

CHOP protocol: streamlining access to definitive intervention for major trauma victims

Min Li Kang¹, MBBS, MRCS, Jerry Tiong Thye Goo¹, MB BCh BAO, FRCS, Daniel Jin Keat Lee¹, MD, FRCS

The Critical Haemorrhage to Operation Room Patient (CHOP) protocol was designed for Khoo Teck Puat Hospital (KTPH), Singapore, to facilitate recognition, escalation and mobilisation of resources in the context of major trauma, with the goal of bringing a severely injured patient rapidly to definitive care. It targets critically injured trauma patients who have, or are assumed to have, ongoing or potentially massive haemorrhage. These patients have the potential for rapid and devastating deterioration and require access to early definitive care by a multidisciplinary trauma team.⁽¹⁻³⁾

The hospital receives an average of 1,200 trauma patients per year, of which 350 are Tier 1 or severely injured patients, making KTPH the centre with the second highest volume of Tier 1 trauma cases in Singapore. The mechanism of trauma for these patients is mainly blunt trauma secondary to road traffic accidents or falls from a height. The hurdles that the trauma team faces in bringing a patient to early definitive care include balancing the immediate need for resuscitation, logistical coordination with the various specialists and mobilisation of appropriate resources – all of which necessarily occur in a high-stress situation. This is made more challenging, as our audits have shown, because less than a third of these patients presented during office hours when a dedicated trauma team is present to facilitate the above.

The CHOP protocol acts to facilitate second-tier activation for a subset of severely injured trauma patients who meet two out of four criteria that are suggestive of active or massive exsanguination: (a) systolic blood pressure (SBP) < 90 mmHg; (b) heart rate > 120 beats per minute (bpm); (c) penetrating injuries to the head, neck, torso or proximal extremities; and (d) positive FAST (focused abdominal sonography in trauma) imaging indicating intra-abdominal or intra-thoracic free fluid. These simple guidelines are based on the Assessment of Blood Consumption Score,⁽⁴⁾ which is validated to predict the need for a massive transfusion protocol. The trauma team may also choose to activate the CHOP protocol for patients who do not fulfil the above criteria but have progressive haemodynamic instability, or who are found to have injuries requiring immediate surgical intervention or angioembolisation.

The second-tier activation kicks off an automated chain of calls from the hospital switchboard to these additional on-call specialists: (a) a general surgery consultant; (b) an anaesthesiologist/intensivist; (c) an interventional radiology consultant, with an additional step to inform; and (d) a backup trauma general surgery consultant, if necessary. It also enables the mobilisation of resources, such as activating the operating theatre (OT) sister to put the OT staff on standby and the blood bank to send two packs of uncrossmatched E-blood immediately to the resuscitation area.

Table 1. Initial experience under the CHOP protocol (n = 10).

Parameter	Mean ± SD (range)
Patient demographic	
Age (yr)	33 ± 11
Presentation during office hours* (%)	20
Mechanism of injury[†]	
Fall from height	2 (20)
Penetrating assault	1 (10)
Road traffic accident	7 (70)
Initial vital sign at ED	
Heart rate (bpm)	129 ± 17
Systolic blood pressure (mmHg)	89 ± 23
Initial investigation at ED	
Haemoglobin (g/dL)	13.5 ± 2.6
International normalised ratio	1.14 ± 1.56
Base excess (mmol/L)	-7.5 ± 8.7
Lactate (mmol/L)	8.3 ± 6.5
FAST positive [†]	6 (60)
Trauma score	
Injury Severity Score	35 ± 15 (13–59)
Trauma Injury Severity Score	79.4 ± 29.1
Management	
Estimated volume of crystalloids infused before blood transfusion (mL)	370 ± 170
Blood transfusion [†]	10 (100)
E-blood/MTP usage at ED [†]	10 (100)
Intravenous tranexamic acid [†]	10 (100)
ED arrival to CT time (min)	63 ± 23
ED arrival to OT/IR time (min)	73 ± 57
Discharge status	
Mortality [†]	2 (20)
Length of hospital stay	
In HDU/ICU (day)	4.1 ± 3.4
Total (day)	10.9 ± 9.4
Duration of ventilation (day)	3.0 ± 2.4

*Monday–Friday 8.00 am–4.30 pm, excluding public holidays.
[†]Data presented as no. (%). CHOP: Critical Haemorrhage to Operation Room Patient; CT: computed tomography; ED: emergency department; FAST: focused abdominal sonography in trauma; HDU: high-dependency unit; ICU: intensive care unit; IR: interventional radiology suite; MTP: massive transfusion protocol; OT: operating theatre; SD: standard deviation

The need for second-tier activation for critically injured patients is not a novel concept. The advent of various protocols, such as Code Crimson in Westmead Hospital, Australia,⁽⁵⁾ and Code Red in Royal London Hospital, United Kingdom,⁽⁶⁾ have

¹Department of Surgery, Khoo Teck Puat Hospital, Singapore

Correspondence: Dr Daniel Jin Keat Lee, Consultant, Department of Surgery, Khoo Teck Puat Hospital, 90 Yishun Central, Singapore 768828. lee.daniel.jk@ktph.com.sg

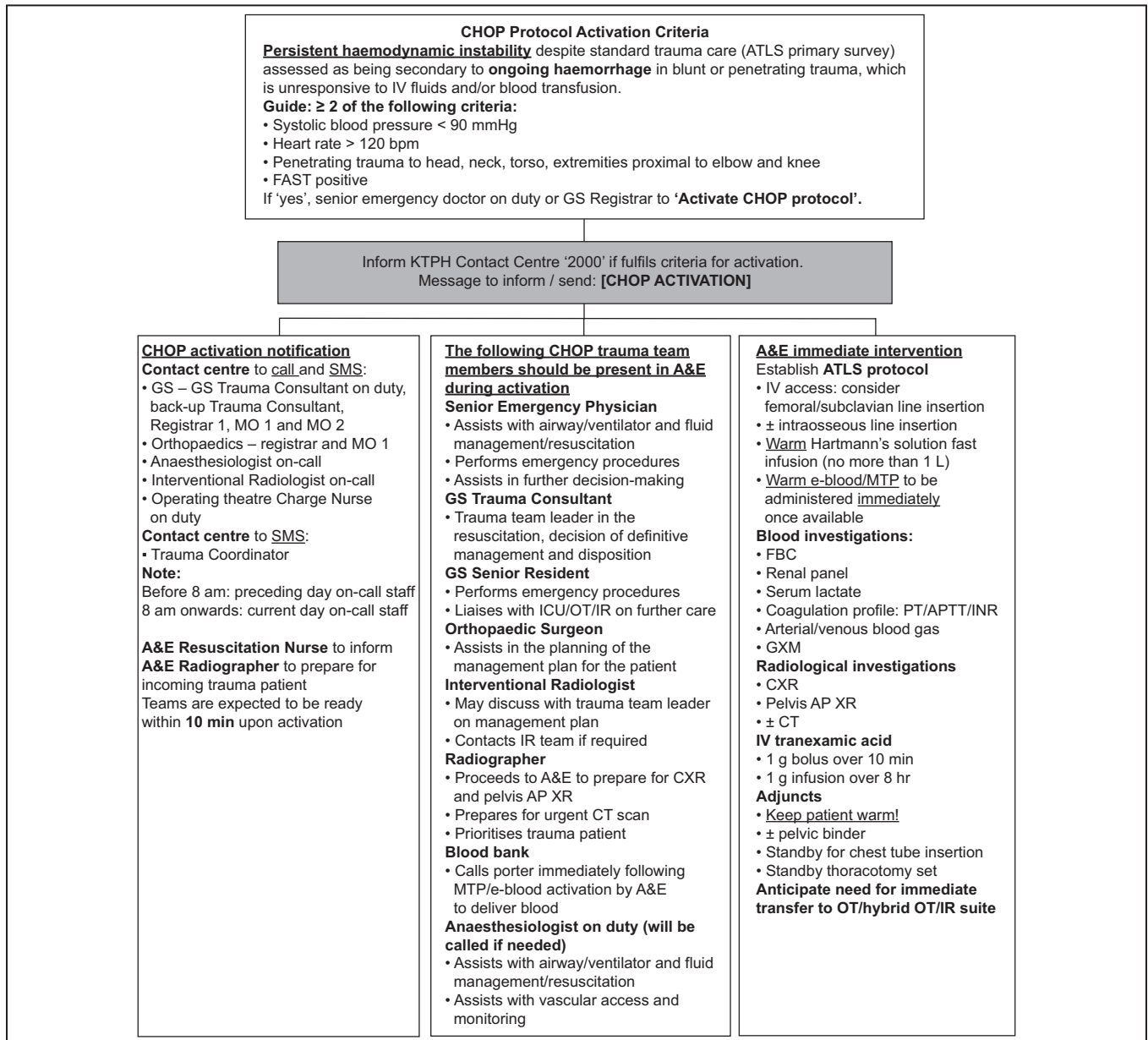


Fig. 1 Flowchart shows the workflow for activation of the Critical Haemorrhage to Operation Room Patient (CHOP) protocol. A&E: Accident and Emergency Department; AP: anteroposterior; ATLS: Advanced Trauma Life Support; CT: computed tomography; CXR: chest radiography; GS: General Surgery; FAST: face, arm, speech test; FBC: full blood count; ICU: intensive care unit; IR: interventional radiology; IV: intravenous; KTPH: Khoo Teck Puat Hospital; MO: medical officer; MTP: massive transfusion protocol; OT: operating theatre; PT/APTT/INR: prothrombin time/activated partial thromboplastin time/international normalised ratio; SMS: short message; XR: radiography

integrated themselves into the management of trauma. However, there has been no equivalent protocol introduced in Singapore yet. The CHOP protocol seeks to fill that role within the local context – taking into account a patient pool that consists mainly of blunt trauma cases – where interventional radiology procedures have taken a step up in importance for minimally invasive procedures, such as embolisation of pelvic vessels.

The CHOP protocol was first implemented in KTPH in March 2018. It blends seamlessly with the pre-existing trauma activation guidelines and Advanced Trauma Life Support protocol to boost efficiency. The key outcome of the CHOP protocol is for definitive care to be initiated within 90 minutes of CHOP activation. Fig. 1 describes the workflow of the CHOP protocol.

The initial experience of the first ten patients covered by the CHOP protocol is described in Table I. The majority (70%) of the patients were victims of blunt trauma from road traffic accidents. The remaining three patients suffered penetrating injuries from stabbing and falls from height, respectively. All the patients met the CHOP criteria, with 70% having a heart rate ≥ 120 bpm, 60% having a positive FAST scan, and 60% having an SBP < 90 mmHg. The average Injury Severity Score (ISS) for these patients was 35, indicating that the CHOP criteria were overall successful in identifying critically injured patients. The average Trauma Injury Severity Score (TRISS) was 79.4, with the outlier low scores both being eventual mortalities in this series. The CHOP workflow also audits the usage of tranexamic acid and early blood transfusion.

Both processes were fulfilled at 100%, which was congruent with the experience of Reed et al in initiating early blood product transfusion in Code Red patients in Scotland.⁽⁷⁾

Early analysis of outcomes in these first ten cases of CHOP activation shows that the target (i.e. access to definitive intervention within 90 minutes) was achieved overall, with an average time of 73 minutes from arrival at the emergency department to transfer to the OT or interventional radiology suite. Upon briefing, the two cases that showed a delay to intervention of more than 90 minutes were noted to have the following contributory factors: delay in activation of CHOP protocol and unfamiliarity with the CHOP protocol. These issues were addressed subsequently with multidisciplinary briefings and simulations to familiarise key members of the trauma teams with the new protocol and availability of resources.

Subsequent outcomes showed a mean length of stay of 4.1 days in intensive care and a mortality rate of 20%. Both cases of mortality had an ISS of 50 and presented with high likelihood of a non-salvageable pattern of injury, as evident from TRISS scores of 17.5 and 36.4, respectively.

In conclusion, the early experience of the CHOP protocol

in KTPH shows that second-tier activation enables the multidisciplinary trauma team to be deployed to provide early definitive intervention for Tier 1 trauma patients. The CHOP protocol, the first of its kind in the local context, has integrated itself with the trauma workflow of our hospital and become an essential part of the pathway to promptly direct critically injured patients to the best possible care.

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