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Dr. Ewelum Johnson Nnadi

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1.Harold Jan R. Terano

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3.Massoud Kaykhaii







MORPHOLOGICAL CHANGES IN THE INTESTINE AND MESENTERY IN BLUNT ABDOMINAL TRAUMA

Sobitkhanov M.S
Sadykov R.A

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Introduction. Blunt abdominal trauma remains an important challenge in emergency surgery because injuries to the intestine and mesentery may initially present with nonspecific clinical findings. Hollow viscus and mesenteric injuries are relatively uncommon, but delayed recognition can have serious consequences. The World Society of Emergency Surgery (WSES) guidelines emphasize the limitations of the initial clinical examination and the importance of repeated assessment when bowel injury is suspected. Contemporary radiological reviews likewise indicate that intestinal and mesenteric injuries may be difficult to identify even with contrast-enhanced computed tomography, particularly when the findings are subtle or indirect.

Materials and methods. The study was based on an experimental model of blunt abdominal trauma in laboratory rats. Morphological changes in the small intestine and mesentery were investigated under three treatment conditions: standard management without specific stimulation of tissue repair, low-level laser therapy, and combined administration of platelet-rich plasma (PRP) with laser treatment. Histological findings from intact animals were used as a reference for normal tissue architecture.

The investigation focused on the temporal progression of post-traumatic injury and repair. Tissue specimens were examined at four observation points: 24 hours and 3, 7, and 14 days after trauma. These intervals were selected to characterize early tissue damage, inflammatory changes, reparative regeneration, and subsequent remodeling.

The morphological investigation included the following groups:

Control group: animals with experimentally induced blunt abdominal trauma receiving standard management, including analgesia, without low-level laser therapy or PRP.

Laser therapy group: animals receiving low-level laser treatment following trauma.

Combined treatment group: animals receiving PRP in combination with low-level laser treatment.

Intact animals served as a morphological reference group.

The experimental procedures included models of abdominal injury of differing severity. Moderate trauma was characterized by intestinal and mesenteric contusions and hematomas without bowel perforation or free intraperitoneal bleeding. More severe trauma involved mesenteric vascular injury and intra-abdominal hemorrhage, requiring surgical intervention. Treatment was selected according to the characteristics of the injury.

In the moderate-trauma experimental group, laser treatment was administered using a Milta device, beginning on the second day after injury and continuing daily for five days.

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In the severe-trauma experimental group, surgical hemostasis was followed by administration of approximately 1.0–1.5 mL of PRP into the mesenteric root. Laser irradiation was subsequently applied to this region in scanning mode at a power density of 50 mW/cm². A topical hemostatic agent, Hemoben, was applied to mesenteric tears. Postoperative external laser treatment was also performed.

Because the combined-treatment protocol included several interventions, its observed effects were evaluated as those of the complete treatment regimen rather than attributed independently to PRP or laser therapy.

Serial histological sections of the small intestine and mesentery were prepared for morphological assessment. Tissue specimens were stained with hematoxylin and eosin and examined using light microscopy.

The intestinal wall was evaluated according to its anatomical layers, including the mucosa, submucosa, muscular layer, and serosa. Particular attention was given to epithelial integrity, villus architecture, enterocyte degeneration, vascular congestion, blood stasis, interstitial edema, hemorrhage, and inflammatory infiltration.

In the mesentery, the assessment included connective tissue organization, vascular integrity, perivascular changes, inflammatory infiltration, and the development of fibrous tissue.

Conclusion Experimental blunt abdominal trauma induced a sequential pattern of morphological changes in the intestinal wall and mesentery, characterized by early microcirculatory disturbances, epithelial injury, edema, and hemorrhage, followed by inflammatory infiltration, tissue regeneration, and fibrotic remodeling. In untreated animals, inflammatory changes were most pronounced on day 3, while residual structural abnormalities and connective tissue proliferation persisted through day 14.

Low-level laser therapy was associated with earlier restoration of intestinal mucosal architecture, reduced inflammatory changes, and less pronounced fibrosis. On day 14, intestinal villus height reached 471±15 μm in the laser therapy group, compared with 432±18 μm in controls.

Combined PRP and laser treatment was associated with near-normal restoration of intestinal architecture and limited fibrotic remodeling. By day 14, villus height reached 479±14 μm, approaching the intact value of 482±16 μm, while the fibrosis score was 0.4±0.1 points, compared with 2.7±0.1 points in controls.

These findings demonstrate differences in the morphological course of post-traumatic tissue repair across the experimental treatment conditions. However, variations in initial injury severity and the use of additional interventions in the combined-treatment protocol preclude attributing the observed effects to PRP alone or establishing the superiority of one treatment regimen.

Further controlled experimental studies with comparable injury severity, standardized treatment protocols, and long-term follow-up are required to determine whether these approaches can consistently limit post-traumatic fibrosis and preserve intestinal and mesenteric structure.