Digestive System Ultrasonography in *Acipenser persicus*

**A.R. Vajhi**, M. Masoudifard, M. Akhtarzade, M. Moghim, M. Molazem

1Clinical Sciences, Faculty of Veterinary Medicine, University of Tehran, Tehran, Iran
2Veterinary Clinician, Chabahar, Iran
3Fisheries Research Center of Mazandaran, Sari, Iran

*Corresponding author

Keywords: *Acipenser persicus*, Digestive system, Ultrasonography

**Introduction**

Sturgeon fishery, the most valuable of the Caspian Sea, is the major economic resource and plays a significant role in the income of the Iranian south Caspian Sea fisheries. *Acipenser persicus* is one of the most important caviar producing fishes in the Caspian Sea and one of the endangered species of the sturgeon fishes so its propagation is under governmental programming using artificial methods. In their propagation duration, because of their artificial feeding, several digestive problems may happen which can be detectable by ultrasonography (US). Lots of histological researches have been done on the digestive system in different fish (1, 2). In addition, US is routinely used for diagnosis of gastrointestinal tract diseases in small and large animal practice such as: neoplasia, inflammations, intussusception, and ETC (3). To the authors' knowledge there is not any studies performed on the normal ultrasonographic findings of sturgeon digestive system. This project was done to determine normal ultrasonographic findings of digestive system and approaches in *Acipenser persicus*.

**Materials and Methods**

A total of 10 adult *Acipenser persicus* (5 female and 5 male), during artificial propagation program, were used in this experiment. They were captured during March and April of 2005 and transferred to the hatcheries by truck equipped with oxygen. They underwent ultrasonographic study using a Pie Medical 200 VET ultrasonic machine and dual-frequency (5 and 7.5 MHz) linear waterproof transducer (Model 40915, 5/7.5 MHz 64E VET. Pie Medical Philpswegl, Maastricht, The Netherlands). To detect the normal location and details of the digestive system, 3 adult *Acipenser persicus* were autopsied primary to the study. Different parts of the digestive system were removed and transferred into a water bath to be examined by US for assessing in vitro echogenicity and shape of different parts of the digestive system. Afterward, the 10 normal fish were placed into a water bath and the ultrasound imaging was taken.

All parts of the digestive system were examined by transverse, sagittal, parasagittal, frontal, and oblique planes. Image acquisition was started from the oral cavity and lips toward rectum and anal orifice. Oral cavity was inspected by sliding the probe caudally on the ventral and lateral part of the body to create sagittal and transverse views. Scanning continued to the other parts of the digestive system too (pharynx, esophagus, glandular stomach, muscular stomach, pyloric process, small intestine, spiral intestine, rectum, and pancreas). Normal ultrasonographic appearance of the digestive system was described and wall diameters and appropriate approaches were recorded.

**Result and Discussion**

Digestive system ultrasonographic in *Acipenser persicus* were as followings:

The lips and the oral cavity were distinctively hyperechoic with a concave surface. Ventral part of the oral cavity was concave and hyperechoic too. The dorsal part of the oral cavity was irregular in shape and protuberant.

The esophagus was shrunk in the lumen and detected in the dorsal part of the heart or aorta. The layers of its wall were often visible. There was no difference between the cranial and caudal parts of the esophagus. The place where the esophagus passes the diaphragm was detectable in sagittal view.

Ultrasonographic examination of the glandular stomach was difficult when it was empty. Five layers of alternating echoes included: an inner hyperechoic layer, representing the mucosal surface, the inner thin and hypoechoic layer (mucosa), a central thin and hyperechoic muscular layer, and the outer and very hyperechoic layer which was serosa. The junction of the glandular stomach with the muscular stomach was visible as a hyperechoic layer.

The wall of the muscular stomach contained: an inner mucosal hyperechoic layer, a thick central muscular layer which was striped and hyperechoic, and an outer serosal layer which was hyperechoic and thin. There was an anechoic layer between mucosal and muscular layers which could have been the submucosa. The space between two adjacent mucosal layers (the stomach lumen), was filled with an anechoic fluid.

The surface of the pyloric process was completely hyperechoic. The deeper parts were not visible because of the dirty acoustic shadow produced by this layer.

Small intestine had a same appearance in all ascending and descending part. Intestinal wall layers from outer to inner consisted of: a thin hyperechoic serosal layer, a thick hypoechoic muscular layer, a
thin hyperechoic summucosal layer, and a mucosal layer with contained two different echoes (hypoechoic and almost anechoic).

In the wall of the spiral intestine, there were a hypoechoic serosal layer and a thick muscular hypoechoic layer under. Beneath these layers, there were a hypoechoic submucosal layer and an isoechoic mucosal layer. Then there was a thin hypoechoic layer separated the lumen from the wall. In the transverse ultrasonographic scans of the spiral intestine, most of the times, the edge shadow artifact was visible due to the large amount of muscular layer in the wall (Fig. 1).

The rectum had a thin hyperechoic serosal layer and a thin hypoechoic muscular layer beneath.

The pancreas had a homogenic hypoechoic texture which was detectable between two ascending and descending parts of the small intestine.

As a non-invasive and safe technique, US was completely able to image the anatomy and show the different layers of the digestive system in *Acipenser persicus*. Although there are some limitations in digestive system ultrasonographic imaging because of artifacts create by gas presence inside the lumen, this problem was not found in *Acipenser persicus* due to lack of gas in its guts. So, no primary preparations such as fasting were necessary prior to US examination.

The muscular stomach was detectable almost in all scanning planes because of the large size and very thick muscular layer.

Short and narrow stripes in the muscular layer of the muscular stomach may represent collagen fibers and smooth muscle bundles. They were look like tendinous and ligamentous structures in other animals in ultrasonographic appearance but less compact. Consider to the topographic and size of the sphincter between muscular and glandular stomach, the only view which could be used for its detection was left lateral parasagital approach.

Ultrasonographic imaging of the esophagus was difficult to some extent. It could be because of thin esophageal layers, its short length, and the location. By the available US machine, it was not possible to differentiate the cranial part of the esophagus (which contains some prominences).

Acoustic shadowing behind the pyloric process could be due to the large amount of fat and excretion in its tissue but it needs more investigation to be proved. Stoskopf (1992) has stated that the location of the pyloric process was in the junction of the muscular stomach with glandular stomach. However, in the present study the region was shown to be placed in the junction of the muscular stomach with the intestine.

In conclusion, since there are not any reports of ultrasonographic findings of the digestive system in *Acipenser persicus* or any other sturgeon fish, the results of the present study would be considered as a reference of US appearance and plans in sturgeon fish.

![Fig. 1 Edge shadow artifact due to the muscular layer in spiral intestine. SI: spiral Intestine, M: abdominal muscle, Ae: edge shadow, Ai: acoustic enhancement](image)

**References**