Fluorescent Detection of Acute Intestinal Ischaemia

Thesis

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By

Ahmed Gamal Eldin Safina
(M.B.; B.Ch)

Supervised by

PROF. DR. AMR ABDULLAH MOHSEN
Professor of General Surgery
Faculty of Medicine, Cairo University

PROF. DR. AHMED FARAG A. FARAG
Professor of General Surgery
Faculty of Medicine, Cairo University

DR. MAHMOUD SABER
Assistant Professor of Surgery

National Institute of Laser Enhanced Sciences, Cairo University

Faculty of Medicine
Cairo University
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بسم الله الرحمن الرحيم

فَأَمَّا الزَّبَدُ فَيَذْهَبُ جُفَاء وَأَمَّا مَا يَنفَعُ النَّاسَ فَيَمْكُثُ فِي الأَرْضِ كَذَلِكَ يَضْرِبُ اللّهُ الأَمْثَالَ

صدق الله العظيم

سورة الرعد الآية 17

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IV	**Intravenous route**	**1**
SMA	**Superior mesenteric artery**	**6**
IMA	**Inferior mesenteric artery**	**7**
AMI	**Acute mesenteric ischemia**	**13**
NOMI	**Non occlusive mesenteric ischemia**	**15**
CT scans	**Computerized tomography scans**	**20**
MRIs	**Magnetic Resonance Imaging**	**21**
CBC	**Complete blood count**	**18**
WBC	**White blood cells**	**18**
SMV	**Superior mesenteric venous thrombosis**	**15**
MRA	**Magnetic Resonance Angiography:**	**21**
ICG	**Indocyanine green**	**44**
LSFG	**Laser speckle flowgraphy**	**43**
UV	**ultraviolet (UV) light**	**47**
CID	**Chemical industries development**	**56**
OR	**Operative room**	**66**
TLC	**Total leukocyte count**	**18**

Abstract

Background:

Mortality related to acute intestinal ischaemia remains very high. Patient survival is dependent on prompt recognition in order to deal with the ischaemic part either with revascularization or excision. Furthermore, if intestinal ends that are not perfectly vascularized, are anastomosed, this anastomosis is bound to fail causing peritonitis.

At operation distinction of viable from non-viable intestine is not always easy. Frequently a bowel loop that looks healthy and is left in the abdomen will develop gangrene within one or two days. Hence the policy of second looks surgery. Waiting for fixed colour changes to develop may take a long time, actually very precious time is wasted. For this ***Horgan and, Gorey (1992)*** stressed for the need for only two tests, fluorescein assessment and Doppler.

Aim of work:

The aim of this work is to assess the sensitivity of IV fluorescein under ultraviolet light for detection of acute intestinal ischaemia, in comparison with the regular visual assessment.

Patients and methods:

This will be a prospective study that will involve twenty patients in whom, at surgery, there is a possibility of acute intestinal ischaemia.

In each case the suspected part of intestine will be examined by the operator under two types of light: 1.Regular white light of the operating room. Ischaemia of the intestine will be assessed depending on the conventional criteria, namely colour change, mesenteric vessels pulsations and intestinal tone and peristalsis.

2. Ultraviolet light, while injecting IV fluorescein sodium at a dose of 10mg/kg. Ischaemia of the intestine will be considered if part of the intestine will not show green fluorescence. Photographs will be taken under both conditions for later evaluation by other surgeons who are not involved in this research.

Intestine that will be judged ischaemic by the fluorescence method will be excised, even if the conventional visualization judgment will not. This will leave brightly fluorescing intestine for anastomosis or for stoma formation.

Assessment (end points)

Result:

Clinical judgment was accurately fair in (85%) whereas fluorescein was more accurate than clinical judgment (100%) the difference was statistically significant ($p<0.05$) as compared with clinical assessment.

CONCLUSION:

We can say that the combination of UV light and fluorescein dye should be considered a valuable diagnostic procedure both for dignosis of early stage of a cute bowel ischemia and for viability of stoma.

Key Words :

fluorescein in intestinal ischemia - fluorescein - mesenteric ischemia .

INTRODUCTION

Viability of the bowel must be evaluated frequently during abdominal surgery. Sufficient blood supply is very important for successful healing of the anastomosis and avoidance of intestinal ischemia and necrosis. Insufficient microcirculation of the anastomotic region leads to anastomotic leakage or stricture, especially in elderly patients. This is associated with an increased length of hospital stay, significant postoperative morbidity and mortality. The reported incidence of anastomotic leakage ranges between 1.2% and 19.2%. Up to 32% of patients with an anastomotic leak die from this postoperative complication **(*Karliczek et al., 2010, Kudszus et al., 2010)***.

Intestinal microcirculation and viability is usually estimated from the color of the serosal surface, presence of bowel peristalsis, pulsation and bleeding from the marginal arteries. This is subjective and based on the experience of the surgeon. Clinical assessment may be deceptive. A dark hue may be due to transient venous insufficiency and the bowel may in fact be viable, whereas in early arterial occlusion it may appear normal. Absence of mesenteric pulsation may be due to hypotension or spasm. Peristalsis may persist even in a grossly ischemic bowel ***(La Hei ER et al., 2001; Karliczek et al., 2009)***.

Clinical risk assessment by the surgeons appeared to have a low predictive value for anastomotic leakage in gastrointestinal surgery ***(Dworkin et al., 1996)***.

It has been shown that improvement in inadequate intra-operative colonic perfusion from increased collateral circulation is unlikely to develop during the first five postoperative days and therefore anastomotic perfusion is probably determined at the time of surgery and should be assessed intra-operative ***(Seike K et al., 2007)***.

At operation distinction of viable from non-viable intestine is not always easy. Frequently a bowel loop that looks healthy and is left in the abdomen will develop gangrene within one or two days. Hence the policy of second looks procedure. Waiting for fixed colour changes to develop may take a long time, actually very precious time is wasted. For this ***Horgan and Gorey (1992)*** stressed the need for a reliable intraoperative viability test. They advised five criteria for an ideal one, which are: 1. the technique must have ready availability, preferably in every operating theater dealing with abdominal emergencies. 2. The necessary equipment must not be cumbersome or require specialized personnel. 3. The method must be accurate with a minimum of false-negative results and, more importantly, few false positives. A false-negative result leaves in situ nonviable bowel, which may lead to early perforation and late stricturing. On the other hand, a false-positive assessment of bowel viability results in the resection of potentially recoverable intestine, which is lost forever and may represent a vital difference for morbidity-mortality and long-term nutrition. 4. The technique must be objective and be reproducible. 5. The method must be cost effective. Only two tests are close to these criteria; fluorescein assessment and Doppler.

Fluorescein is an inexpensive material that is safely given by the intravenous route in many clinical situations. When this material reaches the tissues it can be excited by ultraviolet light and it emits fluorescent green radiation. Fluorescein cannot reach ischemic tissues as their blood supply is cut off, and therefore, ischemic tissues do not give this fluorescence. This fact has been reported by ***(Lange and Boyd, 1942)***.

AIM OF THE WORK

The aim of this work is to assess the sensitivity of IV fluorescein under ultraviolet light for detection of viabililty of acute intestinal ischaemia, in comparison with the regular visual assessment.

ANATOMY OF THE INTESTINE

ANATOMY OF THE SMALL INTESTINE:

Small intestine is a tubular structure that extends from the pylorus to the cecum. The estimated length of this structure varies depending on whether radiologic, surgical, or autopsy measurements are made. In the living, it is thought to measure 4 to 6 meter. The small intestine consists of three segments lying in series: the duodenum, jejunum, and ileum. The duodenum, the most proximal segment, lies in the retroperitoneum immediately adjacent to the head and inferior border of the body of the pancreas. The duodenum is demarcated from the stomach by the pylorus and from the jejunum by the ligament of Treitz. The jejunum and ileum lie within the peritoneal cavity and are tethered to the retroperitoneum by a broad-based mesentery. No distinct anatomic landmark demarcates the jejunum from the ileum; the proximal 40% of the jejunoileal segment is arbitrarily defined as the jejunum and the distal 60% as the ileum. The ileum is demarcated from the cecum by the ileocecal valve ***(Grant et al., 1989)***.

The small intestine contains mucosal folds known as plicae circulars or valvulae conniventes that are visible upon gross inspection. These folds are also visible radiographically and help in the distinction between small intestine and colon, which does not contain them, on abdominal radiographs. These folds are more prominent in the proximal intestine than in the distal small intestine. Other features evident on gross inspection that are more characteristic of the proximal than distal small intestine include a larger circumference, thicker wall, less fatty mesentery, and longer vasa recta **(Fig. 1)**. Gross examination of the small intestinal mucosa also

reveals aggregates of lymphoid follicles. Those follicles, located in the ileum, are the most prominent and are designated Payers' patches ***(Gray et al., 2002).***

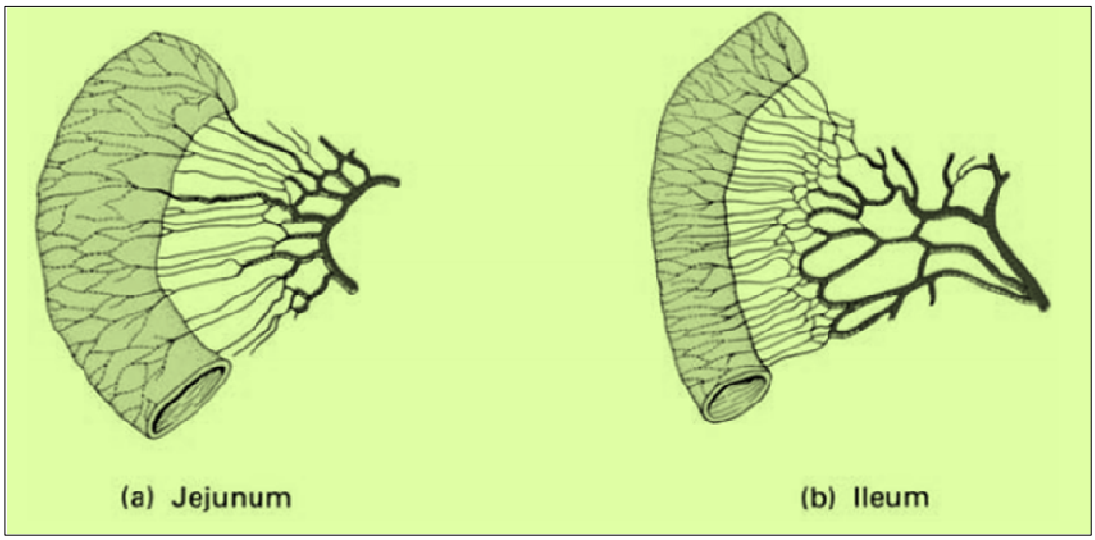

Fig (1): The simple arterial arcades of the jejunum (a) compared with the complex arcades of the ileum (b) ***(Skandalakis et al, 1994)***.

ANATOMY OF THE COLON:

The colon constitutes tube of variable diameter about 150 cm in length. The terminal ileum empties into the cecum through a thickened, nipple-shaped invagination (the ileocecal valve). The cecum is a capacious sac-like segment of the proximal colon with an average diameter of 7.5 cm and length of 10 cm ***(Skandalakis et al., 1994)***.

The ascending colon, about 15 cm in length, runs upward toward the liver on the right side; like the descending colon, the posterior surface is fixed against the retroperitoneum, whereas the lateral and anterior surfaces are true intraperitoneal structures ***(Robert et al., 2007)***.

The transverse colon is about 45 cm in length. Hanging between fixed positions at the hepatic and splenic flexures, it is completely invested in visceral peritoneum ***(Mark Evers, 2007)***.

The splenic flexure is Attached to the superior aspect of the transverse colon is the greater omentum, a fused double layer of visceral and pariet al., peritoneum (four total layers) that contains variable amounts of stored fat ***(Agur AMR et al., 1999)***.

The descending colon lies ventral to the left kidney and extends downward from the splenic flexure for about 25 cm. It is smaller in diameter than the ascending colon. At the level of the pelvic brim, there is a transition between the relatively thin-walled, fixed, descending colon and the thicker, mobile sigmoid colon. The sigmoid colon varies in length from 15 to 50 cm (average, 38 cm) and is very mobile ***(Robert et al., 2007)***.

Blood supply of the intestine:

Celiac Axis:

The celiac axis arises at a right angle from the anterior aspect of the abdominal aorta opposite the lower body of T12 or the upper part of the body of L1. The SMA arises 5 to 15 mm caudal to the origin of the celiac artery. In the classic description of the celiac trunk, the celiac artery gives rise to the common hepatic artery, the splenic artery, and the left gastric artery ***(Chavez C.M et al, 1966)***.