Trauma Surgery & Acute Care Open

When not to explore: a combat-specific decision framework for selective neck exploration at Role 2

Dmytro Mialkovskyi ,[1] Ihor Rusanov,[2,3] Iurii Mikheiev,[3,4] Serhii Machuskyi[1]

[1]Surgery, Zaporizhzhia Military Hospital, Zaporizhzhia, Zaporizhzhia oblast, Ukraine
[2]Vascular Surgery, Zaporizhzhia Military Hospital, Zaporizhzhia, Zaporizhzhia oblast, Ukraine
[3]Zaporizhzhia State Medical and Pharmaceutical University, Zaporizhzhia, Zaporizhzhia oblast, Ukraine
[4]Zaporizhzhia Military Hospital, Zaporizhzhia, Zaporizhzhia oblast, Ukraine

Correspondence to
Dr Dmytro Mialkovskyi;
mialkovskyidmytro@gmail.com

Received 28 July 2026
Accepted 11 September 2026

ABSTRACT

Current civilian algorithms for penetrating neck trauma assume access to definitive vascular reconstruction, endovascular intervention, advanced imaging, and specialist multidisciplinary care. These assumptions may not apply to Role 2 military facilities, where neck exploration can commit the surgeon to procedures that cannot be completed under optimal conditions. This position paper was developed through a focused narrative review of contemporary recommendations and literature on penetrating neck trauma, vascular and aerodigestive injury, temporary hemorrhage control, and combat casualty care, supplemented by targeted PubMed searches addressing penetrating carotid injury, temporary vascular shunting, carotid collateral circulation, aerodigestive trauma, balloon tamponade, and Role 2-to-Role 3 evacuation. We propose a combat-specific framework distinguishing injuries requiring immediate surgery from those in which temporary hemorrhage control, airway protection, stabilization, and evacuation may better preserve definitive treatment options. The framework challenges automatic application of selected civilian indications for neck exploration in stable patients when hemorrhage is controlled and safe evacuation is feasible, extends this selective approach to aerodigestive injuries, and incorporates transport conditions and en-route rescue capability into the decision to operate. We also propose hypotheses regarding common carotid artery shunting, including the potential effects of collateral cerebral perfusion, shunt position, configuration, monitoring limitations, and thromboembolic complications on neurological outcomes. Role 2 decision-making should incorporate surgical capability, physiology, airway security, effectiveness of temporary hemorrhage control, and evacuation feasibility. Safe evacuation depends not only on transport time but also on the reliability of temporary control and the ability to manage deterioration en route. Rather than replacing civilian algorithms, this framework adapts them to combat casualty care while introducing hypotheses requiring prospective clinical and experimental validation.

INTRODUCTION

Penetrating neck trauma remains one of the most challenging injuries encountered in trauma surgery because of the high density of vital vascular, aerodigestive, and neurological structures within a confined anatomical space. Although such injuries account for only a small proportion of all traumatic wounds, they are associated with substantial mortality and long-term disability, particularly when the carotid arteries, major veins, larynx, trachea, or esophagus are involved. Over the past three decades, advances in multidetector CT angiography (CTA), endovascular techniques, critical care, and selective non-operative management have fundamentally changed the management of penetrating neck trauma in civilian trauma centers. As a result, mandatory surgical exploration has largely been abandoned in favor of selective management guided by clinical examination and modern imaging.[1–8]

Current recommendations from organizations such as the Eastern Association for the Surgery of Trauma (EAST), the Western Trauma Association (WTA), the European Society for Vascular Surgery (ESVS), and other expert groups are largely based on the capabilities of well-resourced trauma centers. These recommendations implicitly assume the availability of advanced imaging, vascular and trauma surgeons experienced in carotid reconstruction, hybrid operating rooms, blood component therapy, neurocritical care, and postoperative surveillance. Under these circumstances, immediate neck exploration can often be followed by definitive vascular reconstruction or endovascular intervention, offering the best opportunity to preserve neurological function while achieving hemorrhage control.[1–4 8]

The reality of modern combat casualty care is fundamentally different. Forward surgical teams and Role 2 medical treatment facilities frequently operate under conditions characterized by limited personnel, constrained resources, prolonged evacuation chains, and the constant threat of mass casualty events. Although life-saving surgical interventions can be performed successfully in these environments, definitive vascular reconstruction of complex carotid injuries is often beyond the realistic capability of the treating team. Consequently, the decision to explore the neck carries implications that extend beyond hemorrhage control alone. Once the carotid sheath has been opened and a devastating vascular injury identified, the surgeon may be forced to choose between technically demanding reconstruction, temporary intraluminal shunting, or vessel ligation under circumstances that are considerably less favorable than those assumed by civilian practice guidelines.[9–11] Moreover, the safety of continued temporary control depends not only on evacuation time but also on transport conditions and the ability of the evacuation team to recognize and manage recurrent hemorrhage or airway deterioration en route.[12 13]

This dilemma is particularly important for injuries involving the common or internal carotid artery. While ligation may be unavoidable in exsanguinating

© Author(s) (or their employer(s)) 2026. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ Group.

To cite: Mialkovskyi D, Rusanov I, Mikheiev I, *et al*. *Trauma Surg Acute Care Open* 2026;**11**:e002550.

Trauma Surgery & Acute Care Open: first published as 10.1136/tsaco-2026-002550 on 20 October 2026. Downloaded from https://tsaco.bmj.com on 16 November 2026 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

patients, it is consistently associated with a substantial risk of permanent neurological injury. Likewise, temporary vascular shunts, although well established in extremity trauma, present unique challenges in the carotid circulation. Unlike peripheral vessels, successful carotid shunting depends not only on restoration of antegrade flow but also on preservation of adequate cerebral perfusion, reliable shunt patency, and avoidance of thromboembolic complications. Furthermore, the physiological consequences of carotid shunting may be influenced by shunt configuration and its position relative to the carotid bifurcation, a concept that has received little attention in the existing literature. Importantly, exploration may also convert a temporarily controlled injury into one that requires immediate definitive reconstruction—a capability that may not exist at the forward surgical echelon.[10 11 14–23]

In contrast, selected patients with controlled hemorrhage following balloon tamponade, wound packing, or external compression, preserved airway, and physiological stability may benefit more from rapid evacuation to a higher level of care than from immediate surgical exploration. In these patients, temporary hemorrhage control may preserve not only life but also the opportunity for definitive carotid reconstruction or endovascular repair performed under optimal conditions. Despite the obvious practical relevance of this concept, current civilian algorithms provide limited guidance regarding situations in which surgical restraint may represent the safer strategy within the unique constraints of combat medicine.[24–28]

The management of penetrating neck trauma at Role 2 extends beyond vascular injuries alone. Decisions regarding airway control, laryngeal disruption, tracheal trauma, and suspected esophageal injury are similarly influenced by the limited diagnostic and reconstructive capabilities available at forward surgical facilities. The Role 2 objective is therefore to identify injuries that require immediate airway or operative intervention while avoiding complex definitive aerodigestive reconstruction when immediate threats can be controlled and safe transfer is feasible. Determining which injuries require immediate operative intervention and which can be safely stabilized for evacuation remains one of the most challenging aspects of combat trauma surgery.[3 4 29–34]

The objective of this article is not to replace existing civilian algorithms, but to examine the assumptions underlying their application in combat environments. Based on contemporary evidence and the experience gained during the war in Ukraine, we propose a combat-specific decision framework for selective neck exploration at Role 2. Rather than asking whether a penetrating neck injury should be explored, this framework asks a different question: whether immediate exploration is likely to improve the patient's ultimate outcome, or whether temporary hemorrhage control, airway protection, physiological stabilization, and rapid evacuation may better preserve the opportunity for definitive treatment when transport conditions and en-route rescue capability permit safe transfer.[1–4 8–10 12 13]

METHODS

This position paper was developed through a focused narrative review of contemporary recommendations and relevant literature on penetrating neck trauma, vascular injury and aerodigestive trauma, temporary hemorrhage control, and combat casualty care. Particular attention was given to guidance issued by major trauma and vascular surgery organizations, including the EAST, the WTA, the ESVS, and the Joint Trauma System. The reference lists of key guidelines and review articles were examined to identify additional relevant studies.[1 2 4 8 9]

Evidence was interpreted in the context of the capabilities and constraints of Role 2 medical treatment facilities, including limited access to advanced imaging, endovascular intervention, complex vascular reconstruction, specialist multidisciplinary support, and prolonged or uncertain evacuation. The proposed decision framework was developed by integrating published evidence with the authors' clinical experience in the management of combat-related penetrating neck and vascular injuries during the war in Ukraine.

The framework was designed to distinguish injuries requiring immediate operative intervention from those in which temporary hemorrhage control, airway protection, physiological stabilization, and rapid evacuation may better preserve the opportunity for definitive treatment at a higher echelon of care. Recommendations unsupported by direct comparative evidence are explicitly presented as expert opinion and should be regarded as hypotheses requiring prospective validation.

DISCUSSION

Why civilian algorithms cannot be directly transferred to Role 2 combat care

Contemporary civilian algorithms for penetrating neck trauma have appropriately moved away from routine zone-based exploration toward selective management guided by physiological status, clinical findings, CTA, and targeted endoscopic or operative assessment.[1–8] Within a mature trauma system, this approach reduces unnecessary exploration while enabling rapid definitive treatment of vascular and aerodigestive injuries. The underlying principles remain relevant to combat casualties; however, their application at Role 2 requires recognition that the same clinical finding may lead to a different decision when diagnostic, operative, and evacuation capabilities differ substantially.

Most civilian recommendations implicitly assume that a patient selected for exploration will undergo that procedure in a facility capable of completing the necessary treatment. For a major carotid injury, this may include vascular reconstruction, endovascular intervention, advanced imaging, continuous neurological surveillance, and immediate management of postoperative complications. For complex laryngotracheal or esophageal injuries, definitive management may similarly require specialist expertise, endoscopy, intensive care, nutritional support, and planned reassessment. In such settings, exploration is not merely diagnostic: it is the first stage of a definitive treatment pathway.[1–4 8 14 15 29–32 35]

At Role 2, that pathway may be incomplete. The surgical team may be capable of obtaining proximal and distal vascular control yet unable to perform durable carotid reconstruction under optimal conditions. Endovascular capability is generally absent, specialist support may be unavailable, and blood products, critical-care capacity, operative time, and postoperative surveillance may be constrained. Simultaneous casualties may further limit the resources that can be committed to a single complex reconstruction. Evacuation may be rapid, prolonged, interrupted, or impossible to predict. Thus, the relevant question is not simply whether an injury would warrant exploration in a civilian trauma center, but whether exploration at the current echelon is likely to produce a better outcome than continued temporary control and transfer.[9–11]

This distinction is particularly important when hemorrhage has already been controlled by external compression, wound packing, or balloon tamponade. Opening a contained wound may abolish the tamponade effect and convert a temporarily controlled vascular injury into uncontrolled bleeding requiring

Trauma Surgery & Acute Care Open: first published as 10.1136/tsaco-2026-002550 on 20 October 2026. Downloaded from https://tsaco.bmj.com on 16 November 2026 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

immediate repair, shunting, or ligation. The surgeon may thereby create an irreversible therapeutic commitment without possessing the resources required to complete the optimal procedure. A technically successful exposure may therefore worsen the patient's eventual neurological or functional outcome when it culminates in a compromise procedure that would not have been required had temporary control been maintained until evacuation.[10 24–28]

The proposed Role 2 framework therefore departs from civilian algorithms in its interpretation of an enlarging cervical hematoma. In civilian practice, an expanding hematoma is conventionally classified as a hard sign prompting immediate operative or endovascular intervention. In the combat environment, however, enlargement of the hematoma alone should not automatically mandate neck exploration once the airway has been secured, external hemorrhage is controlled, and the patient remains physiologically stable. We hypothesize that the surrounding tissues may provide progressive tamponade and that, in selected patients, the principal immediate threat is airway compression rather than continued exsanguination. Early definitive airway control may therefore create an opportunity for observation and rapid evacuation without disrupting the contained vascular injury.[1–4 8]

This proposal must not be interpreted as suggesting that every enlarging hematoma will become self-limiting. Persistent external bleeding, rapidly progressive swelling despite airway control, hemodynamic deterioration, loss of temporary hemorrhage control, or evidence of inadequate cerebral perfusion should prompt immediate reconsideration of operative intervention. Rather, our framework distinguishes an enlarging but contained hematoma in a stable, intubated patient from uncontrolled hemorrhage or progressive shock. This distinction and its position within the proposed decision pathway are summarized in figure 1.[1–4 8 9]

The limitations of Role 2 must likewise not become a justification for delaying surgery in patients with uncontrolled hemorrhage, failure of temporary control, an unsecured airway, severe physiological instability, or other immediately life-threatening findings. In such circumstances, operative intervention remains mandatory even when the available options are imperfect. The proposed framework introduces capability, airway security, effectiveness of tamponade, and evacuation feasibility as additional variables in patients whose immediate threats can be temporarily controlled.[1–4 8 9]

A similar consideration applies to cervical bruit or thrill. Although these findings are traditionally regarded as hard signs of vascular injury requiring immediate exploration in civilian practice, they do not necessarily mandate operative intervention at the Role 2 level when hemorrhage is controlled, the airway is secure, and the patient remains physiologically stable. In such patients, bruit or thrill most commonly reflects an underlying arterial injury, pseudoaneurysm, or arteriovenous fistula rather than an immediately life-threatening condition. Once the diagnosis is established, expedited evacuation to a facility capable of definitive vascular or endovascular repair may represent a safer strategy than forward exploration undertaken under resource-limited conditions.[1–4 8 14 15]

A combat-specific approach should consequently distinguish between physiological necessity and anatomical desirability. An injury may ultimately require definitive reconstruction yet not require that reconstruction—or even formal exploration—at the first surgical echelon if hemorrhage, airway, and physiology can be safely stabilized. Civilian algorithms identify the injury that requires treatment; the Role 2 surgeon must additionally determine where and when that treatment can be performed without sacrificing the patient's opportunity for the best definitive outcome.

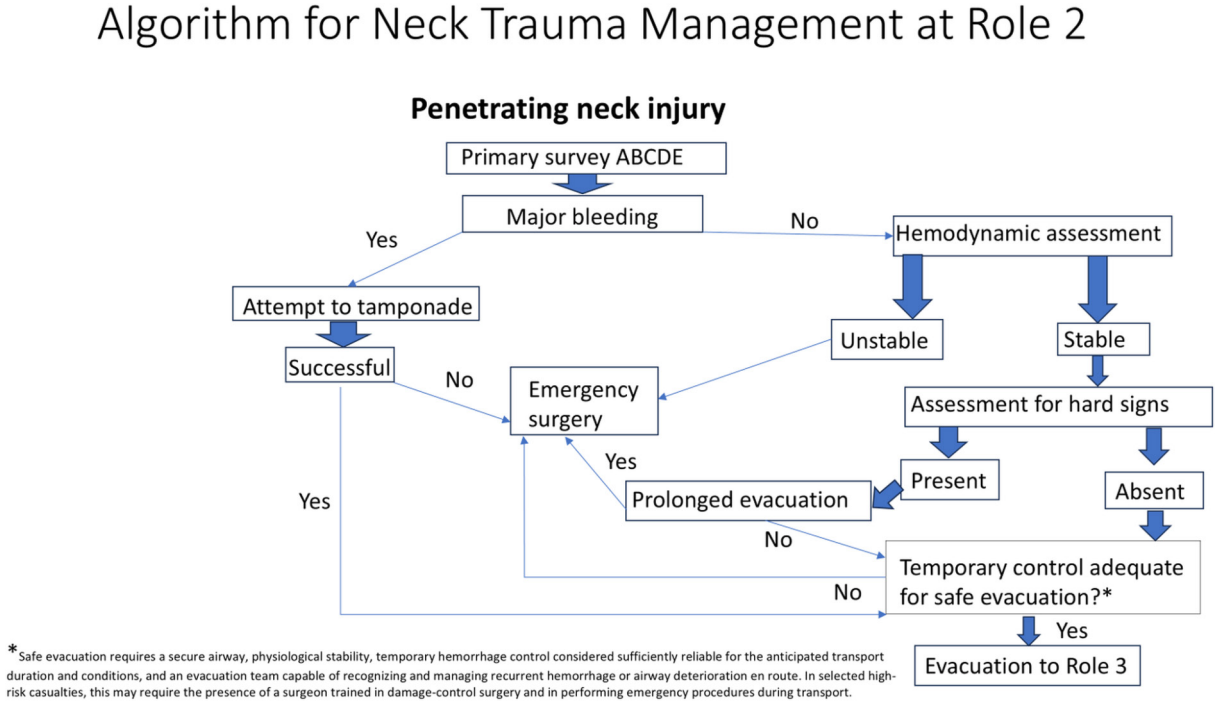


Figure 1 Combat-specific decision algorithm for penetrating neck trauma at Role 2.

Trauma Surgery & Acute Care Open: first published as 10.1136/tsaco-2026-002550 on 20 October 2026. Downloaded from https://tsaco.bmj.com on 16 November 2026 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

PRO: a different treatment objective at Role 2

Damage-control surgery is conventionally understood as the abbreviated control of hemorrhage and contamination, followed by physiological restoration and delayed definitive repair. In penetrating neck trauma at Role 2, this principle should extend beyond limiting operative duration. It should also include avoidance of interventions that convert a potentially reconstructable injury into an irreversible ligation, extensive exposure, or technically compromised repair. We describe this objective as preservation of reconstructive opportunity (PRO).[14]

Preserving reconstructive opportunity does not mean avoiding necessary surgery or transferring an unstable patient with uncontrolled bleeding. Rather, it means recognizing that temporary control may sometimes constitute the most appropriate forward surgical intervention. When hemorrhage is effectively controlled, the airway is secure, physiology is acceptable, and evacuation to a reconstructive or endovascular capability is feasible, maintaining tamponade and expediting transfer may offer greater long-term benefit than immediate exploration. In this context, deliberate restraint is an active damage-control strategy rather than therapeutic inaction.

This concept is most relevant to carotid injuries. Definitive repair generally offers the best prospect of preserving cerebral perfusion in a patient without an established devastating neurological deficit. However, exploration at Role 2 may leave the surgeon facing a lesion that cannot be reconstructed safely because of its location, tissue destruction, contamination, limited conduit options, lack of vascular expertise, or absence of cerebral monitoring. Temporary shunting or ligation may then become the only available solutions. Although either procedure may be lifesaving, each can carry substantial neurological consequences.[10 11 15–23] If the injury had remained controlled until transfer, definitive open or endovascular reconstruction might have remained possible.

PRO also depends on how temporary vascular control is achieved. Conventional temporary intravascular shunts are commonly secured within the proximal and distal vessel ends using external suture ties or clamps. Although necessary to prevent displacement, these fixation points may produce additional intimal or vessel-wall injury and can require excision of otherwise viable arterial segments during subsequent definitive reconstruction. This concern is well described in the temporary-shunt literature, although the available evidence is derived predominantly from extremity vascular trauma rather than carotid injury.[36 37] Thus, temporary shunting should not be assumed to preserve reconstructable arterial length without cost. Conversely, when interruption of the common carotid artery is unavoidable at Role 2 and immediate reconstruction is not feasible, our practice is to preserve as much arterial length as possible by closing the proximal and distal arterial ends with a fine polypropylene running suture rather than applying tight circumferential ligatures, whenever technically feasible. We consider this a technical strategy for preserving subsequent reconstructive options; it is based on operative experience and requires further clinical evaluation.

The same principle applies to other critical structures of the neck. Extensive exploration of a suspected vertebral artery injury may precipitate major hemorrhage from a lesion that could otherwise remain controlled by tamponade until endovascular treatment becomes available.[8 14 35]

With respect to laryngeal and tracheal injuries, airway security remains the priority. In many cases, endotracheal intubation is sufficient to ensure ventilation and allow safe evacuation. However, certain scenarios—such as suspected complete tracheal or laryngeal transection, rapidly progressive subcutaneous emphysema with impending airway compromise, inability to ventilate adequately, or uncontrolled intraluminal bleeding—may necessitate urgent airway intervention at the Role 2 level, including surgical airway access.[1–4 29 30 33]

A similar principle applies to esophageal injuries. In hemodynamically stable patients without extensive contamination or sepsis, initial management at Role 2 may consist of stabilization, broad-spectrum antibiotic therapy, selective drainage when indicated, and expedited evacuation. Conversely, extensive contamination, progressive physiological deterioration, or inability to ensure safe and timely transfer may require operative intervention before evacuation.[1 3 4 31 32 34]

In our experience, the Role 2 objective in these injuries has generally been to secure the airway and control immediately life-threatening contamination or hemorrhage rather than to undertake complex definitive laryngotracheal or esophageal reconstruction. When these objectives can be achieved and the casualty remains physiologically stable, definitive assessment and reconstruction are preferentially deferred to a higher echelon of care.

As with carotid injuries, the decision to proceed with definitive exploration should be guided not only by the anatomical injury itself but also by the likelihood that intervention at the forward surgical echelon will improve the patient's ultimate outcome compared with temporary stabilization and evacuation.

The decision to preserve reconstructive opportunity depends on four conditions. First, the immediate threat must be genuinely controlled rather than merely underestimated. Second, the airway must be secured or reliably maintainable throughout evacuation. Third, the patient must have sufficient physiological reserve to tolerate transfer. Fourth, a credible evacuation pathway to a facility with greater diagnostic or reconstructive capability must exist. Importantly, evacuation feasibility should be assessed not only in terms of transport time, but also according to the anticipated transport conditions, the capabilities of the evacuation team, and the possibility of clinical deterioration or recurrent hemorrhage en route. When temporary hemorrhage control is potentially vulnerable to displacement or failure, evacuation should preferentially be performed by a team capable of recognizing recurrent bleeding and undertaking appropriate interventions during transport. In selected high-risk casualties, this may require the presence of a surgeon trained in damage-control surgery and, where operationally applicable, in performing emergency procedures during transport. If adequate en-route rescue capability cannot be ensured, the threshold for surgical intervention at Role 2 should be lower.[9 10 12 13]

This approach also requires continuous reassessment. Balloon tamponade, packing, or external compression should not be regarded as definitive treatment of a major vascular injury. Recurrent external bleeding, loss of tamponade, hemodynamic deterioration, signs of inadequate cerebral perfusion, or inability to maintain a secure airway should prompt immediate reconsideration of operative intervention. An anticipated evacuation delay may also change the balance in favor of surgery even when temporary control was initially successful. The framework is therefore dynamic: the preferred strategy may evolve as the casualty's physiology, local capability, and evacuation timeline change.[9 10 12 13 24–28]

Importantly, PRO is not synonymous with preservation of the injured vessel at any cost. In an exsanguinating casualty, rapid ligation of a major vessel may be the only realistic lifesaving procedure. The principle applies primarily to the selected patient

Trauma Surgery & Acute Care Open: first published as 10.1136/tsaco-2026-002550 on 20 October 2026. Downloaded from https://tsaco.bmj.com on 16 November 2026 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

in whom temporary control and airway protection have created a window for decision-making. Within that window, the Role 2 surgeon should ask not only, "Can I explore this injury?" but also, "Will exploration here improve the final outcome, and can I complete what the exploration is likely to require?".[9–11 14–16 20–23]

Integrating this objective into combat decision-making reframes successful Role 2 care. Success is not necessarily defined by completion of definitive repair at the forward facility. It may instead consist of controlling hemorrhage, securing the airway, avoiding preventable neurological or functional injury, and delivering the casualty to the appropriate reconstructive team with the greatest number of therapeutic options still intact.

Common carotid artery injuries: why temporary shunting may not always be the optimal damage-control strategy

Temporary intraluminal shunting has become an established component of damage-control vascular surgery for extremity trauma, where it effectively restores distal perfusion while definitive reconstruction is deferred. Extrapolating this strategy to carotid artery injuries, however, may overlook important anatomical and physiological differences unique to the cerebral circulation.[9–11 14–18]

Unlike the extremities, cerebral perfusion following common carotid artery injury may depend not only on antegrade arterial inflow but also on collateral circulation through the carotid bifurcation. In patients with complete interruption of common carotid flow, retrograde perfusion from the external carotid artery into the distal internal carotid artery may contribute to maintenance of cerebral blood flow through collateral pathways. Although the magnitude and clinical significance of this mechanism remain insufficiently studied, its existence is well recognized in cerebrovascular physiology (figure 2A).[15 21–23 38–41]

Consequently, placement of a temporary shunt across the carotid bifurcation may theoretically obstruct this collateral pathway (figure 2B). While antegrade flow through a patent shunt may partially compensate for this loss, cerebral perfusion may become critically dependent on continued shunt patency. In extremity vascular trauma, temporary shunt patency can usually be monitored by serial assessment of distal pulses, Doppler ultrasonography, or other bedside methods. In contrast, reliable monitoring of carotid shunt function in austere combat environments is considerably more challenging. Continuous neurological assessment is frequently impossible in critically injured or sedated patients, and routine vascular surveillance is often

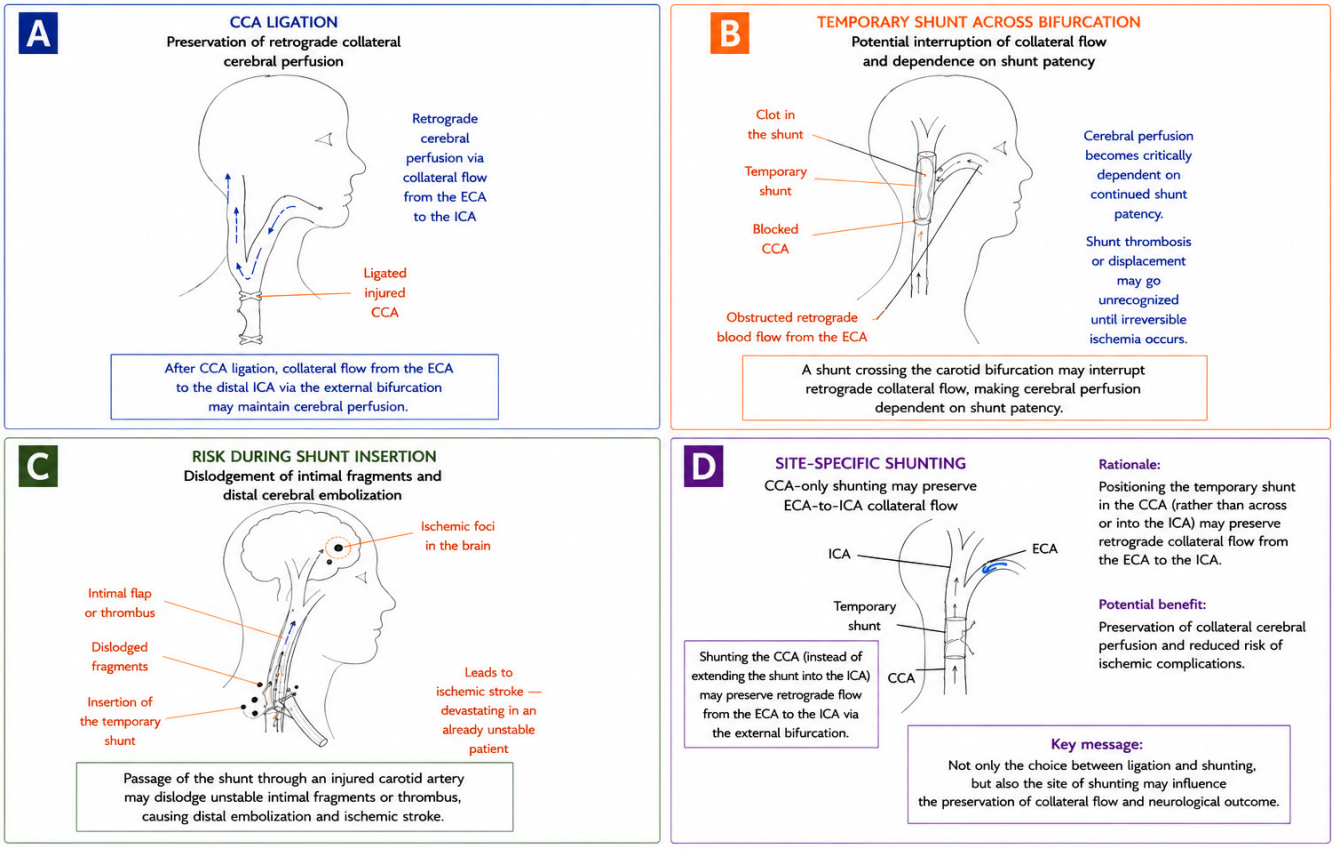


Figure 2 Proposed physiological mechanisms and site-specific considerations for common carotid artery (CCA) ligation and temporary shunting in selected combat casualties. (A) Common carotid artery ligation may preserve retrograde collateral perfusion from the external carotid artery (ECA) toward the distal internal carotid circulation. (B) A temporary shunt advanced across the carotid bifurcation into the internal carotid artery (ICA) may interrupt this collateral pathway and increase dependence on continued shunt patency. (C) Passage of a shunt through an injured carotid segment may dislodge unstable intimal or thrombotic material, potentially causing distal cerebral embolization and ischemic stroke. (D) Conversely, a shunt confined to the common carotid artery may preserve antegrade flow while maintaining external-to-internal carotid collateral perfusion. These proposed mechanisms have not been systematically investigated and should be regarded as physiological hypotheses requiring experimental and clinical validation.[17 21–23 38–41]

Trauma Surgery & Acute Care Open: first published as 10.1136/tsaco-2026-002550 on 20 October 2026. Downloaded from https://tsaco.bmj.com on 16 November 2026 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

unavailable. Consequently, shunt thrombosis or displacement may remain undetected until irreversible cerebral ischemia has occurred.[10 17–19]

The position of the temporary shunt may also influence cerebral perfusion. A shunt confined to the common carotid artery may preserve both antegrade flow through the shunt and retrograde collateral perfusion from the external carotid artery toward the distal internal carotid circulation (figure 2D). In contrast, advancement of the shunt across the carotid bifurcation into the internal carotid artery may interrupt this collateral pathway, potentially rendering cerebral perfusion more dependent on continued shunt patency (figure 2B). Importantly, the precise distal position of temporary carotid shunts is not consistently reported in published military series. Differences in shunt configuration and position may therefore represent an unrecognized source of heterogeneity between reports describing favorable neurological outcomes after carotid shunting and clinical experiences in which shunting has been associated with neurological complications. This proposed mechanism has not been systematically investigated and should be regarded as a hypothesis requiring experimental and clinical validation.[10 11 16 17 20 38–41]

Additional concerns relate to the mechanics of shunt insertion. Combat-related carotid injuries are frequently associated with extensive intimal disruption and intraluminal thrombus formation. Passage of a shunt through the injured arterial segment may dislodge unstable intimal flaps or thrombotic material, potentially resulting in distal cerebral embolization and ischemic stroke (figure 2C). Although direct clinical evidence remains limited, this mechanism represents a biologically plausible source of neurological injury that deserves consideration when selecting the optimal damage-control strategy.[10 11 15–19]

For these reasons, we hypothesize that temporary shunting of the common carotid artery should not be regarded as the default damage-control option in all combat casualties. In selected patients with uncontrollable hemorrhage in whom definitive vascular reconstruction cannot be performed safely at Role 2, common carotid artery ligation may represent the safer strategy, preserving collateral cerebral perfusion while avoiding the potential complications associated with temporary shunting. The proposed physiological mechanisms supporting this concept are summarized in figure 2. This hypothesis warrants prospective investigation.[10 17–23]

CONCLUSIONS

Civilian algorithms for penetrating neck trauma cannot be directly extrapolated to Role 2 combat casualty care because they assume the availability of definitive vascular reconstruction, endovascular intervention, advanced imaging, specialist support, and postoperative surveillance.

At the forward surgical echelon, the decision to explore the neck should be guided not only by the anatomical injury but also by the likelihood that exploration will improve the patient's ultimate neurological and functional outcome within the capabilities of the treating facility.

When hemorrhage is effectively controlled, the airway is secured, physiological status is acceptable, and timely evacuation is feasible, temporary hemorrhage control and rapid transfer may preserve the opportunity for definitive vascular or aerodigestive reconstruction under more favorable conditions than immediate exploration at Role 2. However, successful temporary control should not be equated with safe evacuation: anticipated transport duration and conditions, the reliability of temporary control, and the evacuation team's capacity to manage recurrent hemorrhage or airway deterioration must also inform the decision. If adequate en-route rescue capability cannot be ensured, the threshold for surgical intervention at Role 2 should be lower.

Temporary shunting of the common carotid artery should not automatically be regarded as the default damage-control strategy for all combat casualties. We propose that cerebral perfusion may be influenced by collateral physiology, shunt configuration and position relative to the carotid bifurcation, monitoring limitations, and the potential for thromboembolic complications. A shunt confined to the common carotid artery may theoretically preserve external-to-internal carotid collateral flow, whereas extension across the bifurcation into the internal carotid artery may increase dependence on continued shunt patency. These concepts represent hypotheses requiring prospective validation.

The proposed combat-specific decision framework is intended to complement rather than replace existing civilian algorithms by incorporating the realities of forward military surgery into decision-making for penetrating neck trauma. Its central objective is not avoidance of surgery, but selection of the intervention—and the echelon at which it is performed—that best preserves life, neurological function, and reconstructive opportunity.

Contributors DM conceived the study, developed the conceptual framework, performed the literature review, prepared the figures, drafted the manuscript, and coordinated manuscript revisions. IR, IM, and SM critically reviewed the manuscript, contributed to the interpretation of the concepts and clinical content, and approved the final version for publication. DM is the guarantor of this work and accepts full responsibility for the integrity and accuracy of the manuscript. Generative AI (OpenAI ChatGPT) was used solely to assist with language editing, improving clarity, grammar, and manuscript organization. All scientific concepts, hypotheses, interpretations, figures, and conclusions were developed, critically reviewed, and approved by the authors, who take full responsibility for the content of the manuscript.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial, or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval Not applicable.

Provenance and peer review Not commissioned; externally peer-reviewed.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: https://creativecommons.org/licenses/by-nc/4.0/.

ORCID iD

Dmytro Mialkovskyi https://orcid.org/0000-0001-5565-0850

REFERENCES

1 Tisherman SA, Bokhari F, Collier B, Cumming J, Ebert J, Holevar M, Kurek S, Leon S, Rhee P. Clinical practice guideline: penetrating zone II neck trauma. *J Trauma* 2008;64:1392–405.
2 Sperry JL, Moore EE, Coimbra R, Croce M, Davis JW, Karmy-Jones R, McIntyre RC Jr, Moore FA, Malhotra A, Shatz DV, *et al*. Western Trauma Association critical decisions in trauma: penetrating neck trauma. *J Trauma Acute Care Surg* 2013;75:936–40.
3 Nowicki JL, Stew B, Ooi E. Penetrating neck injuries: a guide to evaluation and management. *Ann R Coll Surg Engl* 2018;100:6–11.
4 Loss L, Henry R, White A, Matsushima K, Barrett C, Lammers D, Schreiber M, Inaba K. Penetrating neck trauma: a comprehensive review. *Trauma Surg Acute Care Open* 2025;10:e001619.
5 Shiroff AM, Gale SC, Martin ND, Marchalik D, Petrov D, Ahmed HM, Rotondo MF, Gracias VH. Penetrating neck trauma: a review of management strategies and discussion of the "No Zone" approach. *Am Surg* 2013;79:23–9.
6 Ibraheem K, Khan M, Rhee P, Azim A, O'Keeffe T, Tang A, Kulvatunyou N, Joseph B. "No zone" approach in penetrating neck trauma reduces unnecessary computed tomography angiography and negative explorations. *J Surg Res* 2018;221:113–20.
7 Inaba K, Branco BC, Menaker J, Scalea TM, Crane S, DuBose JJ, Tung L, Reddy S, Demetriades D. Evaluation of multidetector computed tomography for

Trauma Surgery & Acute Care Open: first published as 10.1136/tsaco-2026-002550 on 20 October 2026. Downloaded from https://tsaco.bmj.com on 16 November 2026 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

penetrating neck injury: a prospective multicenter study. *J Trauma Acute Care Surg* 2012;72:576–83;
8 Wahlgren CM, Aylwin C, Davenport RA, Davidovic LB, DuBose JJ, Gaarder C, Heim C, Jongkind V, Jørgensen J, Kakkos SK, *et al*. Editor's Choice -- European Society for Vascular Surgery (ESVS) 2025 Clinical Practice Guidelines on the Management of Vascular Trauma. *European Journal of Vascular and Endovascular Surgery* 2025;69:179–237.
9 System JT. Vascular Injury. Joint Trauma System Clinical Practice Guideline. Publication date 9 April 2025; version 1.2; 2025.
10 Rusanov I, Mialkovskyi D, Mikheiev I, Kuziv R, Gumeniuk K, Machuskyi S, Valadka A, Armonda RA. Damage Control Surgery for Wartime Carotid Artery Injuries: Interaction Between Role 2 and Role 3 Facilities in Ukraine and a Clinical Case Series Analysis. *EJVES Vasc Forum* 2026;65:107–13.
11 Fox CJ, Gillespie DL, O'Donnell SD, Rasmussen TE, Goff JM Jr, Johnson CA, *et al*. Contemporary management of wartime carotid artery injury. *J Vasc Surg* 2006;44:1184–90.
12 Quinn J, Panasenko SI, Leshchenko Y, Gumeniuk K, Onderková A, Stewart D, Gimpelson AJ, Buriachyk M, Martinez M, Parnell TA, *et al*. Prehospital Lessons From the War in Ukraine: Damage Control Resuscitation and Surgery Experiences From Point of Injury to Role 2. *Mil Med* 2024;189:17–29.
13 Maddry JK, Araña AA, Mora AG, Schauer SG, Reeves LK, Cutright JE, Paciocco JA, Perez CA, Davis WT, Ng PC. Management of Combat Casualties during Aeromedical Evacuation from a Role 2 to a Role 3 Medical Facility. *Mil Med* 2024;189:e1003–8.
14 Feliciano DV. Trauma. In: Moore EE, Feliciano DV, Mattox KL, eds. *Management of peripheral and cervical vascular injuries*. 9th edn. McGraw-Hill, New York. 2021.
15 Lee TS, Ducic Y, Gordin E, Stroman D. Management of carotid artery trauma. *Craniomaxillofac Trauma Reconstr* 2014;7:175–89.
16 Reva VA, Pronchenko AA, Samokhvalov IM. Operative management of penetrating carotid artery injuries. *Eur J Vasc Endovasc Surg* 2011;42:16–20.
17 Asensio JA, Kessler JJ II, Kotaru TR, Kalamchi LD, Miljkovic SS, Dabestani PJ. Penetrating Internal and Common Carotid Artery Injuries Shunts versus no shunts during repair effect on neurological outcomes. *Injury* 2021;52:266–73.
18 Byerly S, Stuber J, Patel D, McElfresh J, Magee GA. The Acute Management of Penetrating Carotid Artery Injuries: A Systematic Review. *Ann Vasc Surg* 2025;113:120–37.
19 DiBartolomeo AD, Williams B, Weaver FA, Matsushima K, Martin M, Schellenberg M, Inaba K, Magee GA. Risk factors for stroke in penetrating cerebrovascular injuries. *J Vasc Surg* 2024;80:1064–70.
20 White PW, Walker PF, Bozzay JD, Patel JA, Rasmussen TE, White JM. Management and outcomes of wartime cervical carotid artery injury. *J Trauma Acute Care Surg* 2020;89:S225–30.
21 Przeslawski C, Knaggs M, Habib PM, Ghamraoui A, Wahl C, Gerken J. A Penetrating Neck Injury Resulting in the Complete Transection of the Ipsilateral Common Carotid Artery, Delayed Contralateral Pneumothorax, and Occult Esophageal Injury: A Case Report With a Multidisciplinary Approach to Management. *Cureus* 2024;16:e56988.
22 Ramadan F, Rutledge R, Oller D, Howell P, Baker C, Keagy B. Carotid artery trauma: a review of contemporary trauma center experiences. *J Vasc Surg* 1995;21:46–55;
23 Moore OS, Karlan M, Sigler L. Factors influencing the safety of carotid ligation. *Am J Surg* 1969;118:666–8.
24 Kong V, Ko J, Cheung C, Lee B, Leow P, Thirayan V, Bruce J, Laing G, Khashram M, Clarke D. Foley Catheter Balloon Tamponade for Actively Bleeding Wounds Following Penetrating Neck Injury is an Effective Technique for Controlling Non-Compressible Junctional External Haemorrhage. *World j Surg* 2022;46:1067–75.
25 Weppner J. Improved mortality from penetrating neck and maxillofacial trauma using Foley catheter balloon tamponade in combat. *J Trauma Acute Care Surg* 2013;75:220–4.
26 Navsaria P, Thoma M, Nicol A. Foley catheter balloon tamponade for life-threatening hemorrhage in penetrating neck trauma. *World J Surg* 2006;30:1265–8.
27 Gilroy D, Lakhoo M, Charalambides D, Demetriades D. Control of life-threatening haemorrhage from the neck: a new indication for balloon tamponade. *Injury* 1992;23:557–9.
28 Tan L, Lim C, Li CX, Kong V, Lee D, Ahn J, Wineberg D, Crawford R, Laher N, Oosthuizen G, *et al*. Foley catheter balloon tamponade for actively bleeding wounds following penetrating neck injury: a systematic review and meta-analysis. *Ann R Coll Surg Engl* 2026;108:249–58.
29 Bhattacharya P, Mandal MC, Das S, Mukhopadhyay S, Basu SR. Airway management of two patients with penetrating neck trauma. *Indian J Anaesth* 2009;53:348–51.
30 Oliveira J, Maia N, Gonçalves J, Almeida V. Airway Management for Penetrating Neck Trauma: A Case Report. *Cureus* 2023;15:e33441.
31 Sudarshan M, Cassivi SD. Management of traumatic esophageal injuries. *J Thorac Dis* 2019;11:S172–6.
32 Chirica M, Kelly MD, Siboni S, Aiolfi A, Riva CG, Asti E, Ferrari D, Leppäniemi A, Ten Broek RPG, Brichon PY, *et al*. Esophageal emergencies: WSES guidelines. *World J Emerg Surg* 2019;14:26.
33 Moonsamy P, Sachdeva UM, Morse CR. Management of laryngotracheal trauma. *Ann Cardiothorac Surg* 2018;7:210–6.
34 Schraufnagel DP, Mubashir M, Raymond DP. Non-iatrogenic esophageal trauma: a narrative review. *Mediastinum* 2022;6:23.
35 du Toit DF, Coolen D, Lambrechts A, de V Odendaal J, Warren BL. The endovascular management of penetrating carotid artery injuries: long-term follow-up. *Eur J Vasc Endovasc Surg* 2009;38:267–72.
36 Lu H, Wang X, Gou W, Zhang J, Lu S. Locked Temporary Vascular Shunt for Wartime Vascular Injuries. *EJVES Short Rep* 2016;33:9–12.
37 Izawa Y, Murakami H, Sato K, Minegishi M, Tsuchida Y. Temporary Intravascular Shunting Using a Pruitt-F3 Carotid Shunt for Traumatic Popliteal Artery Injury. *Plast Reconstr Surg Glob Open* 2024;12:e5980.
38 Zarins CK, DelBeccaro EJ, Johns L, Turcotte JK, Dohrmann GJ. Increased cerebral blood flow after external carotid artery revascularization. *Surgery* 1981;89:730–4.
39 Nakamura A, Wakugawa Y, Yasaka M, Ogata T, Yasumori K, Kitazono T, Okada Y. Antegrade internal carotid artery collateral flow and cerebral blood flow in patients with common carotid artery occlusion. *J Ultrasound Med* 2012;31:1561–6.
40 Wang J, Zheng C, Hou B, Huang A, Zhang X, Du B. Four collateral circulation pathways were observed after common carotid artery occlusion. *BMC Neurol* 2019;19:201.
41 Kaszczewski P, Elwertowski M, Leszczyński J, Ostrowski T, Kaszczewska J, Gałązka Z. Intracranial Flow Volume Estimation in Patients with Internal Carotid Artery Occlusion. *Diagnostics* 2022;12:766.

Trauma Surgery & Acute Care Open: first published as 10.1136/tsaco-2026-002550 on 20 October 2026. Downloaded from https://tsaco.bmj.com on 16 November 2026 by guest. Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.