Diagnostics and surgical treatment of posttraumatic hemopneumothorax

Review article/Artykuł poglądowy © J ORTHOP TRAUMA SURG REL RES 2 (28) 2012

A. M. Khadjibaev, B. I. Shukurov, R. O. Rakhmanov, Sh. Sh. Isakov, A. B. Eshmuratov

Address for correspondence/ Adres do korespondencji:
Farkhadskaya 2
100107 Tashkent
Uzbekistan
Republican Research Center of Emergency medicine
Departament of Emergency surgery
Shukurov Bobir Ibragimovich
tel.: +998971043463
e-mail: shbobir@yahoo.com

Received: 18.07.2011
Accepted: 06.09.2011
Published: 20.04.2012

STATISTIC STATYSTYKA	
Word count Liczba słów	1722
Tables Tabele	6
Figures Ryciny	6
References Piśmiennictwo	19

Summary
There analyzed the results of examination and surgical treatment for 349 injured with closed thoracic trauma (238) and injury (111). I group of comparison included 138 (39,5%) patients who were made examination and traditional treatment without using videothoracoscopy (VTS).II group included 211 (60,5%) patients, who were performed VTS at the stage primary diagnostics and surgical treatment. Authors demonstrated that VTS allows estimating the volume and character of intrapleural complications of thoracic injury, to select optimal surgical approach, to provide early activization of injured patients. To extend indications to VTS allows avoiding thoracotomy in 37,0%,diminishing the frequency of postoperative complications from 25,4% to 10,9%, reducing in-patient treatment time from 8,1±0,36 to 7,1±0,27.
Key words: trauma, hemopneumothorax, diagnosis, surgical treatment, videothoracoscopy

BACKGROUND

The injury rate has become one of the important medico-social problems in industrialized countries that require huge financial expenditure to solve them. [3, 8]. Thoracic traumas take the third place after cripples and craniocerebral trauma making 30-40% of hospital admissions, at that some 90% of the injured are able-bodied population.[1, 10, 11, 15, 17, 18]. Thoracic injury (TI) is run by continuous care and rehabilitation, large quantity of suppurative-septic complications (up to 20%) and high fatal outcomes (from 17 to 30 %) [6, 5, 7, 9, 14, 16].

According to analysis, 15% of patients died after TI had no fatal injuries and they died from defects of medical help. As a rule, injury late diagnostics stipulated inadequacy of primary aid [2, 12, 13, 19]. Poor resolution of simple X-ray of thorax in thoracic injury does not allow estimating the condition of the injured on admission and during the treatment that further results in wrong therapeutic approach [4, 18]. TI diagnostic difficulties lead to unreasonably continuous follow-up, to carry out conservative therapy if urgent surgery is needed. In these cases retention in the selection of correct surgical approach usually results in the development of severe complications and increase in fatal outcomes. Herewith, the frequency of unreasonable thoracotomy ranged from 10 to 15% [13]. In the light of the above-mentioned the urgency of tasks on further TI diagnostics and treatment became obvious.

THE AIM

The aim of present work is to improve the results of TI surgery by early and wide use of medical-diagnostical facilities of videothoracoscopy (VTS).

MATERIAL AND METHODS

There analyzed the findings of examination and surgery cases of 349 patients with closed thoracic injury (CTI) and thoracic injury (TI). I group included 138 (39,5%) patients who had been made examination and traditional treatment without VTS. II group were 211 (60,5%) patients who underwent VTS during primary diagnostics and surgery. There were male 298 (85,4%) and female 51 (14,6%) aged between 17 to 83 years. Half of the injured (51,9%) was admitted within first 6 hours. Of 349 patients 111 (31,8%) had penetrating stub-cut TI and 238 (68,2%) patients had.

We observed that CTI had frequent similar localization on the right and left sides (43,7% and 50,8% correspondingly) and TI prevailed on left side in 76(68,5%) patients.

Combined character of injuries occurred in 38 (27,5%) patients of 1 group of patients and in 51 patients (24,2%) of II group of patients. TI combined more often with craniocerebral traumas and fractures of extremities.

Complex methods of TI patient examination, in addition to general clinical examination, included laboratory (CBC and urine analysis), noninvasive (US and X-ray examination of thorax) and invasive (puncture and pleural cavity draining) methods of investigation as well as VTS (in II group of patients).

TI general clinical manifestations were as following: chest pain in 338 (96,8%) patients, short breath in 241 (69,1%) patients and common fatigue in 312 (89,4%) patients. It should be noted that every fourth injured patient of 94 (26,4 %) patients had a sign of lung tissue damage - blood spitting.

To follow representativeness of comparative groups our research did not include patients with critical conditions and patients with unstable hemodynamics after infusion-transfusion therapy whereas VTS was contraindicated to those patients.

X-ray of thorax revealed different pathological changes in 326 (93,4%) patients. Thus, hemothorax (HT) was determined in 60 (17,2 %) patients, pneumothorax(PT) was in 90 (25,8%) patients, haemopneumothorax (HPT) in 192 (55,0%), subcutaneous emphysema of thorax- in 171 (49%), lung contusion – in 9 (2,6%), heart shadow dilatation - in 7 patients (2%) and pneumomediastinum - in 7 (2%) patients. Single elbow fracture was diagnosed in 52 (21,9%) patients of 1 group of patients and in 21 patients (18,6%) of 2 group of patients. Multiple fractures were found in 82 (68,9%) patients of 1 group of patients and in 82 (72,6%) of 2 group of patients ($p > 0,05$).

USD of thorax and abdominal cavity were performed on 321 (92%) patients. The main task of sonography at thoracic traumas was to detect hemothorax which was diagnosed in 221 (68,8%) cases. USD was not informative due to subcutaneous emphysema of thorax in 26 (8,1%) examined patients. Meanwhile, USD allowed to identify changes on the side of abdominal cavity in 76 (23,7%) patients with combined trauma.

In 2 group of patients it was added VTS to abovementioned list of instrumental investigations (211 injured patients). Indications to VTS were HPT in 135 (64%), HT in 40 (19%), PT in 31 (14,7%), isolated subcutaneous emphysema without HPT signs in 3 (1,4%), dilated heart borders in 2 (0,9%) patients.

We were able to reveal all of the most probable variants of injuries of chest wall, pleural leaves, mediastinum and lungs throughout endoscopic revision of pleural cavity in injured patients with closed thoracic injury (Table 1). It has been determined, that closed trauma certainly combines with subpleural hematomas in elbow fractures (113 patients) and parietal pleura disruptions always take place there (111 patients). In all cases, when hemopneumothorax, pneumothorax as well as subcutaneous emphysema were indicated for VTS, we determined lung lacerations (102 patients) or bullas (2 patients).

The value of VTS increases more in penetrating TI, as the probability of heart and diaphragm damage, reliable diagnostics of which is barely difficult with traditional endovisualization facilities, is much higher than in CTI. Thus, we revealed diaphragm injures in every fo-

urth thoracic injured patient, who underwent videoendoscopy (Table 2). In 2 cases, when clinical, X-ray, US signs were absent, VTS allowed to determine that severe complication of trauma. It should be noted that we have done no single misdiagnosing in VTS group.

RESULTS AND DISCUSSION

Thoracocentesis (32 patients), pleural cavity draining (100 patients) and primary wide thoracotomy (6 patients) were used in I group of patients with traditional surgery approach (Table 3). Small hemothorax or wall pneumothorax up to 1/3 of lung volume was an indication for making thoracocentesis to the injured. Besides, the absence of multiple injuries and localization of injury in "safe zones": out of "cardiac" and "thoracoabdominal" zones are compulsory condition to thoracocentesis in thoracic injuries. About half of patients (14 (43,8%)) underwent to thoracocentesis we were not able to get expected result, therefore we had to perform pleural cavity draining in 12 (37,5%) cases and in 2 (6,3%) patients – wide thoracotomy as well. In recent years we have declined punction way of treatment in thoracic injury complications.

In two groups primary wide thoracotomy provided with adequate extensive surgical approach for reliable elimination of all revealed consequences of thoracic traumas, but nevertheless, predisposing thoracoscopic revision of pleu-

Tab. 1. Character of intrapleural injuries diagnosed within VTS in closed thoracic injury, n=113

Intrapleural injures	Number of patients	
	absolute	%
Subpleural bleeding and hematoma of chest wall	113	100
Ruptures of parietal pleura	111	98,2
Lung lacerations	102	90,3
Lung bulla lacerations	2	1,8
Lung contusion	15	13,3
Intraparenchymal hematoma	8	7,1
Mediastinal hematoma	1	0,9
Ruptures of mediastinal pleura	3	2,7
Pneumomediastinum	8	7,1
Rupture of diaphragm	2	1,8
Hemothorax	93	82,3
Intrapleural bleeding from:		0,0
· Muscular vessels	11	9,7
· Intercostal vessels	2	1,8
· Lung lacerations	15	13,3
· Elbow fractures parts	3	2,7
· Small vessels of mediastinum	3	2,7
· Raptures of diaphragm	1	0,9

Tab. 2. Character of intrapleural injures determined in patients with thoracic injures within VTS, n=98

Intrapleural injures	Number of patients	
	absolute	%
Parawound subpleural haematomas	33	33,7
Elbow and cartilage cut	5	5,1
Lung injure	39	39,8
Intraparenchyme hematomas and subpleural bleeding of lung	5	5,1
Wound and hematomas of mediastinum	2	2,0
Pericardial injure	6	6,1
IVC	1	1,0
Heart injure	2	2,0
Diaphragmal injures	23	23,5
Haemathorax	72	73,5
Intrapleural bleeding from:		
· Muscular vessels	19	19,4
· Intercostal vessels	6	6,1
· Internal thoracic artery	2	2,0
· Lung injuries	15	15,3
· IVC	1	1,0
· Pericardial injuries and heart	3	3,1
· Injury of diaphragm	13	13,3

ral cavity allowed to avoid unnecessary thoracotomy. In II group of patients in all 10 cases of VTS conversions to wide thoracotomy were made manipulations which are technically difficult to carry out with endoscopic technique (suturing of lung ruptures – 3, IVC injuries - 1, heart – 2, pericardiotomy and revision of heart on pericardial injury – 4). Meanwhile, in I group of patients we had to evacuate retained hemotorax in 6 primary and 7 secondary thoracotomy in 3 cases, and in 3 cases - suturing of superficial lung injury(2) and rupture of lung bulla. All mentioned procedures could be performed on VTS.

In second group of patients of 38 cases VTS conversion we could restricted by VATS-manipulations via minithoracotomy approach using the same thoracoscopic technique. Adequate endoscopic revision and assessment of intrapleural situation allowed selecting optimal surgi-

Tab. 3. Results of primary surgical treatment

	Character of primary intervention	Number of patients	Recurrent interventions	
			Character	Quantity
I group	Plural cavity punction	32	Draining	12 (37,5%)
			Thoracotomy	2 (6,3%)
			Total	14 (43,8%)
	Draining of pleural cavity	100	Redraining	2
			Thoracotomy	5
			VATS	2
			VTS	1
			Total	10
	Thoracotomy	6		
	Total	**138**		**24 (17,4%)**
II group	VTS	173	Thoracotomy	1 (0,6%)
	VTS+VATS	28		
	VTS+thoracotomy	10		
	Total	**211**		**1 (0,5%)**

Tab. 4. Character medical procedures within VTS in thoracic injuries

Medical procedure	Number of patients	
	absolute	%
Pleural cavity sanation	198	93,8
Haemothorax evacuation	113	53,6
Bleeding control from:	60	28,4
· muscular vessels	30	14,2
· intercostals	6	2,8
· internal thoracic artery	1	0,5
· injury of lung	13	6,2
· small vessels of mediastinum	3	1,4
· bone fracture of elbows	3	1,4
· injury of diaphragm	4	1,9
Videoassisted suturing of lung injury	21	10,0
Incision of mediastinal pleura	5	2,4
Videoassisted suturing of diaphragmal injury	2	0,9
Videoassisted suturing of lung injury	1	0,5
Coagulation of bullas' rupture	1	0,5

Tab. 5. Character of postoperative complications, n=349

Type of complications	I group, n=138		II group, n=211	
	absolute	%	absolute	%
Unspecific complications	10	7,2	11	5,2
· *Postoperative pneumonia*	10	7,2	11	5,2
Specific complications	25	18,1	12	5,7
· *Wound infection*	2	1,4	2	0,9
· *Ongoing pneumothorax*	14	10,1	-	-
· *Retained hemothorax*	1	0,7	-	-
· *Exudative pleuritis*	6	4,3	9	4,3
· *Lung atelectasis*	1	0,7		
· *Intrapleural bleeding*	1	0,7	1	0,5
Total:	**35**	**25,4**	**23**	**10,9**

cal approach and decreasing the frequency of reoperations in 0.5% versus 17.4% in traditional surgical approach group (Table 3).

In addition to high diagnostical effect of VTS, our method differs with quite wide medical opportunities (table 4 and fig.1-6). This provided to decrease frequency in 4.7% (table 3), whereas in traditional approach primary (6) and secondary (7) thoracotomies were made in 9.4% cases (in 13 of 138 patients).

Clinical experience, skills and assurance gained during this investigation in using of treatment-diagnostic opportunities of VTS allowed us to implement endoscopic technique much wider in combined traumas and abdominal injury. In second group of patients those in-

Tab. 6. Results of traditional methods for patients' treatment

Indication	I group, n=138	II group, n=211	P
Frequency of thoracotomy, %	9,4	5,2	f^2=7,12 p<0,05
Duration of pleural draining, days	4,6±0,31	2,2±0,32	t=5,56 p<0,05
Common frequency of complications, %	25,4%	10,9%	f^2=8,51 p<0,05
Durations of in-patient treatment, days.	8,1±0,36	7,1±0,27	t=2,22 p<0,05

Fig. 1. VTS. Mediastinal pleura cutting

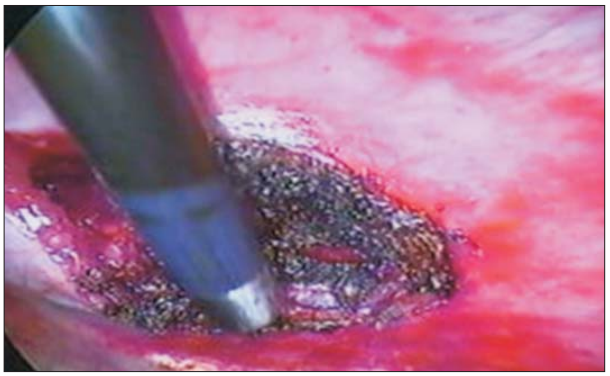

Fig. 2. VTS. Coagulation of injury of parietal pleura

Fig. 3. VTS. Lung injury suturing

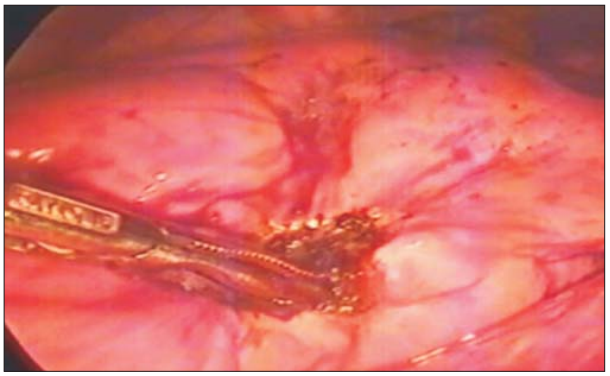

Fig. 4. VTS. Coagulation of lung injury

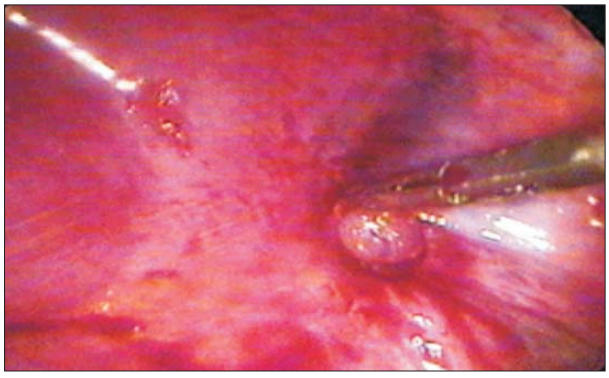

Fig. 5. VTS. Coagulation of diaphragm injury

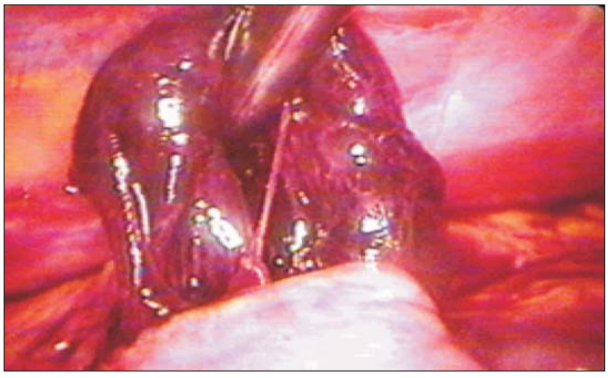

Fig. 6. VTS. Elimination of retained hemothorax

jured patients were 37 (17,5%)s. Usually, laparoscopy was performed at the second stage after VTS. At this stage of laparoscopy implementation in abdominal traumas we tried to restrict indications for diagnostic laparoscopy by two situations: 1) injuries (20) or ruptures of diaphragm (1) revealed within VTS; 2) combined injuries of upper abdominal wall (1) and clinical-sonographic sings of abdominal organs (15).

In 13 (35,1%) cases using endoscopic technique we could avoid laparotomy: we excluded the damage of abdominal organs in 10 patients and we performed endoscopic hemostasis successfully in 3 patients with superficial liver injury. We considered purposeful and more trustful to use wide surgical approach in rest of cases.

Therefore, VTS and VATS allowed us to eliminate intrapleural complications of trauma in 78(37%) patients, excluding routine aspirations of effused blood. Postoperative complications occurred in 23 (10,9%) patients of II group and in 35 (25,4%) patients who underwent traditional approach (Table 5).

Most of postoperative complications were eliminated conservatively or by the means of minor surgery (by pleural punctures and pleural cavity draining). Secondary surgeries such as thoracotomy were made to 7 (5.1%) patients of I ("traditional") group and 1 (0.5%) patient of II group (see table 3).

In comparison with traditional methods advantages of VTS in thoracic injury are also testified by data, shown in table 6, where the differences in two groups have statistically justified character by the frequency of thoracotomy, duration of operative interventions and draining of pleural cavity, complications of traumatic disease in early period.

None of patients had fatal outcome.

Thus, VTS prevails the other noninvasive and minimally invasive methods of thoracic injury diagnostics. In difference to these methods, VTS allows not only to make accurate diagnosis, but also to eliminate injuries, which are not required open intervention with minimal trauma to the injured.

CONCLUSIONS

To apply videothoracoscopy allows performing full-fledged look and diagnosing of injury of thoracic cavity and mediastinum organs, bleeding control, hermetic ruptures of lungs, sanation and draining of pleural cavity. The use of videothoracoscopy enhances diagnostic process, lessens duration of pleural cavity draining in postoperative period, provides early activation of patients, and reduces treatment and rehabilitation time. Videothoracoscopy is to become a part of algorithm of diagnostic and medical procedures in thoracic injury. Surgical approach of treatment for thoracic injury needs to be determined not by the results of primary draining of pleural cavity but by results of thoracoscopic revision considering medical opportunities of videoendoscopic technique.

References/Piśmiennictwo:

1. *Abakumov M.M., Lebedev N.V., Makarchuk V.I. Objective assessment of trauma severity at injured patients with combined injuries.// Â Íńńí.őčđ. – 2001. – Ň. 160, No 6. – Ń. 42–45.*
2. *Bisenkov L.N, Kochegarov Î.V. Diagnosing and treatment of heart injury. // Thoracic and cardiovascular surgery. -1999. – No 2. – p. 39-43.*
3. *Borisov A.E., Mitin S.E., Chlopov V.B. et al. Endovideosurgery opportunities at treatment of chest trauma// Endoscopic surgery – 2001. – No 3. – p. 32.*
4. *Brusov P.G., Kuricin A.N., Urazovski N.Yu. et al. Operative videothoracoscopy at surgical treatment of bullet penetrating chest trauma on medical evacuation stages on local military conflict. // Endoscopic surgery – 1998. – No 3. – p. 10-14.*
5. *Dobrovolski S.R. Treatment of chest trauma//Surgery. – 2007. – No 5. – p. 32-38.*
6. *Ermolov A.S., Abakumov A.V., Pogodina A.N. et al. Diagnostics and treatment of posttraumatic retained haemotorax//Surgery. – 2002. – No 10. – p. 4-9.*
7. *Karimov Sh.I, Krotov N.F., Shoumarov Z.F. et al. The first experience of videothoracoscopic operation at various surgical pathology.//Surgery of Uzbekistan. – 1999. – No 3. – p. 78-80.*
8. *Kochergaev O.V. Diagnostic features of direct lung injuries on combined chest traumas. // Thoracic and cardiovascular surgery. – 2002. – No 1. – p. 48-52.*
9. *Krotov N.F., Ganiev Sh.A., Berkinov U.B. et al. The role of videothoracoscopy in diagnosing and treatment of chest trauma. // Surgery of Uzbekistan. – 2006. – No 3. – p. 62-63.*
10. *Ismailov D.A., Tashbaev A.M., Kurbanov S. Qualified surgical aid on chest trauma// Surgery of Uzbekistan. – 2000. – No 3. – p 43-44.*
11. *Porhanov V.A., Polyakov V.B., Kononenko V.B. et al. Videothoracoscopy in treatment of patients with traumatic injuries of chest//Annals of surgery. – 2001. – No 2. – p. 44-50.*
12. *Florikyan A.K. Surgery of chest trauma. (Pathophysiology, clinical features, diagnostics, treatment) – Charkov: Osnova, 1998. – p.509.*
13. *Sharipov I.A. Chest trauma (problems and release). 2003 – 328 p.*
14. *Ahmed N., Jones D. Video-assisted thoracic surgery: state of the art in trauma care // Int. J. Care Injured. – 2004. – Vol. 35. – P. 479-489.*
15. *Carrillo E.H., Kozloff M., Saridakis A. et al.Thoracoscopic application of a topical sealant for the management of persistent posttraumatic pneumothorax / // J.Trauma. – 2006. – Vol. 60, No 1. – P. 111-114.*
16. *Chan L., Reilly K.M., Henderson C. et al. Complication rates of tube thoracostomy // Amer.J.Emerg.Med. – 1997. – Vol.15, No 4. – P. 368-370.*
17. *Esme H., Solak O., Yurumez Y. et al. The prognostic importance of trauma scoring systems for blunt thoracic trauma / // Thorac.Cardiovasc.Surg. – 2007. – Vol. 55. – P. 190-195.*
18. *Gavelli G., Canini R., Bertaccini P. et al.Traumatic injuries: imaging of thoracic injuries // Europ.Radiol. – 2002. Vol. 12. – P. 1273-1294.*
19. *Villavicencio R.T., Aucar J.A., Wall M.J. Analysis of thoracoscopy in trauma // Surg Endosc. – 1999. – Vol. 13, No 1. – P. 3-9.*