PEER REVIEW HISTORY

BMJ Open publishes all reviews undertaken for accepted manuscripts. Reviewers are asked to complete a checklist review form (see an example) and are provided with free text boxes to elaborate on their assessment. These free text comments are reproduced below. Some articles will have been accepted based in part or entirely on reviews undertaken for other BMJ Group journals. These will be reproduced where possible.

ARTICLE DETAILS

TITLE (PROVISIONAL)	Identifying future 'unexpected' survivors: a retrospective cohort study of fatal injury patterns in victims of improvised explosive devices
AUTHORS	Singleton, James; Gibb, Iain; Hunt, Nicholas; Bull, Anthony; Clasper, Jonathan

VERSION 1 - REVIEW

REVIEWER	Lt Col Nigel Tai MS FRCS RAMC Consultant Surgeon Senior Lecturer in Trauma and Military Surgery Royal Centre for Defence Medicine Director of Trauma Barts Health NHS Trust COI: The authors of this paper are military colleagues of mine and I have collaborated with them on clinical and academic matters in the recent past.
REVIEW RETURNED	09-May-2013

THE STUDY	civilian transferability needs to be de-emphasised; more granular information on specifics of injury complexes needs to be described beyond mere AIS coding (particularly with regard to vascular and solid organ injury mapping), and an important reference missing.
GENERAL COMMENTS	Future Unexpected Survivors – fatal injuries from IED blast trauma 2007-2010. Retrospective Cohort Study: Peer Review by Nigel Tai: Summary: The authors have undertaken a retrospective survey of the injury burden in a cohort of fatally injured UK servicemen and women exposed to blast. They have analysed fatal injury patterns according to whether the patients were on foot or in a vehicle Of 121 cases, with 354 potentially fatal injuries amongst them, the majority (79) were on foot when struck by the IED. Fatal brain injury was observed more often in the mounted (vehicle-borne) group than in the dismounted (on foot) group; Extremity haemorrhage was seen more often in the dismounted group and not at all in the mounted group. The authors concluded that head trauma was an important cause of death in both groups and should be prevented through better protective measures. Exsanguination is an important cause of death and could have been amenable to pre-hospital control in a majority of dismounted patients. Importance:

	Exposure to the consequences of blast – both the from the blast wave, fragment injury and displacement trauma – is the predominant way in which soldiers are injured in modern war, with projectile injury (from bullet) a consistently less common injury mechanism. The recent wars in Afghanistan and Iraq have allowed much better characterisation of injury. This paper addresses a very important topic pertinent to the care of military populations exposed to Blast weaponry. Comments: Title The title “future unexpected survivors” seems questionable: Whilst the knowledge may be applicable to future populations, the dataset is firmly rooted in the recent past. Secondly this study is not addressing what constitutes an unexpected survivor (itself a contentious definition). Rather, it is exploiting injury pattern analysis to determine where future blast mitigation and therapeutic interventions might lead to improved survivability in at-risk populations. A more apposite title would be “Comprehensive mapping of fatal injury patterns observed in victims of improvised explosive devices” – that is, after all, what the authors accomplished. Article Focus Whilst there is some extrapolation possible, the main pertinence of this study is to military populations rather than civilian cohorts, who differ from the military population with regard to age range, pre-morbid conditions, and access to personal protective equipment such as ceramic-plate body armour and helmets. Introduction: No comments Methods: “All P-M CT scans were reported by a single military consultant (IG) the UK’s most experienced radiologist in this area”. The experience and professional expertise of the radiologist concerned is not open to question, but questions of “most experienced” are open to subjective interpretation. Either amend the statement or re-package the information viz “All P-M CT scans were reported by a single military consultant radiologist (IG) who also serves as the senior radiologist (Defence Consultant Advisor) within UK Defence Medical Services . The authors have developed their own methodology for assessing mechanism of death and undertaken an number of classification methods to place patients in to a number of “bins” pertaining to haemorrhage or neurological causes of death, ascribing an AIS of 4 or more as a marker of a particular injury as potentially lethal. It would be helpful to know whether a) this construct has any precedence in the literature, and if so the sensitivity of this cut-off for lethality b) whether the classification methodology was undertaken by more than one individual b) whether there was any attempt to test the methodology for interpretive bias between or within individual reviewers.

	The retrospective nature of the data abstraction – from CT reports and PM reports – seems to have left no room for equivocal data interpretation. Were the data reports sufficiently detailed to leave no room for categorisation uncertainty in every single case that was examined? It would greatly benefit the paper if the organs and vessels contributing to haemorrhagic deaths could be identified, stratified by cavitary or junctional location, so that the readership could gain a greater understanding of the underlying structural injuries. This would also help the authors stated goal of tailoring future intervention to characterisation of injury. This is a crucial improvement - inclusion of such detail would make this paper particularly strong - the data must be present in the original datsets collected - and the absence of this is the single reason why I have graded the paper as requiring "major revision". If this detail is available but sensitivities surrounding restricted data prevent such granularity then this rationale must be more properly and explicitly acknowledged. In the case of brain injury, the authors classify intracranial bleeds as falling in to the “intracavity” group yet this seems to overlap with the CNS injury bin – were these injuries double counted; and if not how was a distinction made ? Results: 81 minutes was declared as time from injury to Death: how was time of injury ascertained; how was time of death ascertained ? Discussion: The surprising and interesting data concerns the over-burdening of injury amongst the supposedly better protected mounted cohort as opposed to the “vulnerable” foot troops. Was this finding true throughout the time period of the study, or were earlier cohorts disproportionately affected ? Were these patients restrained, or is there any evidence of change in restraint that might account for these data ? Similarly, the “comparison with other studies” does not include reference to Eastridge’s study published in 2012 (Death on the battlefield 2001-2011: implications for the future of combat casualty care: J Trauma Acute Care Surg. 2012;73: S431-S437) which extends Eastridge’s DOW paper that is discussed. 4596 battlefield deaths were reviewed for potential survivability and the discussion should be considered incomplete without a consideration or reference to this significant paper. The authors state that civilian medical organisations appear reluctant to add pre-hospital tourniquest to their armamentarium. What is the evidence for this assertion, and are the authors directing these comments at any particular nation or component of the pre-hospital response ?

REVIEWER	Eric Elster MD FACS CAPT MC USN Professor and Chairman Norman M. Rich Department of Surgery Uniformed Services University

REVIEW RETURNED	14-May-2013

GENERAL COMMENTS	Dr. Singleton et al. present a cohort study of UK military personnel killed by IED blasts in Afghanistan. The authors studied mounted and dismounted IED blast casualties in separate cohorts and compared fatal injury patterns between groups. The data presented in this manuscript is timely and will help guide further investigations to benefit combat casualties. Major and minor issues described below. **Abstract/Methods/Results/Discussion: Major Issue** In the abstract, the term "potentially fatal injuries" is used to describe the identified injuries for this study. Then in the methods the term changes from "potentially lethal injuries" and "significant lethal potential" to "fatal injuries" between the first and second paragraph on page 7. The remainder of the manuscript refers to these wounds and "fatal injuries." This transition between terms is not clear based on the current wording in the methods section. Given that the majority of casualties within each group had multiple regions with AIS ≥ 4, and that it is difficult to determine which injury or injuries were specifically responsible for the cause of death, it seems that the "potentially fatal injury" would be better terminology to be used consistently throughout the manuscript. **Methods/Results/Discussion: Major Issue** "Killed in action" and "died of wounds" fatalities are grouped together in each cohort for this analysis, however, given that surgical interventions may have been performed on the "died of wounds" group further clarification is needed on this matter. Methods – Please describe how any interventions in the died of wounds group were accounted for when creating the database, i.e. a casualty with significant extremity injury that then undergoes an amputation prior to death may not have the initial AIS score for that limb described in the autopsy report or PM-CT. There is a comment in the discussion (3rd paragraph of page 10) how the autopsy was performed with knowledge of any resuscitative procedure, however, this needs to described in the methods. Results- Please add to table 1 how many casualties in each group were killed in action vs. died of wounds. **Introduction: Minor Issue** In addition to the advances in combat casualty care and personal protective gear mentioned in the article, vehicle design changes have enhanced survivability during transport. What types of vehicles

	were the combat wounded injured inside? Did the spectrum of injury change over time with the introduction of the MRAP and similar heavily armored vehicles? Does the UK military employ Tactical Combat Casualty Care or another pre deployment combat casualty training? How have these courses influenced the use of tourniquets? What is the current use of tourniquets compared to other coalition forces and are there differences in deaths from extremity injuries? Does your historical data show a decrease in extremity hemorrhage over time consistent with improved and more widely disseminated training? Also, the discussion mentions limited adoption of tourniquets in civilian trauma however recent events in Boston suggest that this may be changing. **Results: Minor Issue** Mounted fatalities suffered injuries to significantly more AIS regions than dismounted fatalities with median values of 6 and 4 regions injured respectively. Would be interesting to note which information was obtain through PM- CT scan versus autopsy. -Insert a comma before respectively. **Results: Major Issue** Figure 2, Figure 3, and Figure 4 all depict specific differences between the two cohorts, however, there is no statistical information included within the graph to denote where statistically significant differences exist. Please highlight (i.e. *) statistically significant differences adjacent to each set of columns. p-values for each of these highlighted columns should also be included either within the graph or in the figure legend. **Methods: Minor** Please describe patients who may have been excluded and how this may impact the analysis.

REVIEWER	Wg Cdr D M Sharma Consultant Urologist St Georges Hospital London No competing interests.
REVIEW RETURNED	27-May-2013

GENERAL COMMENTS	This is a well constructed, valuable and well written piece of

	research. The message is clear and gives direction for research scientists in this area of blast injury. My one point of contention would be that of placing casualties with intracranial haemorrhage within the group of 'intracavity' haemorrhage. Those with intracavity-thorax and abdomen - haemorrhage die of hypovolaemic shock whilst fatalities from intracranial bleeding result from the consequences of raised intracranial pressure. The methods of mitigating these two broad injury categories are different (key message) and maybe intracranial bleeding would sit better within the CNS injury group. However, this is an excellent paper and I agree with the view that it should be published and the message widely disseminated.

REVIEWER	Narayan Yoganandan, PhD Professor of Neurosurgery Chair, Biomedical Engineering Department of Neurosurgery Medical College of Wisconsin Milwaukee, WI 53226
REVIEW RETURNED	06-Jun-2013

GENERAL COMMENTS	The escalation of explosive blast events in recent conflicts has changed the spectrum of injuries to mounted and dismounted service members, and the authors' analyses of fatal injury data from the UK military is a timely effort for advancing mitigation strategies. The focus on head injury results from the mitigation perspective is also appropriate. While differences in the cause of death between mounted and dismounted fatalities are to be expected, data presented in this paper should be of value for potentially adopting different strategies for trauma mitigation. The large sample size and appropriateness of the methods used by the authors to derive their findings deserved consideration for publication. If similar results are also found from populations from other nations, a harmonized strategy may be developed for safety in these military environments. The authors should try to tease information regarding skull fractures, especially vault, as it may reveal the association of brain injuries with contact loading because fractures occur due to dynamic/impact loading to the head. Even if skull fractures might not be the associated outcomes, it would be important to determine the presence of extra-cranial soft tissue swelling on PM-CT scans, and such identifications indicate contact loading to the head. This approach has been used in a similar retrospective analysis from the Crash Injury research and Engineering databases for head injuries in survivors and fatalities from motor vehicle crashes. If vault fractures are common in mounted fatalities, perhaps it is necessary to revisit the vehicle environment and personnel protective equipment for energy absorption characteristics to effectively manage the transmission of the energy input to the personnel from explosion events. Such data may also guide the design and development of a biofidelic Warrior Injury Manikin. As this exercise is currently undertaken by some researchers including the reviewer in the United States, information from the above analyses would be useful for this effort.

VERSION 1 – AUTHOR RESPONSE

Reviewer:Lt Col Nigel Tai MS FRCS RAMC
Consultant Surgeon
Senior Lecturer in Trauma and Military Surgery Royal Centre for Defence Medicine
Director of Trauma Barts Health NHS Trust
COI: The authors of this paper are military colleagues of mine and I have collaborated with them on clinical and academic matters in the recent past.
See below - civilian transferability needs to be de-emphasised; more granular information on specifics of injury complexes needs to be described beyond mere AIS coding (particularly with regard to vascular and solid organ injury
mapping), and an important reference missing.

All three points have been addressed – see comments below.

Summary:
The authors have undertaken a retrospective survey of the injury burden in a cohort of fatally injured UK servicemen and women exposed to blast. They have analysed fatal injury patterns according to whether the patients were on foot or in a vehicle
Of 121 cases, with 354 potentially fatal injuries amongst them, the majority (79) were on foot when uck by the IED. Fatal brain injury was observed more often in the mounted (vehicle-borne) group than in the dismounted (on foot) group; Extremity haemorrhage was seen more often in the dismounted group and not at all in the mounted group.
The authors concluded that head trauma was an important cause of death in both groups and should be prevented through better protective measures. Exsanguination is an important cause of death and could have been amenable to pre-hospital control in a majority of dismounted patients.
Importance:
Exposure to the consequences of blast – both the from the blast wave, fragment injury and displacement trauma – is the predominant way in which soldiers are injured in modern war, with projectile injury (from bullet) a consistently less common injury mechanism. The recent wars in Afghanistan and Iraq have allowed much better characterisation of injury. This paper addresses a very important topic pertinent to the care of military populations exposed to Blast weaponry.
Comments:
Title
The title “future unexpected survivors” seems questionable: Whilst the knowledge may be applicable to future populations, the dataset is firmly rooted in the recent past. Secondly this study is not addressing what constitutes an unexpected survivor (itself a contentious definition). Rather, it is exploiting injury pattern analysis to determine where future blast mitigation and therapeutic interventions might lead to improved survivability in at-risk populations. A more apposite title would be “Comprehensive mapping of fatal injury patterns observed in victims of improvised explosive devices” – that is, after all, what the authors accomplished.

We thank Lt Col Tai for his review.

We agree with Lt Col Tai that the minutiae of defining an ‘unexpected survivor’ can be contentious (e.g. use of mathematical means with various trauma scores or through expert panel analysis) and have therefore refrained from this. However, we would suggest that the concept of an unexpected survivor – a casualty with injuries so severe that their survival is not an anticipated outcome – is a useful tool to communicate both the advances in combat casualty care enabling such outcomes to be achieved, and that it succinctly describes the aim to identify areas to further improve outcome and so generate the next cohort of cases able to survive due to advances made in mitigation and trauma management who would currently not survive. We would therefore suggest that the title be amended to ‘Identifying future ‘unexpected’ survivors: a retrospective cohort study of fatal injury patterns in

victims of improvised explosive devices', rather than the suggested title, although if the editor preferred we would leave out reference to unexpected survivors.

Article Focus
Whilst there is some extrapolation possible, the main pertinence of this study is to military populations rather than civilian cohorts, who differ from the military population with regard to age range, pre-morbid conditions, and access to personal protective equipment such as ceramic-plate body armour and helmets.

We accept the only limited extrapolation to the world of civilian trauma is possible from a study with an exclusively military population. That is why we have been careful to suggest crossover only where relevant, specifically with regard to haemostatic techniques; given the worldwide prevalence of explosive incidents targeting civilians or causing civilian casualties in addition to intended military targets, the applicability of such techniques and their potential to improve outcome warrants focussed research in this area and dissemination of these techniques beyond military medical providers. Further caveats have been added to the manuscript to clarify this.

Introduction:
No comments
Methods:
"All P-M CT scans were reported by a single military consultant (IG) the UK's most experienced radiologist in this area". The experience and professional expertise of the radiologist concerned is not open to question, but questions of "most experienced" are open to subjective interpretation. Either amend the statement or re-package the information viz "All P-M CT scans were reported by a single military consultant radiologist (IG) who also serves as the senior radiologist (Defence Consultant Advisor) within UK Defence Medical Services.

We are of course keen to minimise any subjective content. The statement has therefore be amended to "All PM CT scans were reported by a single military consultant (IG) the UK's most experienced radiologist in reporting post mortem blast trauma imaging."

The authors have developed their own methodology for assessing mechanism of death and undertaken an number of classification methods to place patients in to a number of "bins" pertaining to haemorrhage or neurological causes of death, ascribing an AIS of 4 or more as a marker of a particular injury as potentially lethal. It would be helpful to know whether a) this construct has any precedence in the literature, and if so the sensitivity of this cut-off for lethality b) whether the classification methodology was undertaken by more than one individual c) whether there was any attempt to test the methodology for interpretive bias between or within individual reviewers.

We have utilised previously published work describing lethality according to the AIS 2005 Military update. In answer to a), as per reference 13 in the manuscript (Champion HR, Holcomb JB, Lawnick MM, et al. Improved Characterization of Combat Injury. J. Trauma 2010;68(5):1139-5), the lethal potential of AIS 2005 Military injuries has been published. The published fatality rates by Max AIS (MAIS) in Champion's paper were as follows

MAIS % killed (actual numbers)
1 0 (0)
2 0 (0)
3 3 (6/186)
4 32 (48/146)
5 58 (144/249)
6 85 (297/353)

However in our study all casualties were fatalities and we therefore did not discuss these survival rates in detail. Given the increments in fatality rates between AIS 3-4 and 4-5, ≥4 was felt to be the most appropriate cut-off. Of note only 8 of our cases had a MAIS of 4, 54 had a MIAS of 5 and 59 had a MAIS of 6, which we believe does make our methodology more robust.
b) AIS scores were taken from JTTR records of all injuries sustained by each case as recorded at autopsy. Trauma research nurses from ADMEM (trained in AIS injury recording) attending the autopsy record the injuries as described by the pathologist. The injury description was then classified in terms of mechanism of death as haemorrhagic, severe CNS injury, or other mechanisms. This was performed by the first author (JS), after discussion with the senior author. The few cases where the cause of death was not clear (referred to as disrupted in the manuscript) were excluded as we felt even a multiple assessment approach would still have led to uncertainty.

The retrospective nature of the data abstraction – from CT reports and PM reports – seems to have left no room for equivocal data interpretation. Were the data reports sufficiently detailed to leave no room for categorisation uncertainty in every single case that was examined?

The PM-CT data was obtained through analysis of the CT images by JS and IG, rather than from written reports, so every opportunity to clarify ambiguities was taken for this dataset and the methodology could actually be considered prospective to a degree here. AIS codes were taken from autopsy reports via JTTR. Cases where the mechanism was not clear did occur and were allocated to the ‘other mechanism’ group.

It would greatly benefit the paper if the organs and vessels contributing to haemorrhagic deaths could be identified, stratified by cavitary or junctional location, so that the readership could gain a greater understanding of the underlying structural injuries. This would also help the authors stated goal of tailoring future intervention to characterisation of injury. This is a crucial improvement - inclusion of such detail would make this paper particularly strong - the data must be present in the original datsets collected - and the absence of this is the single reason why I have graded the paper as requiring "major revision". If this detail is available but sensitivities surrounding restricted data prevent such granularity then this rationale must be more properly and explicitly acknowledged.

We agree that increasing the resolution of the data would enhance the paper. However, as presumed by Lt Col Tai, security/vulnerability issues explicitly prevent such detailed release of injury data, The paper has been amended to acknowledge this.

In the case of brain injury, the authors classify intracranial bleeds as falling in to the “intracavity” group yet this seems to overlap with the CNS injury bin – were these injuries double counted; and if not how was a distinction made ?

This is valuable point to highlight and we thank Lt Col Tai for this. These injuries were not double counted. In a single isolated case, a head injury description fell into an overwhelmingly haemorrhagic mechanism (AIS code 122604.6 Transverse sinus open laceration (bleeding out externally) or segmental loss). The overwhelming majority of CNS bleeds – given that their pathological mechanism is neurological injury via raised ICP – were classified within the CNS trauma ‘bin’. The methods section has been clarified to explain this.

Results:
81 minutes was declared as time from injury to Death: how was time of injury ascertained; how was time of death ascertained?

Time of injury was determined through JTTR which in turn gleans this information through classified

military documentation of combat events compiled by commanders on the ground at the time. Time of death was also determined through JTTR, and is the documented official time of death for each case. Such timings may be affected by availability of a medic to document time of death, but the forward deployment of medical assets will have mitigated against this to a significant degree.

Discussion:
The surprising and interesting data concerns the over-burdening of injury amongst the supposedly better protected mounted cohort as opposed to the “vulnerable” foot troops.
Was this finding true throughout the time period of the study, or were earlier cohorts disproportionately affected ? Were these patients restrained, or is there any evidence of change in restraint that might account for these data ? Similarly, the “comparison with other studies” does not include reference to Eastridge’s study published in 2012 (Death on the battlefield 2001-2011: implications for the future of combat casualty care: J Trauma Acute Care Surg. 2012;73: S431-S437) which extends Eastridge’s DOW paper that is discussed. 4596 battlefield deaths were reviewed for potential survivability and the discussion should be considered incomplete without a consideration or reference to this significant paper.

Restraint data was not universally available and was not deemed reliable, therefore was not subject to analysis. There is likely to be a difference in threat magnitude experienced by mounted and dismounted casualties but this can’t be discussed further in open literature. Eastridge’s follow up paper was not published when this manuscript was written. However, we agree it has relevance and so the discussion has been amended accordingly.

The authors state that civilian medical organisations appear reluctant to add pre-hospital tourniquest to their armamentarium. What is the evidence for this assertion, and are the authors directing these comments at any particular nation or component of the pre-hospital response?

Doyle GS, Taillac PP. Tourniquets: A Review of Current Use with Proposals for Expanded Prehospital Use. Prehosp. Emerg. Care 2008;12(2):241-56

Lee C, Porter KM, Hodgetts TJ. Tourniquet use in the civilian prehospital setting. Emergency Medicine Journal 2007;24(8):584-87

Both papers comment on a reluctance to utilise tourniquets in a civilian setting due to concerns regarding potential complications. Comments within the paper aren’t directed at any specific nation. The 30 reference limit prevented these articles being formally referenced in our manuscript. However, as this has been highlighted in the review process, the references have been amended to include Doyle and Taillic’s review of tourniquet usage.

Reviewer: Eric Elster MD FACS
CAPT MC USN
Professor and Chairman
Norman M. Rich Department of Surgery
Uniformed Services University
Dr. Singleton et al. present a cohort study of UK military personnel killed by IED blasts in Afghanistan. The authors studied mounted and dismounted IED blast casualties in separate cohorts and compared fatal injury patterns between groups. The data presented in this manuscript is timely and will help guide further investigations to benefit combat casualties. Major and minor issues described below.
Abstract/Methods/Results/Discussion: Major Issue
In the abstract, the term “potentially fatal injuries” is used to describe the identified injuries for this study. Then in the methods the term changes from “potentially lethal injuries” and “significant lethal potential” to “fatal injuries” between the first and second paragraph on page 7. The remainder of the

manuscript refers to these wounds and “fatal injuries.” This transition between terms is not clear based on the current wording in the methods section.
Given that the majority of casualties within each group had multiple regions with AIS ≥ 4, and that it is difficult to determine which injury or injuries were specifically responsible for the cause of death, it seems that the “potentially fatal injury” would be better terminology to be used consistently throughout the manuscript.

We thank Capt Elster for this comment and the manuscript has been amended accordingly.

Methods/Results/Discussion: Major Issue
“Killed in action” and “died of wounds” fatalities are grouped together in each cohort for this analysis, however, given that surgical interventions may have been performed on the “died of wounds” group further clarification is needed on this matter.
Methods – Please describe how any interventions in the died of wounds group were accounted for when creating the database, i.e. a casualty with significant extremity injury that then undergoes an amputation prior to death may not have the initial AIS score for that limb described in the autopsy report or PM-CT. There is a comment in the discussion (3rd paragraph of page 10) how the autopsy was performed with knowledge of any resuscitative procedure, however, this needs to be described in the methods.

Surgical interventions are recorded in the UK JTTR. Only six DOW cases had significant surgeries; all had thoracotomies, two had also undergone extremity debridement. All other extremity injuries were unaltered surgically. Given that DOW applies to those cases reaching a medical treatment facility, some cases died en route to Camp Bastion (in the care of the MERT(E) UK rotary wing casevac asset which includes a consultant anaesthetist in addition to paramedics and force protection personnel) and some cases were certified on arrival to the UK/US Military Hospital, Camp Bastion, Helmand province without undergoing surgery. Detail on this small group was not included in the original manuscript but the methods has been amended to describe the fact.
PM-CT scans were performed on all retrieved remains. Casualties undergoing major debridement had the excised/recovered distal limb scanned along with the residual limb. This level of detail was thought to be potentially sensitive and so omitted from the manuscript.

Results- Please add to table 1 how many casualties in each group were killed in action vs. died of wounds.

The table has been added to as per Capt Elster’s request.

Introduction: Minor Issue
In addition to the advances in combat casualty care and personal protective gear mentioned in the article, vehicle design changes have enhanced survivability during transport. What types of vehicles were the combat wounded injured inside? Did the spectrum of injury change over time with the introduction of the MRAP and similar heavily armored vehicles?

These are entirely reasonable questions. However, security/vulnerability issues
prevent detailed vehicle information being released for publication.

Does the UK military employ Tactical Combat Casualty Care or another pre deployment combat casualty training? How have these courses influenced the use of tourniquets? What is the current use of tourniquets compared to other coalition forces and are there differences in deaths from extremity injuries? Does your historical data show a decrease in extremity hemorrhage over time consistent with improved and more widely disseminated training? Also, the discussion mentions limited adoption of tourniquets in civilian trauma however recent events in Boston suggest that this may be changing.

The UK military provides a comprehensive combat casualty training programme from battlefield casualty drills (BCDs) for every soldier, through to battlefield ATLS (BATLS) for team medics, combat medics, nursing personnel (commissioned and non-commissioned) and medical officers and this has been ongoing since 1985. BATLS is regularly reviewed and updated to reflect advances in trauma management, in both the MTF and pre-hospital domains. With respect to the questions regarding tourniquet use and the effect of UK military medical doctrine, these matters are beyond the scope of this paper and we would draw attention to work by others who have addressed these issues in the recent literature:

Tourniquet Use in Combat Trauma: UK Military Experience Lieutenant S Brodie, Timothy J Hodgetts, Jo Ollerton, Judith McLeod, Paul Lambert, Peter Mahoney J R Army Med Corps 2007;153:4

Due to limitations in references (max 30) the following reference of a review of tourniquet use by civilian medical providers was not originally included (Doyle GS, Taillac PP. Tourniquets: A Review of Current Use with Proposals for Expanded Prehospital Use. Prehosp. Emerg. Care 2008;12(2):241-56). This paper was written prior to 15 April 2013. However, Boston provides a sad reminder of the use of explosive weapons against civilians and the need to transfer all relevant lessons learnt in military combat care to global trauma care in general, and referenced reports of civilian tourniquet use have been included in the discussion.

Results: Minor Issue
Mounted fatalities suffered injuries to significantly more AIS regions than dismounted fatalities with median values of 6 and 4 regions injured respectively.
Would be interesting to note which information was obtain through PM- CT scan versus autopsy.
-Insert a comma before respectively.

The number of injuries was as per the autopsy report AIS categorisation. However, the pathologist and radiologist worked as a multi-disciplinary team so the autopsy report can be considered a synergistic output from physical and radiological investigations.

The punctuation has been corrected.

Results: Major Issue
Figure 2, Figure 3, and Figure 4 all depict specific differences between the two cohorts, however, there is no statistical information included within the graph to denote where statistically significant differences exist. Please highlight (i.e. *) statistically significant differences adjacent to each set of columns. p-values for each of these highlighted columns should also be included either within the graph or in the figure legend.

For figures 2 and 3, the statistical information is in the text immediately preceding the graphs, and was not therefore duplicated within the figure. For figures 2 and 3, groups were compared using a Mann Whitney U test, so the p value is a summary statistic showing statistical difference between the groups rather than individual pairs of columns.

Figure 4 has been amended with p-values within the graph.

Methods: Minor
Please describe patients who may have been excluded and how this may impact the analysis.

Figure 1 summarises the process of case inclusion/exclusion and this was not duplicated in the text. Aside from the one case where the autopsy result was not available for legal reasons, the 24 cases

not analysed were so disrupted as to prevent meaningful pathoanatomical study. This point has not been emphasised in the manuscript, again to avoid duplication.

Reviewer: Wg Cdr D M Sharma
Consultant Urologist
St Georges Hospital
London
No competing interests.
This is a well-constructed, valuable and well written piece of research. The message is clear and gives direction for research scientists in this area of blast injury.
My one point of contention would be that of placing casualties with intracranial haemorrhage within the group of 'intracavity' haemorrhage. Those with intracavity-thorax and abdomen -haemorrhage die of hypovolaemic shock whilst fatalities from intracranial bleeding result from the consequences of raised intracranial pressure. The methods of mitigating these two broad injury categories are different (key message) and maybe intracranial bleeding would sit better within the CNS injury group.
However, this is an excellent paper and I agree with the view that it should be published and the message widely disseminated.

We thank Wg Cdr Sharma for his review.
With regard to the mechanistic categorisation of intra-cranial haemorrhage, this is a valid point and constraints of manuscript length led to a failure to adequately explain this in the first instance. There was only one case of an intra-cranial bleed which would have caused death by hypovolaemic shock (an AIS 6 injury, code122604.6 Transverse sinus open laceration (bleeding out externally) or segmental loss). All other cases of intra-cranial bleeds were classified as CNS injury cases and the methods section has been amended to clarify that point.

Reviewer: Narayan Yoganandan, PhD
Professor of Neurosurgery
Chair, Biomedical Engineering
Department of Neurosurgery
Medical College of Wisconsin
Milwaukee, WI 53226
The escalation of explosive blast events in recent conflicts has changed the spectrum of injuries to mounted and dismounted service members, and the authors' analyses of fatal injury data from the UK military is a timely effort for advancing mitigation strategies. The focus on head injury results from the mitigation perspective is also appropriate. While differences in the cause of death between mounted and dismounted fatalities are to be expected, data presented in this paper should be of value for potentially adopting different strategies for trauma mitigation. The large sample size and appropriateness of the methods used by the authors to derive their findings deserved consideration for publication. If similar results are also found from populations from other nations, a harmonized strategy may be developed for safety in these military environments.
The authors should try to tease information regarding skull fractures, especially vault, as it may reveal the association of brain injuries with contact loading because fractures occur due to dynamic/impact loading to the head. Even if skull fractures might not be the associated outcomes, it would be important to determine the presence of extra-cranial soft tissue swelling on PM-CT scans, and such identifications indicate contact loading to the head. This approach has been used in a similar retrospective analysis from the Crash Injury research and Engineering databases for head injuries in survivors and fatalities from motor vehicle crashes. If vault fractures are common in mounted fatalities, perhaps it is necessary to revisit the vehicle environment and personnel protective equipment for energy absorption characteristics to effectively manage the transmission of the energy input to the personnel from explosion events. Such data may also guide the design and development of a biofidelic Warrior Injury Manikin. As this exercise is currently undertaken by some researchers

including the reviewer in the United States, information from the above analyses would be useful for this effort.

We thank Prof Yoganandan for his review.

Detailed subgroup analysis, such as of the head injuries would be useful and merit more profound investigation in their own right. However, we feel entering in to such an analysis is beyond the scope of this manuscript. In addition such information would have to be heavily censored anyway, due to security concerns highlighting potential vulnerability.

VERSION 2 – REVIEW

REVIEWER	Lt Col Nigel Tai MS FRCS RAMC Senior Lecturer Academic Department of Military Surgery and Trauma Royal Centre for Defence Medicine, B'ham, UK Director of Trauma Barts Health NHS Trust
REVIEW RETURNED	21-Jun-2013

- The reviewer completed the checklist but made no further comments.