

## Original Article

## The Role of Endoscopic Autopsy in Trauma Cases: The First Report from Iran

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**Background:** The traditional autopsy is unpleasant for the family members of the dead person. The aim of this study was to assess abdominal traumas by a laparoscope and to determine the accuracy of laparoscopic examination in comparison with the traditional autopsy.

**Methods:** From December 2004 through August 2005, 50 fresh cadavers (<24 hours old) of blunt trauma victims were selected. They were first assessed by a laparoscope for intraperitoneal and retroperitoneal organs and then the traditional autopsy was performed as gold standard. The organs were assessed regarding the nature and intensity of damages and the results were compared with laparoscopic findings. The diagnostic accuracy of laparoscope was determined for each case with 95% confidence intervals (CIs) using Fisher's exact test.

**Results:** The accuracy for investigation of intraperitoneal and retroperitoneal organs and the overall accuracy values were significant. The accuracy of laparoscope for detecting intraperitoneal organ damage was 90% (95%CI of 81.7% to 94.8%) while for the retroperitoneal organs was 92% (95%CI of 84.7% to 96%). The overall accuracy of laparoscope was 84% (with 95%CI of 74.3% to 90.5%).

**Conclusion:** The sensitivity and specificity of laparoscopic examination for intraperitoneal organs are acceptable but its accuracy for retroperitoneal organs is lower. Therefore, it seems that laparoscopic examination is an eligible substitute for the traditional autopsy.

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**Keywords:** Accuracy • autopsy • intra-abdominal organs • laparoscopy • trauma

### Introduction

Autopsy and precise determination of the main cause of death is a cornerstone of data collection in medicine. Moreover, autopsy is a valuable means for the education of residents in several countries.<sup>1</sup> On the other hand, conventional autopsy is mostly inconvenient for family members of the deceased person.<sup>2</sup>

In spite of the abovementioned advantages of autopsy, it is being used less frequently worldwide.<sup>2-5</sup> A study showed that its frequency has declined from 15% to 7%, mostly due to disapproval of the family members. Another important cause is the disability of the physicians to request autopsy permission from the family members.<sup>2</sup> Recently, laparoscopy has been increasingly utilized by the researchers to evaluate the nature and intensity of damages to intra-abdominal organs. The purpose of this study was to evaluate the accuracy of laparoscopy to assess the nature and intensity of damages to intra-abdominal organs in fatal traumas.

### Materials and Methods

We selected 50 fresh cadavers (<24 hours old) from patients who had passed away due to blunt

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trauma from December 2005 through August 2006 in Kahrizak Forensic Medicine Center and enrolled them in a prospective case-series after approval of the Research Deputy of the Forensic Medicine Organization and Ethics Committee of our university. The cadavers with a crushed abdominal wall or a rigid abdominal wall (due to any reason) were excluded.

After approval of the family members of the deceased person, their intra-abdominal organs (including solid organs, hollow viscus, and retroperitoneal organs) were initially evaluated for the presence and intensity of possible damage using laparoscopy. We first made a one-centimeter incision under the umbilicus and inserted a 10-millimeter trochar. The abdomen was then inflated by CO<sub>2</sub> and a 30-degree camera was used to visualize the abdomen. Then, we inserted 25-millimeter trochars in the midline of the epigastric and suprapubic regions and began evaluating the abdomen using a grasper and a dissector. The solid organs like liver, spleen, and the diaphragm were evaluated followed by evaluation of the anterior aspect of the stomach, hiatus, gastrocolic ligament, the posterior aspect of the stomach, pancreas, and the small intestine from the ligament of Treitz, ascending, transverse, and descending colon. Pelvic fossa was investigated for hematomas. After assessment of bladder, we dissected the splenic and hepatic flexures and evaluated the retroperitoneal organs for hematomas. Then, we opened gerota fascia. We recorded the intensity of each injury by grading.

Afterward, conventional autopsy was performed as the gold standard by another physician who was unaware of the laparoscopy results. We evaluated the same organs and recorded the results by grading. Thereafter, the results of laparoscopy and autopsy were compared for each single organ and overall. The results were assumed wrong in the presence of discordance between the two methods. The results were evaluated by Fischer's exact test in SPSS version 12.0. *P* values below 0.05 were considered

significant. We calculated sensitivity, specificity, and accuracy with 95% confidence intervals (CIs). The sample size was calculated to be 50 according to the supposed sensitivity of 85% (10% error based on previous studies) and first order error of 0.05. The calculation equations for diagnostic accuracy are summarized in Box 1.

## Results

There were 44 male cadavers in the total number of 50. The mean age was 49±19 years (11 – 82). The characteristics of the patients, the trauma mechanism, and the death etiology are summarized in Table 1.

We could not evaluate intra-abdominal organs with laparoscopy in two patients; one due to massive intra-abdominal bleeding and the other one because of diaphragmatic rupture and displacement of intra-abdominal organs into the thorax. Laparoscopy was carried out successfully in the rest of the patients. However, ileus (34%), adhesions from previous laparotomies (8%), abdominal wall rigidity (4%), and young age (2%) were the main limitations of laparoscopy. The most common assessed damage was to the liver (22%) and spleen (16%). The indicators of diagnostic accuracy for each organ with a 95% CI are presented in Table 2. All indicators were statistically significant except for the indicators of rectum and bladder which were not calculable with the present data, and kidneys.

Furthermore, the diagnostic accuracy indicators for intra- and extraperitoneal organs and overall diagnostic accuracy indicators were statistically significant (Tables 2 and 3).

For intraperitoneal organs, the sensitivity of laparoscopy was 73.3% (95%CI of 48 to 89.1%), and the specificity was 97.1% (95%CI of 85.5 to 99.5%) with an accuracy of 90% (95%CI of 81.7 to 94.8%). For extraperitoneal organs, the values were 33.3% (95%CI of 9.7 to 70%), 100% (95%CI of 92 – 100%), and 92% (95%CI of 84.7 to 96%), respectively.

Overall, sensitivity of laparoscopy was 65% (95%CI of 43.3 to 81.9%), its specificity was 96.7% (95%CI of 83.3 to 99.4%), and its accuracy was 84% (95%CI of 74.3 to 90.5%). The mean duration of laparoscopy was longer than autopsy (75±25 vs. 48±14).

## Discussion

Autopsy is still the best postmortem diagnostic

### Box 1. Indicators calculating formulation.

Sensitivity=TP/(TP+FN)

Specificity=TN/(TN+FP)

Accuracy=(TP+TN)/(TP+TN+FP+FN)

TP=True positive

TN=True negative

FP=False positive

FN=False negative

**Table 1.** Absolute and relative frequency of the cadavers based on demographic features, trauma mechanism, and death etiology.

	Absolute frequency	Relative frequency
Gender		
Male	44	88%
Female	6	12%
Trauma mechanism		
Pedestrian with motor vehicle accident	24	48%
Two-vehicle accident	14	28%
Motorbike with a motor vehicle accident	6	12%
Falling	4	8%
Death under ruins	2	4%
Death etiology		
Intracranial hematoma	23	46%
Multiple blunt trauma	22	44%
Internal bleeding	3	6%
Major vessel rupture	1	2%
Vertebral injury	1	2%

modality and has a fundamental role in medical education as well.<sup>6,7</sup> The advantages of this means of diagnosis are unanimous.<sup>2, 8</sup> However, today the use of autopsy in medical education is declining because of community attitudes, clinicians' and pathologists' reluctance, hospital concerns about legal actions, religious attitudes, funding priorities, and consent from the family.<sup>7</sup>

Laparoscopic postmortem evaluation with minimal invasion is precise and does not distort the morphology of the cadaver and is, therefore, more acceptable for the family members of the deceased person.<sup>9</sup> There have been cases of approval of laparoscopic autopsy despite disapproval of the

conventional autopsy.<sup>10,11</sup> This method enables us to verify the presence of focal damages by a macroscopic view.

Our results revealed that the indicators of diagnostic accuracy of laparoscopy for intraperitoneal organs were remarkable (a sensitivity, specificity, and accuracy of 100% for spleen, diaphragm, stomach, small intestine, colon, and gallbladder and 82% for liver, an overall sensitivity of 73.3%, specificity of 97.1%, and accuracy of 90%). While assessing the intraperitoneal damages, two cases of hepatic damage near the inferior vena cava were missed, which could be referred to as the limiting point of

**Table 2.** Diagnostic accuracy indicators of laparoscopy specified for each organ.

Organ/ Indicator	Sensitivity (%)	Specificity (%)	Accuracy (%)	P value
Liver*	81.8 (52.3 – 94.9)	97.4 (86.8 – 99.6)	94.0 (86.9 – 97.4)	0.0001
Spleen*	100 (67.6 – 100)	100 (91.6 – 100)	100 (95.9 – 100)	0.0001
Diaphragm*	100 (51 – 100)	100 (92.3 – 100)	100 (96.2 – 100)	0.0001
Stomach* and gallbladder*	100 (20.7 – 100)	100 (92.7 – 100)	100 (96.3 – 100)	0.0001
Colon* and small intestine*	100 (43.9 – 100)	100 (92.4 – 100)	100 (96.2 – 100)	0.0001
Rectum** and bladder**	0 (0 – 79.4)	100 (92.7 – 100)	98.0 (92.3 – 99.5)	—
Pancreas*	50 (9.4 – 90.6)	100 (92.6 – 100)	98.0 (92.9 – 99.5)	0.04
Kidneys***	33.3 (6.2 – 79.2)	100 (92.4 – 100)	96.0 (90.0 – 98.5)	0.06
Intraperitoneal	73.3 (48.0 – 89.1)	97.1 (85.5 – 99.5)	90.0 (81.7 – 94.8)	0.0001
Extraperitoneal	33.3 (9.7 – 70.0)	100 (92.0 – 100)	92 (84.7 – 96.0)	0.01
Overall*	65.0 (43.3 – 81.9)	96.7 (83.3 – 99.4)	84 (74.3 – 90.5)	0.0001

\*=significant based on Fischer's exact test ( $P < 0.05$ ); \*\*=incalculable based on present data; \*\*\*=insignificant based on Fischer's exact test ( $P > 0.05$ ).

**Table 3.** Laparoscopy results compared with conventional autopsy.

Method 1/Method 2	Positive autopsy	Negative autopsy	Total
Positive laparoscopy*	13	1	14
Negative laparoscopy	7	29	36
Total	20	30	50

\*=significant based on Fischer's exact test ( $P < 0.0001$ ); odds ratio=53.8 (95%CI of 6 to 483).

this method. One other case was misdiagnosed due to postmortem changes. Cacchione et al.<sup>2</sup> reported that the areas behind the liver and the parenchyma of the liver were difficult to study. They also mentioned that inside the lumen of the stomach and intestine and adrenals were difficult areas to evaluate. The results of this study are less satisfactory than the results of Avrahami et al.<sup>8</sup> who achieved a sensitivity of 91% for intraperitoneal organs in a study on 25 cases.

However, the accuracy indicators of retroperitoneal organs were lower (a sensitivity of 50% for pancreas, 33.3% for kidneys, and incalculable for rectum and bladder with an overall sensitivity of 33.3%, specificity of 100%, and accuracy of 92%). While evaluating retroperitoneal organs, we missed one case of rectal rupture, one case of bladder rupture due to pelvic fracture, and one case of pancreatic duct rupture. In our study, the sensitivity of the laparoscopic evaluation of the retroperitoneal organs was lower than that reported by Avrahami et al. who reported a sensitivity of less than 58%.<sup>8</sup> Retroperitoneum is recommended to be evaluated freshly, prior to diffusion of blood or fluids from other organs, as these fluids may obscure retroperitoneal signs and the view of these organs.<sup>2</sup>

The overall sensitivity, specificity, and accuracy of laparoscopy in this study was 65%, 96.7%, and 84%, respectively. Avrahami et al.<sup>8</sup> reported a very high correlation (100%) between the results of laparoscopy and conventional autopsy in the evaluation of intraperitoneal injuries and intrathoracic bleeding. However, this correlation declines to 60 – 80% when evaluating extraperitoneal organs, mesenteric bleeding, retroperitoneal bleeding, great vessel injuries, and lung injuries. Cacchione et al.<sup>2</sup> showed a very high (100%) correlation between laparoscopy and conventional autopsy results without mentioning the values of sensitivity, specificity, and accuracy.

Laparoscopy can clearly visualize intra-abdominal organs and, in addition to screen display, it can be recorded for later reviews or educational purposes.<sup>2</sup> However, it is not an accepted substitution for the educational autopsies and forensic aims. Limitations of this method

include the need for the presence of surgeon, lack of abdominal wall rigidity, and intra-abdominal adhesions.<sup>12</sup> We also faced limitations including lack of enough laparoscopic expertise and difficulties in supplying appropriate equipment. Of note, this method has no use in diagnosing extra-abdominal injuries (like intracranial, vertebral, and pelvic injuries).<sup>2</sup> It is also more expensive and time consuming.

This study was the first of the kind in Iran. A larger sample size and standard grading are the distinguishing features of this study compared with the previous studies. Moreover, other studies have evaluated death without specifying its etiology while our study focused on death due to trauma. Determination of the adequacy of the sensitivity and accuracy of this method in diagnosing intra-abdominal injuries warrants more extensive studies with larger sample sizes and this study can serve as a pilot for others of this kind.

Laparoscopic autopsy is acceptably sensitive and specific for evaluation of intraperitoneal organs; however, it is less sensitive for extraperitoneal organs, which reduces the acceptance of this method as a proper substitute for conventional autopsy as the goal standard in postmortem diagnostic evaluation of abdominal injuries.

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