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

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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 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 second highest centre for Tier 1 trauma in Singapore. The mechanism of trauma for these patients is mainly blunt trauma secondary to road traffic accidents or falls from 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 that 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 a 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: (i) systolic blood pressure (SBP) < 90 mmHg; (ii) heart rate > 120 beats per minute (bpm); (iii) penetrating injuries to head, neck, torso or proximal extremities; and (iv) 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; (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 stand by the OT staff and the blood bank to send two packs of uncrossmatched E-blood immediately to the resuscitation area.

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 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 stepped 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 of patients (70%) were victims of blunt trauma from road traffic accidents. The remaining two 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 a 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%, 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%. In the two cases of mortality, both cases had an ISS of 50 and presented with high likelihood of a non-salvageable pattern of injury as seen from the TRISS score of 17.5 and 36.4, respectively.

In conclusion, the early experience of the CHOP protocol in KTPH shows that a 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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FIGURE

WORKFLOW FOR CRITICAL HEMORRHAGE to OPERATION-ROOM PATIENT (CHOP) ACTIVATION

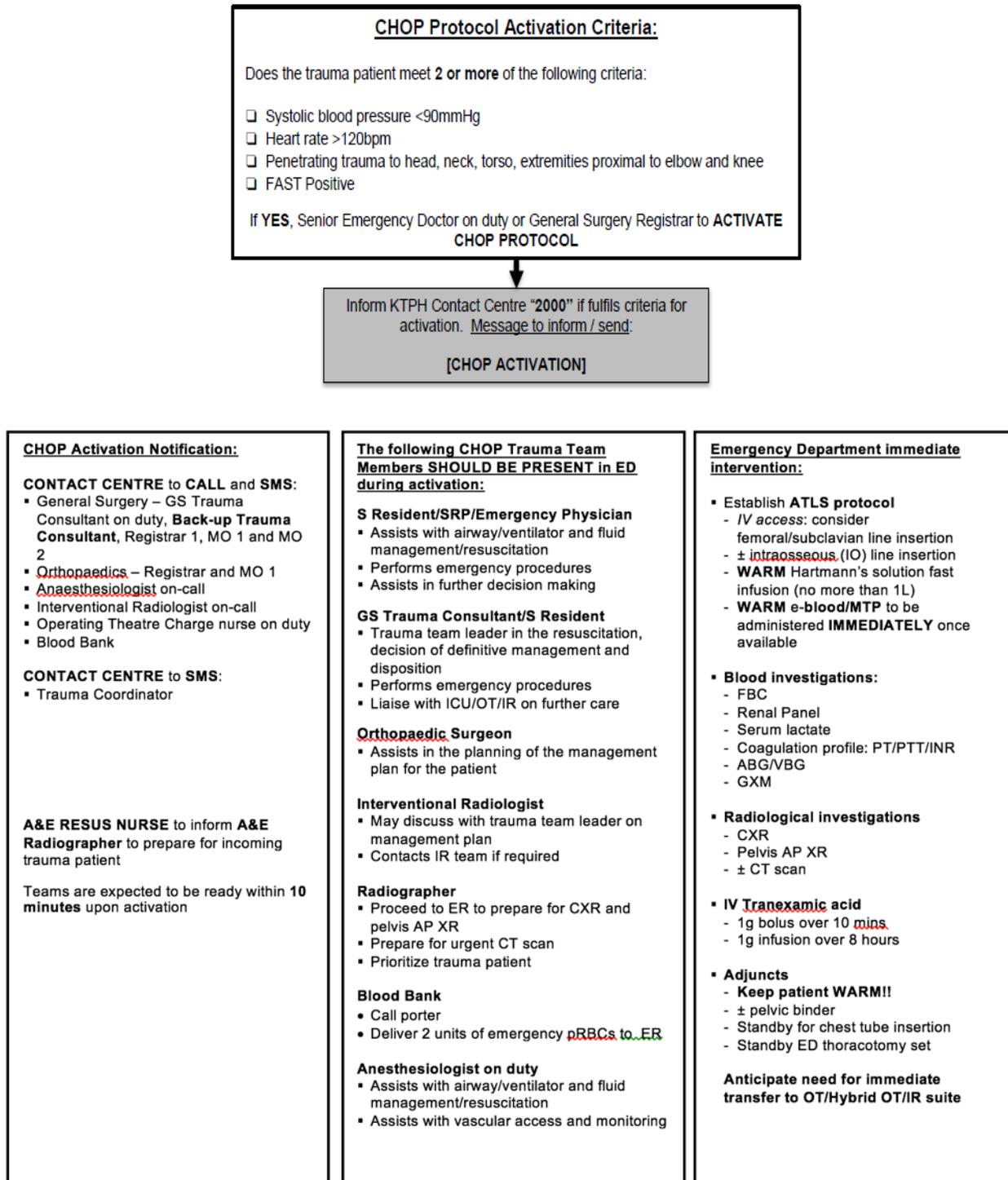


Fig. 1 Workflow for the activation of the CHOP protocol.

Table I. Initial experience of patients under the CHOP protocol (n = 10).

Parameter	Mean \pm SD (range)/No. (%)
Patient demographic	
Age (yr)	33 \pm 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 signs at ED	
Heart rate (bpm)	129 \pm 17
Systolic blood pressure (mmHg)	89 \pm 23
Initial investigations at ED	
Haemoglobin (g/dL)	13.5 \pm 2.6
International normalised ratio	1.14 \pm 1.56
Base excess (mmol/L)	-7.5 \pm 8.7
Lactate (mmol/L)	8.3 \pm 6.5
FAST positive	6 (60)
Trauma score	
Injury Severity Score	35 \pm 15 (13–59)
Trauma Injury Severity Score	79.4 \pm 29.1
Management	
Estimated volume of crystalloids infused before blood transfusion (mL)	370 \pm 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 \pm 23
ED arrival to OT/IR time (min)	73 \pm 57
Discharge status	
Mortality	2 (20)
Length of hospital stay	
LOS in HDU/ICU (day)	4.1 \pm 3.4
Total LOS (day)	10.9 \pm 9.4
Duration of ventilation (day)	3.0 \pm 2.4

*Monday through Friday 8.00 am to 4.30 pm, excluding public holiday.

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; LOS: length of stay; MTP: massive transfusion protocol; OT: operating theatre