JACS
Journal of Acute Care Surgery

Journal homepage: https://www.jacs.or.kr
https://doi.org/10.17479/jacs.2023.13.2.58
eISSN : 2288-9582 pISSN : 2288-5862

Original Article

Delphi Method Consensus-Based Identification of Primary Trauma Care Skills Required for General Surgeons in Japan

Kazuyuki Hirose [a], Soichi Murakami [a,*], Yo Kurashima [a], Nagato Sato [b], Saseem Poudel [a], Kimitaka Tanaka [a], Aya Matsui [a], Yoshitsugu Nakanishi [a], Toshimichi Asano [a], Takehiro Noji [a], Yuma Ebihara [a], Toru Nakamura [a], Takahiro Tsuchikawa [a], Toshiaki Shichinohe [a], Kazufumi Okada [c], Isao Yokota [c], Naoto Hasegawa [b], Satoshi Hirano [a]

[a] Department of Gastroenterological Surgery II, Hokkaido University Faculty of Medicine, Graduate School of Medicine, Sapporo, Japan
[b] Department of Surgery, Kushiro City General Hospital, Kushiro, Japan
[c] Department of Biostatistics, Graduate School of Medicine, Hokkaido University, Sapporo, Japan

Article history:
Received: February 18, 2023
Revised: May 12, 2023
Accepted: June 29, 2023

Corresponding Author:
Soichi Murakami
Department of Gastroenterological Surgery II, Hokkaido University Faculty of Medicine, Graduate School of Medicine, Kita-15, Nishi-7, Kita-ku, Sapporo, Hokkaido 060-8638, Japan
Email: so-ichi@huhp.hokudai.ac.jp

ABSTRACT

Purpose: General surgeons at regional hospitals should have the primary trauma care skills necessary to treat critically ill trauma patients to withstand transfer. This study was conducted to identify a consensus on primary trauma care skills for general surgeons.

Methods: An initial list of acute care surgical skills was compiled, and revised by six trauma experts (acute care surgeons); 33 skills were nominated for inclusion in the Delphi consensus survey. Participants (councilors of the Japanese Society for Acute Care Surgery) were presented with the list of 33 trauma care skills and were asked (using web-based software) to rate how strongly they agreed or disagreed (using a 5-point Likert scale) with the necessity of each skill for a general surgeon. The reliability of consensus was predefined as Cronbach's $\alpha \geq 0.8$, and trauma care skills were considered as primarily required when rated 4 (agree) or 5 (strongly agree) by ≥ 80% participants.

Results: There were 117 trauma care specialists contacted to participate in the Delphi consensus survey panel. In the 1st round, 85 specialists participated (response rate: 72.6%). In the 2nd round, 66 specialists participated (response rate: 77.6%). Consensus was achieved after two rounds, reliability using Cronbach's α was 0.94, and 34 items were identified as primary trauma care skills needed by general surgeons.

Conclusion: A consensus-based list of trauma care skills required by general surgeons was developed. This list can facilitate the development of a new trauma training course which has been optimized for general surgeons.

Keywords: Delphi method, surgeons, surgery, training, trauma

Introduction

In many countries, established trauma care systems use the "Hub-and-Spokes" model of care [1-3] consisting of a bypass protocol that results in the direct transport of severely injured patients to major trauma centers (MTCs) where there are trauma surgeons and other organ specialists [3].

In the US, the American College of Surgeons Committee on Trauma set the criteria for hospitals to gain trauma center status whereby function and education is assessed, and certification is based on strict criteria [4]. Level III trauma centers function as secondary acute care hospitals (SACHs) in rural areas. The surgeon in charge of trauma treatment has the skills and knowledge necessary for resuscitation, stabilization, and transfer of patients, and maintains an adequate level of treatment supported by regular re-education.

The current trauma emergency medical care system in Japan was established in the mid-1970s and is stratified into primary,

secondary, and tertiary hospitals [5,6]. However, there is no system in place to assure its quality, and the requirements and training systems for staff vary widely according to the conditions at each hospital. Furthermore, the number of trauma surgeries has decreased recently; this is in part due to a reduced number of traffic accidents [7], and improvements in interventional radiology. Because of these factors, it has become difficult to provide radical treatment for patients with severe trauma in regional SACHs. However, a comprehensive trauma treatment system for trunk injuries (including transfer to MTCs) has not yet been established, and its introduction is urgently needed.

To address these concerns, there is a need to establish a "Hub-and-Spokes" type consolidation system of trauma care. To this end, it is necessary to clarify the trauma care skills that general surgeons working in SACHs, which can be referred to as the "Spoke To this end it is necessary to clarify the trauma care skills that general surgeons working in SACHs, which can be referred to as the "Spoke", should possess to transport severe trauma patients to the MCTs, as well as to train them to be able to perform these skills. The present study was conducted to evaluate and reach a consensus regarding the essential trauma care skills required for general surgeons by conducting expert interviews and a Delphi survey.

Materials and Methods

1. Design

The study methodology comprised research team discussions, expert panel interviews, and Delphi surveys distributed for completion among trauma specialists. An initial list of acute care surgical tasks was created by the research team based on a literature review of previous reports and studies that investigated training in trauma care. This list was emailed, for review and modification, to a panel of six trauma experts (acute care surgeons). A Delphi survey was conducted to establish a consensus based on feedback from trauma specialists.

2. Compilation and review of a list of trauma care skills

A total of 31 items regarding trauma care skills undertaken by general surgeons were compiled through research team discussions including a researcher, surgical educator, and acute care surgeon. In this study, the term “general surgeon” included surgeons who practice digestive, cardiovascular, or thoracic surgery. Six experts certified as acute care surgeons by the Japanese Association for Acute Medicine were chosen for the experts to be interviewed. The compiled list of 31 items was sent to these experts via e-mail, and they provided feedback on whether each trauma care skill would be primarily required by general surgeons. This resulted in 33 items being included in the Delphi consensus survey (Table 1).

Table 1. Primary trauma care skills selected by the research team and through interviews with experts.

	Skill
1	Tracheal intubation
2	Intraosseous infusion
3	Cricothyrotomy
4	Chest drainage
5	FAST
6	Non-invasive external pelvic compression (circumferential wrapping)
7	Exposure of common carotid artery & internal jugular vein
8	Open aorta cross-clamping (including anterior side thoracotomy)
9	Pericardiostomy
10	Open chest cardiac massage
11	Heart injury repair
12	Median sternotomy thoracotomy
13	Clamshell thoracotomy
14	Pulmonary hilum clamp
15	Pulmonary injury repair
16	Crash laparotomy (trauma incision)
17	Five points gauze packings
18	Portal triad occlusion (Pringle maneuver)
19	Peri-hepatic gauze packing
20	Suture hepatorrhaphy
21	Intestinal injury repair (direct suture)
22	Bowel resection
23	Retroperitoneal maneuver (Cattel-Braasch maneuver, Mattox's maneuver)
24	Abdominal aorta exposure & clamp
25	Inferior vena cava exposure & repair
26	Distal pancreatectomy
27	Splenic injury repair
28	Splenectomy
29	Renal injury repair
30	Nephrectomy
31	Preperitoneal pelvic packing
32	REBOA
33	Femoral artery & vein exposure

FAST = focused assessment with sonography for trauma; REBOA = resuscitative endovascular balloon occlusion of the aorta.

3. Selection of the Delphi panel

To constitute the Delphi survey panel, invitations were emailed to all 117 councilors of the Japanese Society for Acute Care Surgery (JSACS) with a request to participate in the Delphi consensus survey.

4. Survey process

The Delphi consensus survey was conducted using web-based

software (Google Forms). All invited specialists completed the survey rounds.

In the 1st round, participants were presented with a predefined list of 33 items and asked to rate how strongly they agreed or disagreed [using a 5-point Likert scale (1 Strongly disagree, 2 Disagree, 3 Undecided, 4 Agree, and 5 Strongly agree)] with the necessity of each procedure. Moreover, the participants could provide comments/revisions to each item, and add additional relevant trauma care skills which they thought a general surgeon should possess. All survey participants were asked to respond within five weeks, and reminder letters were sent to non-responders approximately two weeks before the deadline.

In the 2nd round, participants (1st -round responders) were asked to rate the same 33-item list again, after the results of the 1st round (graphs of group ratings for each item) were shared. Furthermore, these participants were asked to rate new skills that had been suggested for inclusion by more than two participants during the 1st round (Figure 1).

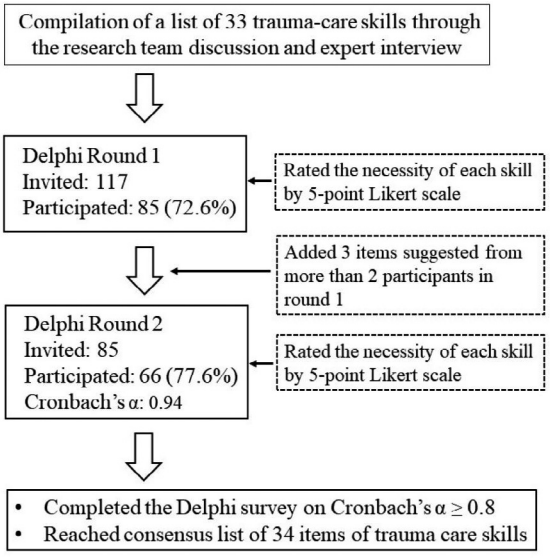

Figure 1. Flowchart of the Delphi consensus survey.

5. Statistical analysis

The mean and 95% confidence intervals were calculated for all procedures. Cronbach's α was calculated for internal consistency among the responses from specialists. JMP Pro Version 13.1 (SAS Institute Inc., NC, USA) was used for statistical analysis.

6. Consensus decision

It was determined that the Delphi survey would need to be conducted in at least two rounds to reflect accurate results and facilitate reassessment of participant answers (from the 1st round) in a 2nd round of the survey. Consensus was predefined as Cronbach's α ≥ 0.8, which has previously been reported as being representative of an acceptable measure of internal reliability [8,9], and the items were retained when they were rated 4 or 5 by ≥ 80% members of the Delphi survey panel.

7. Ethical considerations

The study protocol was reviewed and approved by the Institutional Review Board of the Faculty of Medicine, Hokkaido University (IRB approval no.: 2017-95). All participants responded to the Delphi consensus survey anonymously to the researcher, and their personal information was protected during data collection and analysis.

Results

1. First round Delphi survey

There were 117 specialists initially contacted, of whom 85 participated in the 1st round of the Delphi survey (response rate: 72.6%). Table 2 shows participant characteristics. In this round, two or more respondents suggested the inclusion of three additional items, "diaphragm repair," "ostomy," and "temporary abdominal closure," to the list.

Table 2. Characteristics of the Delphi survey participants (n = 85).

Characteristics	Median (interquartile range)
Post graduate year	26 (22-33)
Case number for trauma surgery as an operator / year	2.5 (2.5-7.5)
Case number for trauma surgery as a supervising assistant / year	7.5 (2.5-15)
Publication number in the field of "trauma"	3 (1-8)
Participation number of trauma training course	
JATEC	70
ATOM	28
SSTT	27
Cadaver–based educational seminar for trauma surgery	24
DSTC	17

JATEC = Japan advanced trauma evaluation and care; ATOM = advanced trauma operative management; SSTT = surgical strategy and treatment for trauma; DSTC = definitive surgical trauma care.

2. Second round Delphi survey

In the 2nd round of the survey, the 85 specialists who responded in the 1st round were contacted, and 66 participated and rated the skill items in the revised list (response rate: 77.6%). The consensus achieved after two rounds of the survey was reliable (Cronbach's α score of 0.94), and there were 34 items regarding trauma care skills retained that had responses rated 4 or 5 by ≥ 80% participants (Table 3).

Table 3. Developed consensus-based skill list.

	Skill	Mean	SD	Rating 4 or 5 %
Basic skills	Tracheal intubation	4.97	0.17	100
	Intraosseous infusion	4.33	0.80	81.82
	Cricothyrotomy	4.85	0.36	100
	Chest drainage	4.98	0.12	100
	FAST	5.00	0.00	100
	Non-invasive external pelvic compression (Sam sling, sheet lapping)	4.67	0.56	95.45
Thoracic skills	Open aorta cross-clamping (including anterior side thoracotomy)	4.70	0.52	96.97
	Pericardiostomy	4.39	0.67	89.39
	Open chest cardiac massage	4.73	0.66	95.45
	Heart injury repair	4.02	0.66	84.85
	Pulmonary hilum clamp	4.21	0.73	84.85
	Pulmonary injury repair	4.24	0.65	93.94
Abdominal and pelvic skills	Crash laparotomy (trauma incision)	4.94	0.24	100
	Five points gauze packings	4.94	0.24	100
	Porta hepatis clamp (Pringle's maneuver)	4.85	0.40	98.48
	Peri-hepatic gauze packing	4.91	0.34	98.48
	Liver injury suture	4.64	0.54	96.97
	Intestinal injury repair (direct suture)	4.92	0.32	98.48
	Bowel resection	4.92	0.32	98.48
	Retroperitoneal maneuver (Cattel Braasch maneuver, Mattox's maneuver)	4.64	0.57	98.48
	Distal pancreatectomy	4.27	0.64	89.39
	Splenic injury repair	4.14	0.85	87.88
	Splenectomy	4.89	0.31	100
	Renal injury repair	4.02	0.62	87.88
	Nephrectomy	4.47	0.68	92.42
	Diaphragm repair	4.58	0.60	93.94
	Ostomy	4.80	0.47	96.97
	Temporary abdominal closure	4.80	0.43	98.48
	Pelvic gauze packing	4.56	0.65	90.91
Vascular skills	Common carotid artery & internal jugular vein exposure	4.11	0.63	84.85
	Abdominal aorta exposure & clamp	4.47	0.63	95.45
	Inferior vena cava exposure & repair	4.27	0.64	89.39
	REBOA	4.33	0.70	89.39
	Femoral artery & vein exposure	4.47	0.66	93.94
Rejected skills	Median sternotomy thoracotomy	3.77	0.71	69.70
	Clamshell thoracotomy	4.11	0.82	77.27

FAST = focused assessment with sonography for trauma; REBOA = resuscitative endovascular balloon occlusion of the aorta.

Discussion

A consensus-based list of trauma care procedural skills required for general surgeons was developed by using interviews with experts and a Delphi survey which returned a high response rate and showed internal consistency. Following expert approval, "tracheal intubation," "intraosseous infusion," "focused assessment with sonography for trauma (FAST)," and "non-invasive external pelvic compression" were included in the required trauma care skills for general surgeons. Based on the recommendations from the 1st round of the Delphi survey, "diaphragm repair," "ostomy," and "temporary abdominal closure" were included in the final list. Since abdominal trauma surgery often involves cases of open abdominal non-closure, the addition of "temporary abdominal closure" was considered to be reasonable. Finally, the included 34 items were classified into the

following four groups: basic, thoracic, abdominal and pelvic, and vascular skills.

Basic skills (No's. 1-6; Table 3) are included in the Japan Advanced Trauma Evaluation and Care (JATEC) simulation training programs [10], which is the original Japanese trauma training course that was developed in 2002 to inculcate basic process knowledge and skills in trauma care. The JATEC training program was developed with reference to the clinical theory of Advanced Trauma Life Support [11] which is managed by the American College of Surgeons Committee on Trauma. Although basic process skills are required by all physicians involved in trauma care, general surgeons do not always practice these skills, therefore, we have included them in the list.

The purpose of thoracic surgery in trauma cases is to control intrathoracic or pericardial bleeding as well as lung air leaks, and perform decompression for reducing excessive pericardial or intrathoracic pressure [12,13]. "Pericardiostomy," "heart injury repair," "pulmonary hilum clamp," "pulmonary injury repair," "open cardiac massage," and "open aorta cross-clamping" are essential skills to fulfill the aims mentioned above and are generically called "resuscitative thoracotomy (RT)" [14,15]. It seemed reasonable for these skills to be retained in the list. However, "median sternotomy" and "clamshell thoracotomy" were rated 4 or 5 by < 80% participants in both rounds of the Delphi consensus survey and therefore were considered "rejected skills."

In the clinical management strategy for abdominal trauma, it is important to control hemorrhagic shock caused by acute bleeding, and peritonitis secondary to digestive tract injuries. Intraperitoneal bleeding is detected using "FAST;" moreover, a "crash laparotomy" is required in patients with a positive FAST who are in a state of shock refractory to intravenous infusion. Therefore, "FAST" and "crash laparotomy" were considered to be essential skills for treatment of patients with abdominal trauma. Moreover, "five-point gauze packing" to control abdominal bleeding and "peri-hepatic gauze packing" to control hepatic bleeding are important skills in damage control surgery (DCS). "Peri-hepatic gauze packing" is an effective technique for severe liver injury [16]; however, it requires adequate training because, if incorrectly performed, it may cause inadequate hemostasis or complications such as edema of the intestinal tract or venous embolism [17]. Furthermore, "temporary abdominal closure" is an essential skill following surgery. In the case of DCS for massive intestinal tract injury, only hemostasis and resection should be undertaken; intestinal anastomosis should be delayed until reoperation 24-48 hours later [18]. Therefore, "intestinal injury repair" and "bowel resection" were considered important skills for DCS. In case of DCS for colonic injury, "ostomy" was not mandatory. Some prospective studies reported that the rate of anastomotic leak for colonic anastomoses was 2.5%, which is acceptable [19,20]. Another study recommended the construction of an artificial anus in patients with severe complications [21]. "Ostomy" was necessary in case of extraperitoneal rectal injury that could not be sutured [22,23]; therefore, this skill was included.

The "resuscitative endovascular balloon occlusion of the aorta (REBOA)" technique has recently emerged as an alternative method of RT with aortic cross-clamping for non-compressible torso hemorrhage (NCTH). Some studies have compared REBOA and RT. Abe et al [24], and DuBose et al [25] reported that the in-hospital mortality of patients who received REBOA or RT for NCTH did not differ significantly. Conversely, Aso et al [26] reported that the REBOA group had lower mortality and fewer severe chest complications than the RT group. Therefore, REBOA may be another choice for NCTH among general surgeons.

In the US, medical residents are required to undergo a 5-year surgical training program certified by the Accreditation Council for Graduate Medical Education to be board-certified general surgeons [27], and registration of surgical and nonsurgical cases is required for trauma surgery. The American College of Surgeons (ACS) / Association of Program Directors in Surgery surgical resident skills curriculum was developed jointly and includes 16 basic surgical skills, 15 advanced skills, and 10 team-based skills [28]. The list developed in this survey is mostly consistent with this curriculum and partially includes skills in advanced trauma training courses such as Advanced Trauma Operative Management [29] which is provided by the ACS fellowship programs (Table 4). Therefore, our list orders the trauma skill levels of American surgical residents who are part of the ACS fellowship program.

Since trauma training based on the Japanese surgical specialist program includes points from off-the-job training, the required points can be obtained even if there are not enough clinical cases in trauma surgery. The off-the-job training includes specific simulation training programs such as JATEC, Advanced Trauma Operative Management and advanced surgical skills for exposure in trauma [30], as well as trauma workshops sponsored at conferences. Table 4 shows a comparison between the skills for which consensus was obtained in this Delphi survey, and the skills included in each course program. We believe that program development, based on these consensus-based skills, will contribute to the construction of an optimal training system that can supplement procedures that general surgeons cannot learn in the existing courses.

There is a limitation to this study. Since some councilors of the JSACS participating in this survey may not be directly involved in trauma care, there is a possibility that not all participants accurately selected the trauma care skills currently required in clinical cases.

Table 4. A comparison of consensus-based skill list with essential education in US, and existing training courses in trauma care.

	Consensus-based skills of this study	ACS/APDS surgical resident skills curriculum	JATEC	ATOM	ASSET
Basic skills	Tracheal intubation	○	○		
	Intraosseous infusion		○		
	Cricothyrotomy	○	○		
	Chest drainage	○	○		
	FAST		○		
	Non-invasive external pelvic compression (Sam sling, Sheet lapping)		○		
Thoracic skills	Open aorta cross-clamping (including anterior side thoracotomy)				○
	Pericardiostomy				
	Open chest cardiac massage				
	Heart injury repair			○	
	Pulmonary hilum clamp				○
	Pulmonary injury repair				
Abdominal and pelvic skills	Crash laparotomy (trauma incision)	○			
	Five points gauze packings			○	
	Porta hepatis clamp (Pringle's maneuver)			○	
	Peri-hepatic gauze packing				
	Liver injury suture			○	
	Intestinal injury repair (direct suture)	○		○	
	Bowel resection	○		○	
	Retroperitoneal maneuver (Cattel Braasch maneuver, Mattox's maneuver)				○
	Distal pancreatectomy			○	
	Splenic injury repair			○	
	Splenectomy	○		○	
	Renal injury repair			○	
	Nephrectomy			○	
	Diaphragm repair			○	
	Ostomy				
	Temporary abdominal closure	○			
	Pelvic gauze packing				○
Vascular skills	Common carotid artery & internal jugular vein exposure				○
	Abdominal aorta exposure & clamp				○
	Inferior vena cava exposure & repair			○	○
	REBOA				
	Femoral artery & vein exposure				○

FAST = focused assessment with sonography for trauma; REBOA = resuscitative endovascular balloon occlusion of the aorta; ACS = American College of Surgeons; APDS = Association of Program Directors in Surgery; ATOM = advanced trauma operative management; JATEC = Japan advanced trauma evaluation and care; ASSET = advanced surgical skills for exposure in trauma.

Conclusion

This study determined the trauma care skills required by general surgeons at regional hospitals. This was achieved using a Delphi consensus survey with respondents who were specialists in trauma surgery. These findings facilitate an "essential need assessment" to develop a novel trauma-training program that is optimized for general surgeons. Future research should investigate the proficiency of general surgeons in the primary trauma care skills identified in this study.

Acknowledgment

This work was supported by the Japan Society for the Promotion of Science (JSPS) KAKENHI Grant Number JP16K11392. The authors would like to thank all the JSACS councilors who participated in this survey. We would have been unable to complete the survey without their assistance.

Author Contributions

Conceptualization: SM, KH, YK and SH. Methodology: YK. Formal investigation: KH. Data analysis: KO, IY, SM, KH and YK. Writing original draft: KH and SM. Writing - review and editing: YK, NS, SP, KT, AM, YN, TA, TN, YB, TN, TT, TS, NH and SH.

Conflicts of Interest

The authors declare that they have no competing interests.

Funding

SM, YK, SP, KT, AM, YN, TA, TN, YE, TN, TT, and SH were recipients of JSPS KAKENHI. TS was a recipient of JSPS KAKENHI and Japan's Agency for Medical Research and Development. IY reports grants from KAKENHI and Japan's Agency for Medical Research and Development, as well as Health, Labour and Welfare Policy Research Grants, research funds from Nihon Medi-Physics, and speaker fees from Chugai Pharmaceutical Co, and AstraZeneca, outside the submitted work.

Ethical Statement

This research did not involve any human or animal experiments.

Data Availability

All relevant data are included in this manuscript.

References

[1] MacKenzie EJ, Rivara FP, Jurkovich GJ, Nathens AB, Frey KP, Egleston BL, et al. A national evaluation of the effect of trauma-center care on mortality. N Engl J Med 2006;354(4):366-78.
[2] Liberman M, Mulder DS, Lavoie A, Sampalis JS. Implementation of a trauma care system: evolution through evaluation. J Trauma 2004;56(6):1330-5.
[3] Balasubramanian I, Mohan HM, Whelan RJ, McDermott F, Winter DC. Restructuring an evolving Irish trauma system: What can we learn from Europe and Australia? Surgeon 2016;14(1):44-51.
[4] American College of Surgeons Committee on Trauma [Internet]. Resources for Optimal Care of the Injured Patient 2014. 2014 [updated 2023 Jan 19]. Available from: https://www.facs.org/media/yu0laoqz/resources-for-optimal-care.pdf.
[5] Mashiko K. Trauma systems in Japan: history, present status and future perspectives. J Nippon Med Sch 2005;72(4):194-202.
[6] Kobayashi K. Challenges for improving trauma care in Japan. J Trauma 2005;58(6):1134-9.
[7] Cabinet Office, Government of Japan [Internet]. White Paper on Traffic Safety in Japan 2020. 2020 [updated 2022 Nov 13]. Available from: https://www8.cao.go.jp/koutu/taisaku/r02kou_haku/english/pdf/wp2020.pdf.
[8] Singh P, Aggarwal R, Zevin B, Grantcharov T, Darzi A. A global Delphi consensus study on defining and measuring quality in surgical training. J Am Coll Surg 2014;219(3):346-53.e7.
[9] Nagpal K, Arora S, Abboudi M, Vats A, Wong HW, Manchanda C et al. Postoperative handover: problems, pitfalls, and prevention of error. Ann Surg 2010;252(1):171-6.
[10] Developing Committee on the Course of Trauma Care Training of the Japan Association for the Surgery of Trauma: Guideline for Initial Trauma Care. Japan Advanced Trauma Evaluation and Care, 5th ed. Tokyo (Japan): Herusu Shuppan Company; 2016. [in Japanese].
[11] Carmont MR. The Advanced Trauma Life Support course: a history of its development and review of related literature. Postgrad Med J 2005;81(952):87-91.
[12] LoCiecero J 3rd, Mattox KL. Epidemiology of chest trauma. Surg Clin North Am 1989;69(1):15-9.
[13] Mattox KL Wall MJ Jr, Tsai P. Trauma Thoracotomy: Principles and Techniques. In: Mattox KL, Moore EE, Feliciano DV eds. Trauma, 7th Ed. New York (NY): McGraw-Hill Education; 2013. p. 461-7.
[14] Wall MJ Jr, Huh J, Mattox KL. Indications for and Techniques of Thoracotomy. In: Feliciano DV, Mattox KL, Moore EE, eds. Trauma, 6th Ed. New York (NY): McGraw-Hill Education; 2008. p. 512-23.
[15] Burlew CC, Moore EE. Emergency Department Thoracotomy. In: Mattox KL, Moore EE, Feliciano DV eds. Trauma, 7th Ed. New York (NY): McGraw-Hill Education; 2013. p. 236-50.
[16] Beal SL. Fatal hepatic hemorrhage: an unresolved problem in the management of complex liver injuries. J Trauma 1990;30(2):163-9.
[17] Aydin U, Yazici P, Zeytunlu M, Coker A. Is it more dangerous to perform inadequate packing? World J Emerg Surg 2008;3:1.
[18] Carrillo C, Fogler RJ, Shaftan GW. Delayed gastrointestinal reconstruction following massive abdominal trauma. J Trauma 1993;34(2):233-5.
[19] Chappuis CW, Frey DJ, Dietzen CD, Panetta TP, Buechter KJ, Cohn I. Management of penetrating colon injuries. A prospected randomized trial. Ann Surg 1991;213(5):492-8.
[20] Sasaki LS, Allaben RD, Golwara R, Mittal VK. Primary repair of colon injuries: a prospected randomized study. J Trauma 1995;39(5):895-901.
[21] Pasquale M, Fabisn TC. Practice management guidelines for trauma from Eastern Association for the Surgery of Trauma. J Trauma 1998;44(6):941-56; discussion 956-7.
[22] Velmahos GC, Gomez H, Falabella A, Demetriades D. Operative management of civilian rectal gunshot wounds: simpler is better. World J Surg 2000;24(1):114-8.
[23] Navsaria PH, Shaw JM, Zellweger R, Nicol AJ, Kahn D. Diagnostic laparoscopy and diverting sigmoid loop colostomy in the management of civilian extraperitoneal rectal gunshot injuries. Br J Surg 2004;91(4):460-4.
[24] Abe T, Uchida M, Nagata I, Saitoh D, Tamiya N. Resuscitative endovascular balloon occlusion of the aorta versus aortic cross clamping among patients with critical trauma: a nationwide cohort study in Japan. Crit Care 2016;15;20:400.
[25] Dubose JJ, Scalea TM, Brenner M, Skiada D, Inaba K, Cannon J et al. The AAST prospective Aortic Occlusion for Resuscitation in Trauma and Acute Care Surgery (AORTA) registry: data on contemporary utilization and outcomes of aortic occlusion and resuscitative balloon occlusion of the aorta (REBOA). J Trauma Acute Care Surg 2016;81(3):409-19.
[26] Aso S, Matsui H, Fushimi K, Yasunaga H. Resuscitative endovascular balloon occlusion of the aorta or resuscitative thoracotomy with aorta clamping for noncompressible torso hemorrhage: A retrospective nationwide study. J Trauma Acute Care Surg 2017;82(5):910-4.
[27] Accreditation Council for Graduate Medical Education [Internet]. Surgery. [updated 2023 Jan 19]. Available from: https://www.acgme.org/specialties/surgery/overview/.
[28] American College of Surgeons [Internet]. Educational Programs ACS/APDS Surgery Resident Skills Curriculum. [updated 2023 Jan 19]. Available from: https://www.facs.org/for-medical-professionals/education/programs/acs-apds-surgery-resident-skills-curriculum/.

[29] Jacobs LM, Burns KJ, Kaban JM, Gross RI, Cortes V, Brautigam RT, et al. Development and evaluation of the advanced trauma operative management course. J Trauma 2003;55(3):471-9; discussion 479.

[30] Mark W, Deborah A, Danielle Haskin, Richard A, Sharon M, George D, et al. Advanced surgical skills for exposure in trauma (ASSET): the first 25 courses. J Surg Res 2013;183(2):553-8.