeding) • information not available for 3/15, • euthanised for unrelated condition 1/15
Limitations:	<ul style="list-style-type: none"> • Small sample size • Abdominal lavage was only performed in one case and there was no comparison of treatment protocols • Survival information was not available for 3/15 cases • Neomycin is rarely used in current clinical practice

Hawkins (1993)	
Population:	Horses with peritonitis at a single equine hospital 1985-1990 Peritonitis: Peritoneal fluid total nucleated cell count > 10 x 10 ⁹ cells/l
Sample size:	67 Peritonitis due to: <ul style="list-style-type: none"> • intestinal rupture [n=14] • after abdominal surgery [n=25] • no intestinal rupture or abdominal surgery [n=28]
Intervention details:	Antibiotics only: <ul style="list-style-type: none"> • penicillin (22000IU/kg q6-12h) [n=38] • gentamicin (2.2-3.3mg/kg q8-12h) [n=44] • metronidazole (15-25mg/kg q6-12h) [n=13] Peritoneal lavage (no further details) [n=9]
Study design:	Case series
Outcome studied:	Survival to discharge from the hospital
Main findings: (relevant to PICO question):	<p>There is a high mortality with septic peritonitis after abdominal surgery</p> <ul style="list-style-type: none"> • Survival to discharge from hospital: 27/67 (40.3%) • Survival of cases undergoing peritoneal lavage: 6 out of 9 (60%)

Limitations:	<ul style="list-style-type: none"> • No details of substance, volume, frequency of peritoneal lavage • Very limited details of other treatments given • No statistical comparison of interventions • No follow-up of survival after discharge from the hospital • The dosing regime of gentamicin is not consistent with that used in current clinical practice
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Henderson (2008)

Population:	Horses with peritonitis at two UK equine hospitals over 12 years. Peritonitis: Peritoneal fluid total nucleated cell count > 5 x 10 ⁹ cells/l Excluded: 1. post-laparotomy/ laparoscopy cases 2. gastrointestinal rupture
Sample size:	65 The effect of treatment was compared for 50 horses with idiopathic peritonitis. 15 horses with identified causes of peritonitis were excluded from treatment comparison.
Intervention details:	<ul style="list-style-type: none"> • Broad-spectrum antibiotics (no further details provided) [n=56], with anthelmintics [n=7] • Peritoneal lavage [n=9] via exploratory laparotomy [n=5] or standing drain placement [n=4]
Study design:	Case series
Outcome studied:	<ul style="list-style-type: none"> • Survival • Development of complications
Main findings: (relevant to PICO question):	84% of cases survived to 12 months. There was no association of treatment method with outcome or complication rate.
Limitations:	<ul style="list-style-type: none"> • Few details of treatment methods including type of antimicrobials and solution used/ frequency of abdominal lavage. • It is not described within the 50 horses with idiopathic peritonitis how many horses there were in each treatment group or the outcome of each treatment group

Javsicas (2010)

Population:	Post-partum mares (within 7 days of foaling) with peritonitis or a confirmed uterine tear treated at two equine hospitals 1990-2007 Peritonitis: Peritoneal fluid total nucleated cell count > 10 x 10 ⁹ cells/l, total protein concentration > 2.5g/dL, predominance of degenerative neutrophils +/- intracellular bacteria on cytological examination Excluded: vaginal laceration, gastrointestinal rupture, death on day of admission
Sample size:	49

Intervention details:	Medical [n=15]; antibiotic therapy Surgical [n=34]; ventral midline coeliotomy Abdominal lavage was performed in both groups and frequency of abdominal lavage was not different between the treatment groups
Study design:	Case series
Outcome studied:	Survival to discharge
Main findings: (relevant to PICO question):	Overall survival to discharge: 76% Survival was not different between medically (11 out of 15 survived) and surgically treated (26 out of 34 survived) cases. Use of peritoneal lavage was not different between survivors and non-survivors
Limitations:	<ul style="list-style-type: none"> • No definitive diagnosis of uterine tear in 7/11 surviving medically treated cases • No details of peritoneal lavage treatment or antibiotics used • No follow up information beyond discharge

Matthews (2001)

Population:	Horses with peritonitis attributed to <i>Actinobacillus equuli</i> seen at one Australian equine hospital 1993-1999 Peritonitis: not defined
Sample size:	51
Intervention details:	<ul style="list-style-type: none"> • Antibiotic treatment (procaine penicillin 20mg/kg IV BID [n=31], procaine penicillin and gentamicin sulphate 6.6mg/kg IV SID [n=20] for 5-14d, followed by trimethoprim sulphonamide 5mg/kg for 2 weeks [n=6]) • Abdominal drain [n=2]
Study design:	Case series
Outcome studied:	Clinical improvement Survival to discharge
Main findings: (relevant to PICO question):	All horses survived to discharge and were clinically normal at the time of discharge
Limitations:	No description of use of abdominal drain; it is unclear whether the abdomen was lavaged or a drain placed without lavage. No comparison of interventions No follow up beyond discharge from the hospital

Nieto (2003)

Population:	Horses at a single equine hospital treated with a closed negative suction drainage system 1989-1996 Patients included had abdominal surgery [n=54], reproductive abnormalities [n=7] or peritonitis (peritoneal fluid total nucleated cell count > 10 x 10 ⁹ cells/l) [n=6]
Sample size:	67

Intervention details:	<ul style="list-style-type: none"> Abdominal lavage [n=66] with lactated Ringer's solution or saline containing; heparin [n=39], potassium penicillin G [n=7] or aminoglycosides [n=16] or 0.1% povidone iodine [n=2]. No lavage [n=1] Closed negative suction drain system [n=67] Systemic antibiotic therapy (combination of beta-lactam antibiotic and aminoglycoside in 60% cases, the remainder were given an additional antibiotic)
Study design:	Case series
Outcome studied:	Volume of fluid retrieved Complications Survival to discharge from the hospital and long-term
Main findings: (relevant to PICO question):	<ul style="list-style-type: none"> On average 83% of lavage fluid was retrieved Complications reported in 49% included obstruction of drain, leakage of fluid/omental migration through the abdominal wall after drain removal, pain, structural damage to drain, haematoma formation around drain. Incisional suppuration occurred in 32% of surgical cases and 5 developed an incisional hernia. Survival to discharge from the hospital: 93% Long-term survival: 78% survived >7 months. Death was due to colic (n=4), laminitis (n=3), adhesions (n=3), peritonitis (n=1)
Limitations:	No comparator group No description of treatment allocation between different disease states Several different disease states were included making comparison of treatment outcomes difficult 0.1% povidone iodine solution was used for lavage. 3% and 10% povidone iodine solution has previously been shown to cause inflammation (Schneider et al., 1988)

Nogradi (2011)	
Population:	Horses with peritonitis 2004-2007 Peritonitis: peritoneal fluid total nucleated cell count > 10 x 10 ⁹ cells/l or total protein concentration > 25g/l.
Sample size:	55
Intervention details:	<ul style="list-style-type: none"> Non-surgical: Abdominal lavage [n=21]; 1-4x/ daily with polyionic crystalloid solution by gravity flow for 1-12 days.Antibiotic therapy Surgical: Exploratory laparotomy [n=26]
Study design:	Case series
Outcome studied:	Survival rate Factors associated with survival

<p>Main findings: (relevant to PICO question):</p>	<p>Survival rate:</p> <ul style="list-style-type: none"> • Total 43/55 (78%) • Non-surgical 27/29 (93.1%) • Surgical: Abdominal surgery within 2 weeks of diagnosis 11/18 (61%) <p>Abdominal lavage 17/21 (80.9%)</p> <p>Factors associated with survival (multivariate model)</p> <ul style="list-style-type: none"> • Packed Cell Volume on presentation • Coeliotomy <p>Treatment with antibiotics vs antibiotics and peritoneal lavage was not associated with survival</p>
<p>Limitations:</p>	<p>Duration of survival was not defined</p> <p>Limited details of antibiotic treatment protocols are described</p> <p>The statistical details of the comparison of antibiotics vs antibiotics and peritoneal lavage is not provided.</p>

Schneider (1988)	
<p>Population:</p>	<p>Healthy, adult ponies</p>
<p>Sample size:</p>	<p>24</p>
<p>Intervention details:</p>	<p>Peritoneal lavage performed once with 20l of:</p> <ol style="list-style-type: none"> 1. sterile saline (0.9% NaCl) [n=6] 2. sterile saline containing 5 x 10⁶ U of potassium penicillin and 3g neomycin [n=6] 3. Povidone-iodine diluted to 3% with sterile saline [n=6] 4. Povidone-iodine diluted to 10% with sterile saline [n=3] <p>Control population:</p> <ol style="list-style-type: none"> 5. Lavage catheter placed, no fluid instilled [n=3]
<p>Study design:</p>	<p>Randomised controlled trial</p>
<p>Outcome studied:</p>	<ul style="list-style-type: none"> • Clinical response (pain) • Peritoneal fluid nucleated cell count, cytology, protein concentration • Peritoneal cavity at necropsy • Survival to 96h, at which time all ponies were euthanised for post mortem examination

<p>Main findings: (relevant to PICO question):</p>	<p>All ponies undergoing abdominal lavage showed signs of discomfort</p> <p>Lavage with 10% povidone-iodine [n=3]:</p> <ul style="list-style-type: none"> • All ponies treated showed severe abdominal pain, tachycardia and pyrexia. • 1 pony died after 30h and another was euthanised after 36h • 1 pony survived to 96h • No further ponies were lavaged with 10% povidone-iodine • Diffuse, fibrinous peritonitis <p>Lavage with 3% povidone iodine</p> <ul style="list-style-type: none"> • Diffuse peritonitis <p>Lavage with sterile saline/ sterile saline & antibiotics</p> <ul style="list-style-type: none"> • No significant difference to controls at post mortem examination <p>Povidone-iodine solution (3% and 10%) caused irritation to peritoneal surfaces and should not be used to lavage the peritoneal cavity</p>
<p>Limitations:</p>	<p>Randomisation process not described</p> <p>More dilute povidone-iodine solution was not trialed</p> <p>Only a single lavage procedure was performed</p> <p>These were healthy ponies without pre-existing abdominal inflammation or infection</p>

Appraisal, application and reflection

Only low-quality evidence is available comparing the use of antibiotics with the combined use of antibiotics and peritoneal lavage to treat horses with peritonitis. There are many likely confounding factors in the case series reported which are inherent to use of case series. This includes unblinded treatment selection; it is likely that more severely affected cases or those where the abdomen is contaminated with gastrointestinal or uterine contents are treated with peritoneal lavage and antibiotics whereas those thought to be less severely affected are treated with antibiotics alone. There is also significant variation in the treatments used between cases within studies and between studies, including the use of treatment protocols which are now outdated, in particular, aminoglycoside choice, dose and frequency, (Golland et al., 1994, Hawkins et al., 1993). There is variation in the class of antibiotics, doses and frequency used and duration of treatment for cases within and between studies. A single study (Nieto et al., 1993) included patients in which abdominal lavage was performed using povidone-iodine solution, which has been shown to cause peritoneal inflammation (Schneider et al., 1988) and several studies do not describe the fluid used for lavage the abdomen (Hawkins et al., 1993, Henderson et al., 2008, Javsicas et al., 2010, Matthews et al., 2001). Financial constraints may have influenced the choice of treatment and the survival of patients reported. Patients in all the case series studies described received additional treatments including intravenous fluid therapy, non-steroidal anti-inflammatory medication, gastroprotectants, anti-endotoxic medication and prokinetics. The impact of these treatments was not analysed in most studies and is not described in this summary.

Conclusion:

There is no evidence in equids that there is a difference in survival when the use of antibiotics is compared to the use of antibiotics combined with peritoneal lavage. However, the quality of data available is insufficient to direct clinical practice apart from two areas; in peritonitis caused by *Actinobacillus equuli*, treatment with antibiotics alone is sufficient, and the use of antiseptic solutions such as povidone iodine to lavage the abdomen causes inflammation and is detrimental to the patient. More definitive conclusions cannot be drawn until higher quality evidence on this topic is available.

Methodology Section

Search Strategy	
Databases searched and dates covered:	CAB Abstracts on OVID Platform 1973- Week 17 2017 PubMed accessed via the NCBI website 1973- Week 17 2017
Search terms:	<ol style="list-style-type: none"> 1. (equine or horse or equus or colt or equid) and peritonitis) 2. (antibiotic or antimicrobial or antibacterial or anti-microbial) 3. (lavage OR surgery OR exploratory laparotomy OR laparotomy OR coeliotomy OR celiotomy) 4. 1 and (2 or 3)
Dates searches performed:	11 th May 2017

Exclusion / Inclusion Criteria	
Exclusion:	Non-English language papers Single case reports Book chapters and literature reviews without novel information Not relevant to the question
Inclusion:	Papers comparing the use of antimicrobials with the combination of antimicrobials and peritoneal lavage were included. Due to the very limited available literature papers describing the use of antimicrobials or antimicrobials and peritoneal lavage or peritoneal lavage were included even when there was not a direct comparison of treatment modalities.

Search Outcome						
Database	Number of results	Excluded – non-English Language	Excluded – case report	Excluded – narrative review/ opinion pieces	Excluded – not relevant to PICO	Total relevant papers
CAB Abstracts	195	44	15	7	121	8
NCBI PubMed	134	3	6	3	115	7
Total relevant papers when duplicates removed						8

CONFLICT OF INTEREST

The author declares no conflicts of interest.

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