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VOLUME 13 ISSUE 3

June/July 2018

EquineWellnessMagazine.com

EQUINE LEAKY GUT



SYNDROME

PART 1

By Michael I. Lindinger, PhD, and Shannon Stanley, MSc

A LEAKY GUT ALLOWS UNDESIRABLE MOLECULES INTO YOUR HORSE'S BODY, ADVERSELY AFFECTS HER NUTRIENT ABSORPTION, CAUSES INFLAMMATION, AND MAY SERIOUSLY IMPAIR HER BODILY FUNCTIONS.

Does your horse seem “off”? Perhaps her manure is loose and she seems a little colicky. Her performance is not at its usual level, her behavior is iffy, and she's not interested in finishing her feed. These sometimes subtle signs may be associated with sub-clinical leaks within the gastrointestinal tract (GIT). The first part of this article describes leaky gut syndrome (LGS) in horses, and subsequent articles will address how nutrients, probiotics and prebiotics can help maintain and repair healthy barrier function.

LGS occurs when GIT barrier functions have been compromised, causing the intestinal tract to leak molecules and other substances that should not enter the interior of the body. The entire digestive system keeps exterior matter outside the horse even though the GIT is within the body. A healthy GIT only allows beneficial molecules across the barrier. With a leaky GIT, pathogens invade and cross the barrier, resulting in inflammation and impaired function. Equine LGS resembles irritable bowel syndrome in humans and other animals.

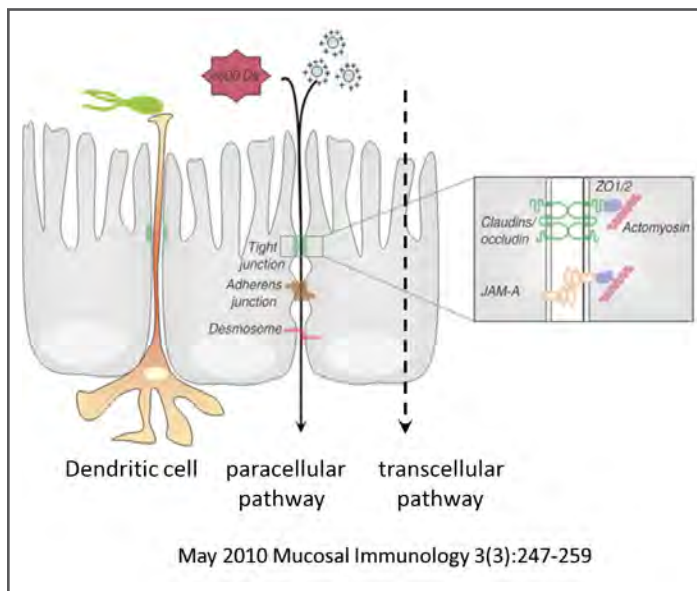
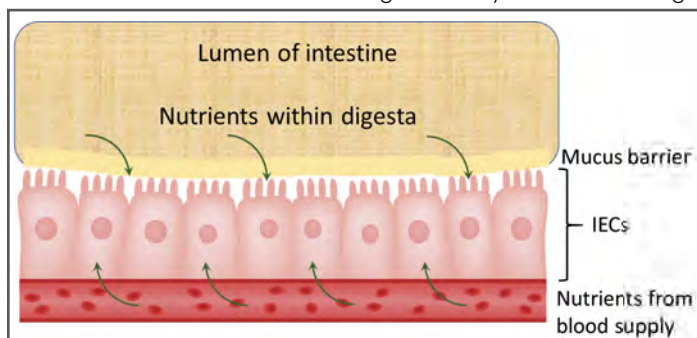
WHY THE HEALTHY GIT IS NOT LEAKY

The complex processes of nutrient absorption cannot occur effectively when the GIT becomes leaky. This is because effective nutrient absorption requires a tight

barrier. In addition, the barrier is supposed to keep pathogens out of the body.

The intestinal barrier is made up of intestinal epithelial cells (IECs), along with a mucosal layer lying over the villi and produced by IECs. The IECs are connected to each other by a network of tight junctions – adherens junctions, desmosomes and other connector proteins. Molecules cross the intestinal barrier in two ways: through cells (the transcellular pathway) or between cells (the paracellular pathway). In a normal healthy GIT, the paracellular movement of molecules is what prevents the passage of pathogens from within the intestine into the horse's body.

Images courtesy of Michael Lindinger



May 2010 Mucosal Immunology 3(3):247-259

The junctional proteins can be disrupted by intestinal pathogens or mechanical damage, resulting in leakage. One challenge to maintaining barrier function occurs when damaged or aged cells are being shed, because the adjacent cells must try to maintain barrier function. Any step in the process can be disrupted by pathogens, leading to a leaky barrier and intestinal inflammation. Leakiness typically occurs in relatively small regions of the GIT, but prolonged exposure to toxic materials or chronic suppression of intestinal immune health can lead to large regions of leakiness, as seen with advanced colitis or colonic ulcers.

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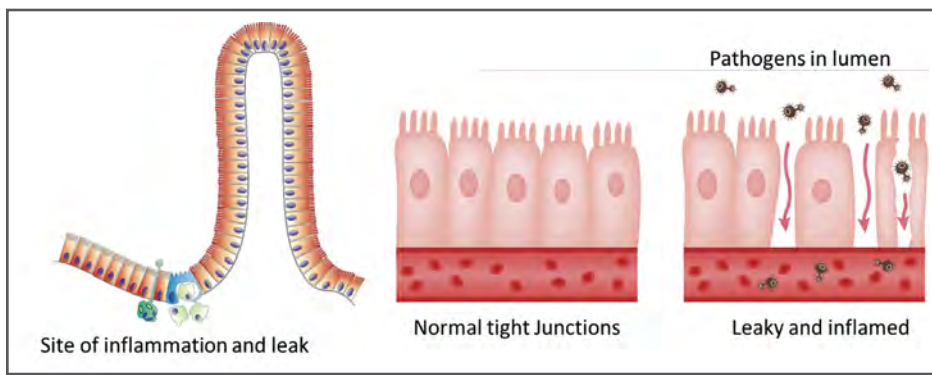
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BARRIER DISRUPTION

Injury to the mucosal layer or underlying IECs can be caused by drugs routinely used in equine medicine; by ingestion of plant and bacterial toxins; or by mechanical damage from foreign material or colic. The mucous layer is the first barrier, and pathogens must penetrate it to reach the epithelial cells during infection. Pathogenic microorganisms have developed diverse ways to invade and degrade the mucosal barrier – a thinned mucosal barrier allows pathogens to more easily reach the IECs. Many pathogens interfere with the mucosal layer and the junctional proteins, resulting in a widened intercellular paracellular pathway, and allowing pathogens into the IECs and body. An inflammatory response will be directed towards pathogens, but inflammation can also result in increased IEC damage and leakiness until repair occurs.

The inflammatory response to injury is intended as a controlled mechanism that initiates and accompanies wound repair and the healing process. This is characterized by an infiltration of immune response cells, increased local blood flow and increased IEC metabolism leading to the controlled repair of damaged areas. The inflammation may become uncontrolled when injury is severe or prolonged, and can contribute to massive tissue destruction requiring medical intervention.


An immune response begins whenever a foreign or pathogenic substance enters a part of the body it shouldn't. Cells within the immune system are able to sense and recognize these substances as foreign, and in response, they signal other immune system cells to deal with them. The dendritic cells of the innate immune system actually penetrate the IEC barrier from the inside of the horse, providing an early warning and detection system for immune response. Macrophages are large cells capable of surrounding and “eating” foreign matter. They can be recruited from elsewhere in the body to come to the injury site, and are produced in large numbers in response to the injury. Other pathogenic molecules are transported to the liver by the bloodstream, where de-toxifying systems within the liver break them down into less toxic or non-toxic molecules. These responses can also be accompanied by inflammatory responses with increased local blood flow and cellular metabolism.

When the site of injury is large, inflammatory and immune responses will be large. Unfortunately, it's often not until a large response has occurred that the problem becomes obvious to the horse owner. By this time, the severity of the lesion(s) can be such that inflammatory and immune responses have progressed from local to whole body or systemic, and are accompanied by increased body temperature, heart and respiratory rates, and a rise in the indices of immune cells in the hematology profile.

FACTORS CONTRIBUTING TO LEAKY GUT IN HORSES

Stressors and intestinal pathogens contribute to a leaky gut in the horse. Common stressors include seasonal changes in forage type and quality; the quantity and frequency of grain feeding; the presence of mycotoxins and other pathogens within forage and feeds; types and amounts of supplements used; medications; exercise and training stress; transport stress; heat stress; excessive time spent in stalls; and mistreatment by people or other horses. You may be able to control some stressors (e.g. forage and feed quality, supplements, medications, horse handling practices), while others are “normal” (i.e. exercise, training, transport) or only poorly controlled (environmental stresses, forage).

Nutrition and other aspects of horse care work hand in hand to maintain a healthy GIT barrier. The GIT possesses defenses to deal with the vast array of ingested pathogens; these include stomach acidity, antimicrobials within the mucous barrier lining the inside of the GIT, beneficial microbes within the GIT, and the physical barriers of both the mucous layer and underlying intestinal epithelial cells (IECs).

At this point, it is very desirable to do everything reasonable to protect and maintain barrier and digestive functions in the GIT. It is also evident that if we don't do anything when we know barrier function has been compromised, the situation can get worse in a hurry. We therefore need to provide nutritive and medical support that work together, in an integrative way, to promote rapid pain relief and healing. Nutritive approaches to maintaining healthy barrier function will be the topic of the next two parts of this article. 

Dr. Michael Lindinger is President of the Nutraceutical Alliance, former professor at the University of Guelph, and is involved in animal health research and nutraceutical product development. Shannon Stanley (MSc) is an animal biosciences and nutrition graduate.