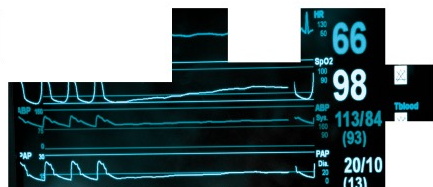
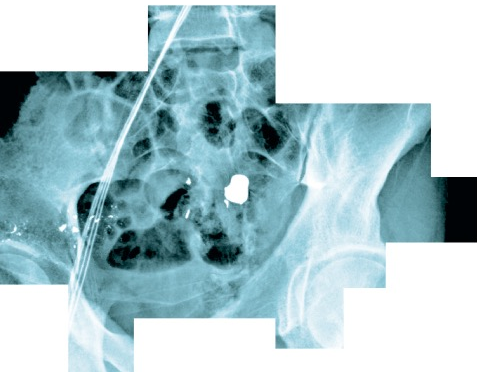




ASSOCIATION QUÉBÉCOISE
DE CHIRURGIE

18 AU 21 MAI 2023
Hilton Lac-Leamy, Gatineau

TRAUMA RECONSTRUCTION DE PAROI



Traumatisme par explosions

Julien Clément
Chirurgien général
CHU de Québec - UL



DIVULGATION DES CONFLITS D'INTÉRÊTS POTENTIELS

TYPE D'AFFILIATION

Aucune

COMPAGNIES

PÉRIODE



Objectifs

- *Discuter des mécanismes de l'explosion;*
- *Identifier les différentes lésions possibles en contexte d'explosion;*
- *Proposer une stratégie diagnostique et thérapeutique de ces lésions de blast;*
- *Se familiariser avec la décontamination en centre hospitalier*

Messages Clé

- Les lésions traumatiques par explosion sont rares dans un contexte civil.
- Ces lésions comportent des caractéristiques des mécanismes pénétrants, contondants et de brûlures
- Plus souvent qu'autrement, nous sommes en réaction face à ces situations

Niveaux de données probantes

Niveau

Type de preuve

- I Preuve obtenue par méta-analyse de multiples essais cliniques, contrôlés et bien conçus. Essais avec répartition aléatoire (randomisés) présentant de faible taux de résultats faussement positifs et faussement négatifs (puissance élevée).
- II Preuve obtenue au moyen d'au moins un essai expérimental bien conçu. Essai avec répartition aléatoire présentant un taux élevé de résultats faussement positifs ou négatifs (faible puissance).
- III Preuve obtenue au moyen d'essais quasi-expérimentaux bien conçus tels, essais sans répartition aléatoire (non-randomisés), avec un seul groupe témoin, avant-après, de cohortes, séries temporelles, ou encore essais cas-témoins appariés.
- IV Preuve obtenue au moyen d'essais observationnels bien conçus tels essais comparatifs et descriptifs corrélatifs ainsi qu'études de cas.
- V Preuve issue de rapport de cas et d'exemples cliniques.

Échelle de recommandations

Grade	Recommandation
A	Preuves de type I ou observations concordantes provenant de multiples essais de types II, III ou IV.
B	Preuves de types II, III ou IV et observations généralement concordantes.
C	Preuves de types II, III ou IV mais observations non concordantes.
D	Peu, sinon aucune preuve empirique systématique.

EXPLOSION + INJURY+ GUIDELINES

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- Books and Documents
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- Randomized Controlled Trial
- Review
- Systematic Review

PUBLICATION DATE

- 1 year
- 5 years
- 10 years
- Custom Range

44 results

Hamstring Strain **Injury** in Athletes: A Summary of Clinical Practice **Guideline**

1 Recommendations: Using the Evidence to Guide Physical Therapist Practice.

[No authors listed]

J Orthop Sports Phys Ther. 2022 Mar;52(3):127-128. doi: 10.2519/jospt.2022.0501.

PMID: 35227082 Review.

Hamstring strain **injuries** (HSIs) are common in sports that involve high-speed running, jumping, kicking, **explosive** lower extremity movements, or lifting objects from the ground. ...

Clinical practice **guideline** for transurethral plasmakinetic resection of prostate for benign prostatic hyperplasia (2021 Edition).

Zeng XT, Jin YH, Liu TZ, Chen FM, Ding DG, Fu M, Gu XQ, Han BM, Huang X, Hou Z, Hu WL, Kang XL, Li GH, Li JX, Li PJ, Liang CZ, Liu XH, Liu ZY, Liu CX, Liu JM, Luo GH, Luo Y, Qin WJ, Qiu JH, Qiu JX, Shang XJ, Shi BK, Sun F, Tian GX, Tian Y, Wang F, Wang F, Wang YH, Wang YJ, Wang ZP, Wang Z, Wei Q, Xiao MH, Xu WH, Yi FX, Zhu CY, Zhuang QY, Zhou LQ, Zou XF, Xing NZ, He DL, Wang XH; Chinese Urological Doctor Association (CUDAs); Urological Association of Chinese Research Hospital Association (CRHA-USA); Uro-Health Promotive Association of China International Exchange and Promotive Association for Medical and Health Care (CPAM-UHPA).

Mil Med Res. 2022 Apr 1;9(1):14. doi: 10.1186/s40779-022-00371-6.

PMID: 35361280 **Free PMC article.**

It has become well established in clinical practice with good efficacy and safety. In 2018, we issued the **guideline** "2018 Standard Edition". However much new direct evidence has now emerged and this may change some of previous recommendations. ...Questions related to compl ...

Drowning Management.

Parenteau M, Stockinger Z, Hughes S, Hickey B, Mucciarone J, Manganello C, Beeghly A.

Mil Med. 2018 Sep 1;183(suppl_2):172-179. doi: 10.1093/milmed/usy136.

PMID: 30189074

Highly skilled swimmers and aquatically adaptable service members such as **U.S.** Navy Divers, Sea, Air and Land (SEAL) Teams, and **Explosive** Ordnance Disposal (EOD) technicians, die every year from drowning. Drowning is the cause of over 500,000 deaths annually across ...

[Blast lung **injuries**].

Clapson P, Pasquier P, Perez JP, Debien B.

Rev Pneumol Clin. 2010 Sep;66(4):245-53. doi: 10.1016/j.pneumo.2010.07.008. Epub 2010 Sep 21.

PMID: 20933166 Review. French.

In armed conflicts and during terrorist attacks, **explosive** devices are a major cause of mortality. The lung



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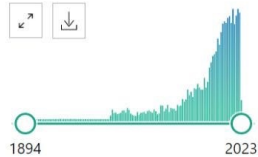
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ARTICLE ATTRIBUTE

- Associated data

ARTICLE TYPE

- Books and Documents
- Clinical Trial
- Meta-Analysis
- Randomized Controlled Trial
- Review
- Systematic Review

PUBLICATION DATE

1 year

The physical basis of explosion and blast injury processes.

1 Proud WG.
 Cite J R Army Med Corps. 2013 Mar;159 Suppl 1:4-9. doi: 10.1136/jramc-2013-000030.
 PMID: 23631318 Review.

Share This article gives a basic overview of **explosive** technology and the underlying physical processes that produce the **injuries** encountered. In particular aspects relevant to primary and secondary **injuries** are discussed....



The Beirut Port explosion: injury trends from a mass survey of emergency admissions.

2 Mansour HA, Bitar E, Fares Y, Makdessi AA, Maalouf A, Ghoul ME, Mansour MA, Chami A, Khalil M, Jalkh A, Cherfan D, Fares J, Khuri FR, Mansour AM; Beirut Port Ammonium Nitrate Explosion Consortium. Lancet. 2021 Jul 3;398(10294):21-22. doi: 10.1016/S0140-6736(21)01246-0. PMID: 34217389 No abstract available.

Share



Explosion fatalities in Sweden, 2000-2018.

3 Junuzovic M.
 Cite Med Sci Law. 2022 Apr;62(2):88-94. doi: 10.1177/00258024211025228. Epub 2021 Jun 22.
 PMID: 34156888 Free PMC article.

Share Most victims died on site. Adult males dominated in the study material, but **explosions** also killed four children. **Explosives** were most commonly involved in occupational blast deaths, suicides and homicides, followed by flammable gases and fluids. ...Prevention effort ...



[Explosion trauma part 1 : Physical principles and pathophysiology].

4 Hauer T, Grobert S, Wenniges H, Huschitt N, Willy C.
 Cite Unfallchirurg. 2022 Feb;125(2):145-159. doi: 10.1007/s00113-021-01073-9. Epub 2021 Oct 5.
 PMID: 34609541 German.

Share After **explosions**, various **injury** mechanisms lead to multiple **injuries** that can affect the entire body. ...Knowledge of the **injury** mechanics and the pathophysiology of blast **injuries** should help the interdisciplinary team to master this challenge ...

1
1
Review > J Emerg Med. 2015 Oct;49(4):573-87. doi: 10.1016/j.jemermed.2015.03.013.

Epub 2015 Jun 10.

Blast Injuries

Zara R Mathews ¹, Alex Koifman ²

Affiliations + expand

PMID: 26072319 DOI: 10.1016/j.jemermed.2015.03.013

Abstract

Background: Blast injuries in the United States and worldwide are not uncommon. Partially due to the increasing frequency of both domestic and international terrorist bombing attacks, it is prudent for all emergency physicians to be knowledgeable about blasts and the spectrum of associated injuries.

Objective: Our aim was to describe blast physiology, types of blast injuries associated with each body system, and manifestations and management of each injury.

Discussion: Blast injuries are generally categorized as primary to quaternary injuries. Primary injuries result from the effect of transmitted blast waves on gas-containing structures, secondary injuries result from the impact of airborne debris, tertiary injury results from transposition of the entire body due to blast wind or structural collapse, and quaternary injuries include almost everything else. Different body systems are affected and managed differently. Despite previous dogma, multiple studies now show that tympanic membrane perforation is a poor predictor of other blast injury.

Conclusions: Blast events can produce a myriad of injuries affecting any and every body system. All emergency physicians should be familiar with the presentation and management of these injuries. This knowledge may also be incorporated into triage and discharge protocols guiding management of mass casualty events.

Keywords: blast; bombing; disaster; mass casualty; terrorism.

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FI



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INNOVATION COLLABORATION



ASSOCIATION QUÉBÉCOISE
DE CHIRURGIE

1
2

Review

> J Trauma. 2007 Jun;62(6 Suppl):S38. doi: 10.1097/TA.0b013e318065414f.

Things that go boom: injuries from explosives

Brian J Eastridge ¹

Affiliations + expand

PMID: 17556962 DOI: 10.1097/TA.0b013e318065414f



Injuries From Explosions: Physics, Biophysics, Pathology, and Required Research Focus

Howard R. Champion, MD, FRCS, FACS, John B. Holcomb, MD, FACS, and Lee Ann Young, MA

Background: Explosions cause more complex and multiple forms of damage than any other wounding agent, are the leading cause of death on the battlefield, and are often used by terrorists. Because explosion-related injuries are infrequently seen in civilian practice, a broader base of knowledge is needed in the medical community to address acute needs of patients with explosion-related injuries and to broaden mitigation-focused research efforts. The objective of this review is to provide insight into the complexities of explosion-related injury to help more precisely target research efforts to the most pressing areas of need in primary prevention, mitigation, and consequence management.

Methods: An understanding of the physics and biological consequences of explosions together with data on the nature or severity of contemporary combat injuries provide an empiric basis for a comprehensive and balanced portfolio of explosion-related research. Cited works were identified using MeSH terms as directed by subtopic. Uncited information was drawn from the authors' surgical experience in Iraq, analysis of current combat trauma databases, and explosion-related research.

Results: Data from Iraq and Afghanistan confirm that survivable injuries from explosions are dominated by penetrating fragment wounds, substantiating longstanding and well-known blast physics

mechanisms. Keeping this factual basis in mind will allow for appropriate vectoring of funds to increase understanding of this military and public health problem; address specific research and training needs; and improve mitigation strategies, tactics, and techniques for vehicles and personal protective equipment.

Conclusions: A comprehensive approach to injury from explosions should include not only primary prevention, but also injury mitigation and consequence management. Recalibration of medical research focus will improve management of injuries from explosions, with profound implications in both civilian and military healthcare systems.

J Trauma. 2009;66:1468–1477.

Plusieurs centaines
d'incidents criminels
avec explosions par an
aux USA.

- “Explosions produce the ultimate polytrauma causing an astonishing variety of injuries by multiple mechanisms in multiple body regions that range from concussion and minor lacerations to traumatic amputations, from crush syndrome to ocular injuries, to death from blunt or penetrating injury or both. There is no other wounding agent so effective at inflicting such a diverse constellation of injuries.”

COOPER, GRAHAM J., PH.D.; MAYNARD, ROBERT L. B.Sc., M.B., B.Ch.; CROSS, NORMAN L. F.S.S.; HILL, JAMES F. M.B., B.S., M.R.C.P.

Author Information 

The Journal of Trauma: Injury, Infection, and Critical Care 23(11):p 955-967, November 1983.

Abstract

The physical factors responsible for injury following an **explosion** in a room or building are: direct exposure to overpressure; blast-induced whole body displacement; impact of blast-energized debris; burns from flash and hot gas. The patterns of injury seen in the casualties from four terrorist bombings are described to illustrate the types and severity of particular wounds. The most common fatal injury is brain damage; 'blast lung' is uncommon in civilian terrorist bombings; flash burns, fractures, serious soft-tissue damage, and eardrum injuries are seen in people close to the bomb, who usually require hospital admission; many others taken to hospital can be treated for injury by debris and released. The environment and its internal structure and the position of the occupants of the space can influence the type and severity of injuries.

© Williams & Wilkins 1983. All Rights Reserved.

Explosion fatalities in Sweden, 2000–2018

Mensura Junuzovic ¹

Affiliations + expand

PMID: 34156888 PMID: PMC8996294 DOI: 10.1177/00258024211025228

[Free PMC article](#)

Abstract

Epidemiological aspects of explosion-related deaths in a civilian setting may bring comprehensive knowledge that is important for prevention efforts. This Swedish national study aimed to describe the extent of such deaths, circumstances and fatal injuries. Data, including all explosion-related deaths in Sweden from 2000 through 2018, were retrieved from the register of the National Board of Forensic Medicine. Among all 87 cases found, accidental deaths accounted for 62%, suicides for 21%, homicides for 7% and undetermined manner of death for the remaining 10% of cases. Most victims died on site. Adult males dominated in the study material, but explosions also killed four children. Explosives were most commonly involved in occupational blast deaths, suicides and homicides, followed by flammable gases and fluids. The incidence showed a significant decrease since the 1980s, based on the incidence rate from this study and a previous Swedish study (1979-1984). As already rare occurrences, blast-related deaths are challenging to prevent. Prevention efforts are needed to restrict the availability of explosives and focus on lowering the occupational risk for injury. In addition, child deaths must not be neglected. A vision of no fatalities is an appropriate goal for acting against explosion-related deaths in a civilian setting.

Keywords: Explosion; accident; blast; death; homicide; suicide.

- 87 cas en 18 ans, inclut accident, homicides et suicides
- Donnée présente dans le registre des traumatismes du Québec

Prévalence au Québec

	2019-2020 n (%)	2020-2021 n (%)	2021-2022 n (%)	Total n (%)
Nombre de patients victimes d'explosion	8 (0.03)	16 (0.06)	11 (0.04)	35 (0.04)
Nombre de patients inscrits au SIRTQ	27834	25701	27394	80929

PRÉVALENCE AU QUÉBEC

SOURCE : REGISTRE DE TRAUMA DU QUÉBEC

Détails des mécanismes de traumatismes	n (%)
<u>Explosion et éclatement d'une chaudière</u>	<u>1 (2.86)</u>
<u>Explosion et éclatement d'une bouteille de gaz</u>	<u>2 (5.71)</u>
<u>Explosion et éclatement de pneumatique ou de tuyau sous pression</u>	<u>15 (42.86)</u>
<u>Explosion et éclatement d'autres appareils précisés sous pression</u>	<u>7 (20.0)</u>
<u>Projections de feu d'artifice</u>	<u>1 (2.86)</u>
<u>Explosion d'autres matériaux : explosion (dans): dépôt, grenier, munitions, usine, gaz explosif, matériaux explosifs</u>	<u>8 (22.86)</u>
<u>Lésion auto-infligée par utilisation de matériel explosif</u>	<u>1(2.86)</u>

A SE RAPPELER

- Effet du « blast » + projection : trauma contondant
 - Poumons, intestin, tympan
- • Fragmentation : trauma pénétrant
- Chaleur reliée : Brûlures

En bref : c'est le pire des scénarios

LE CONTEXTE EST IMPORTANT

- Milieu civil
 - Accidents
 - Industriel
 - Suicide
 - « Darwinisme »
 - Homicide/acte criminel
- Relié à un conflit
 - Militaire
 - Terroriste

Une explosion en milieu fermée est beaucoup plus létale.



*« Nous on fabrique des bombes
De plus en plus en plus de bombes
Nous on fabrique des bombes
On peut en tuer des millions à la ronde »*

Michel Pagliaro



Effet Léthal	CIVIL	Conflits
Onde de choc	++	+
fragmentation	0	+++
Brûlures	++	+
Contamination	+, dépend du contexte	Sauf si « dirty bomb »



- TOUT
- TRAVAIL
- IMAGES
- VIDÉOS
- CARTES
- ACTUALITÉS
- PLUS

132 000 000 Résultats Date ▾ Vue compacte

2,000 to 4,000 artillery shells

Currently, Ukrainian forces are firing **2,000 to 4,000 artillery shells** a day, a number frequently outmatched by the Russians. Over time, that pace has caused problems for Ukrainian soldiers using M777 howitzers, such as shells not traveling as far or as accurately. Some of the issues can be traced, in part, to the howitzer's design.

Représentation pour calibre 155mm, artillerie conventionnelle

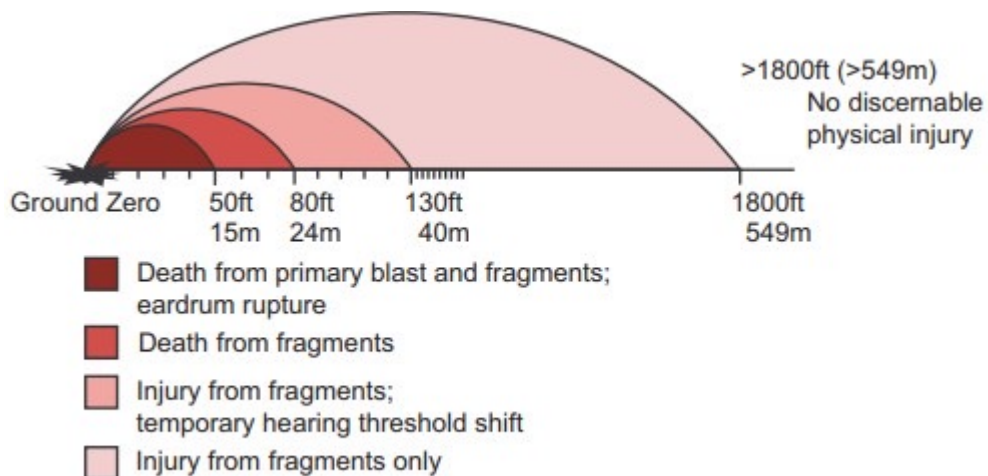


Fig 1 Mortality and morbidity as a function of distance from

MARATHON DE BOSTON

- 6 morts
- 264 blessés
- 2 bombes artisanales
- Blessures similaires à blessures de guerre



The Boston Globe

TUESDAY, APRIL 16, 2013

Marathon terror

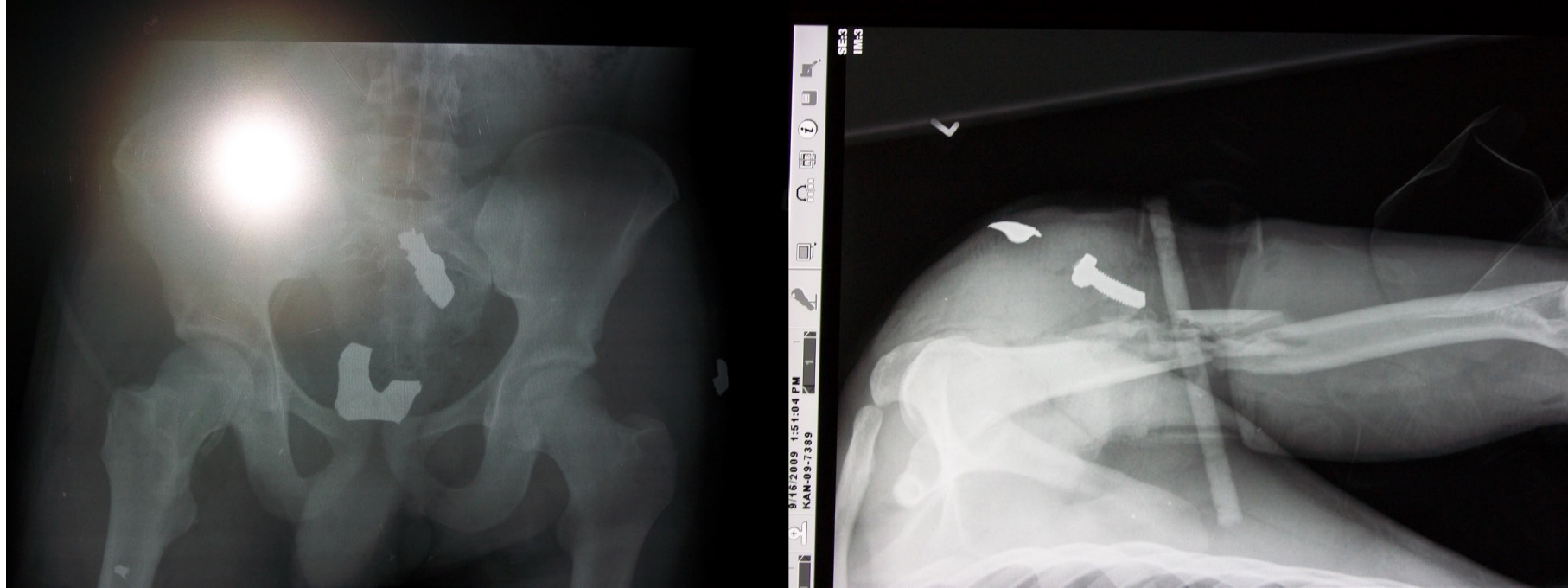


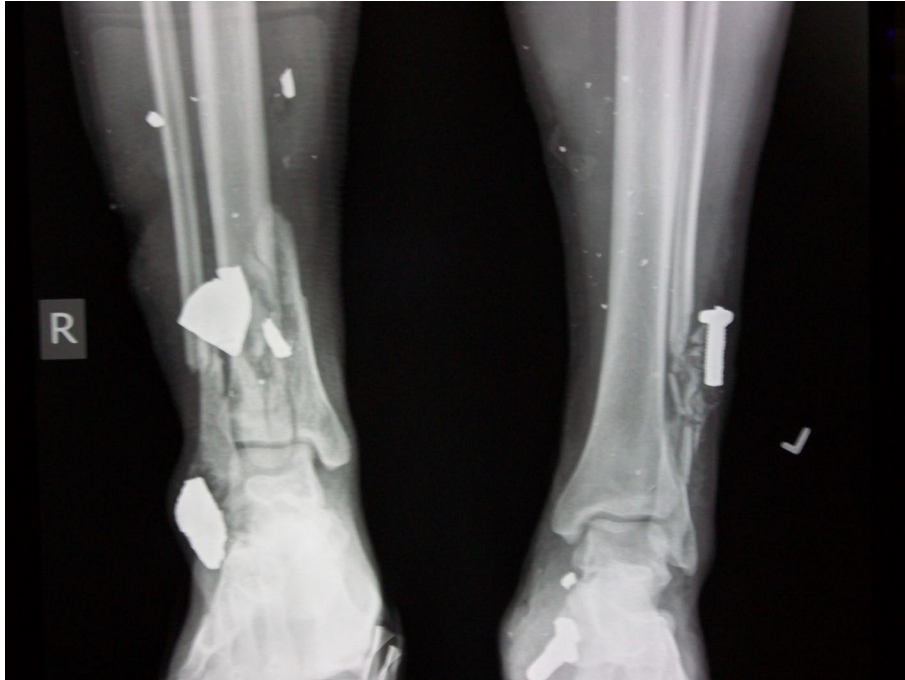
A woman received help at the scene of the first of two explosions on Boylston Street Monday. Medical workers at the finish line treated life-threatening wounds and losses of limbs.











1 Canadian Field Hospital
W 1.049 : L 2.753

CHEST, PELVIS, HUMERUS, FOREARM, BILATERAL TIB/FIB



■ Concept de prise en charge chirurgicale

- ATLS
 - Suivre les protocoles établis
 - Identifier toutes les lésions
 - Éviter les distractions
- Débridement des plaies et des tissus dévitalisés en cas de plaies pénétrantes

Au niveau civil

- **Accident avec des gaz ou incendie dans un endroit fermé**
- **Accident industriel**
- **Autres**

Multiple injuries, homes destroyed in east Ottawa gas leak explosion



All accounted for after gas leak triggered blast, emergency officials say

CBC News · Posted: Feb 13, 2023 6:53 AM EST | Last Updated: February 14



Massive explosion destroys several homes in Ottawa

13 days ago | 1:51

ORATION

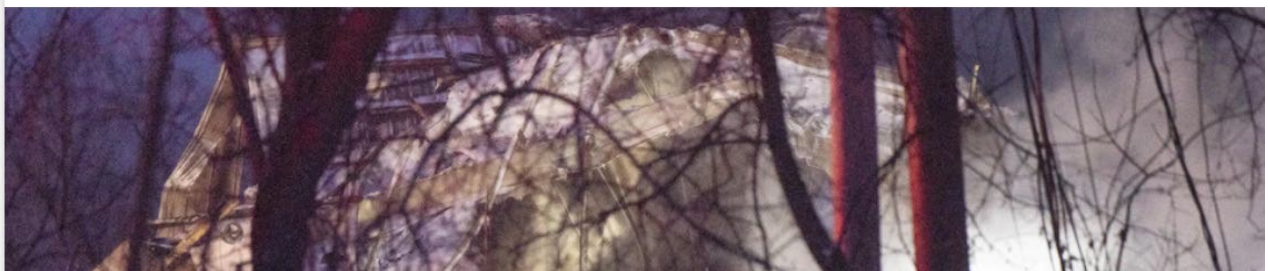


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Explosion à Saint-Roch-de-l'Achigan : les trois victimes identifiées



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La tâche des pompiers n'a pas été de tout repos le jour de l'explosion.

PHOTO : LA PRESSE CANADIENNE / RYAN REMIOW



ORATION

PRÉVENTION : PROTECTION



- Prévention primaire



DÉCONTAMINATION

- Equipement de protection individuel (EPI)
- Zone froide –
Zone chaude



EN RÉSUMÉ

- Infréquent
- Grande différence entre trauma civil ou reliés à un conflit
- Multiplicités des mécanismes
- Conserver un haut indice de suspicion pour les blessures internes

Questions?

