The organization of surgical services during the Homeland War in Croatia

Klinički bolnički centar Split
University hospital of Split

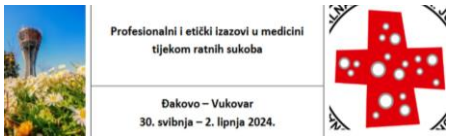
SVEUČILIŠTE U SPLITU
MEDICINSKI FAKULTET
UNIVERSITY OF SPLIT
SCHOOL OF MEDICINE

Prof. Mihovil Biočić

Prof. Vedran Radonić

Prof. Ivica Grković

University Hospital of Split & University of Split School of Medicine, Split, Croatia



HKLD
HRVATSKO KATOLIČKO LIJEČNIČKO DRUŠTVO

How to transition from peace to war?

How to transition from peace to war?

Klinički bolnički centar Split
University hospital of Split

Hospital in ‘war mode’

On 1st April 1991, the day after ‘Bloody Easter’, reorganisation started:

-Introduction of backed-up shift schedules

-Organisation of supplies and reserves of medicines, medical materials, blood products, food, water, fuel, auxiliary lighting…

-Organisation of mobile surgical teams with appropriate equipment

-Special education for all hospital employees, medical and non-medical

-Underground hospital spaces and areas were reorganized so that two operating theaters were created with all the necessary support

-200 beds were shifted to the hospital substructure

-Atomic shelter was turned into paediatric facility for 60 children

Hospital in ‘war mode’

-Organisation of dislocated ‘hospitals in reserve’ for 1x200 and 2x50 wounded (in hotel Split and Zenta)

-‘War medical sets’ were created and stocked

Hospital in ‘war mode’- dispersion

Smaller war hospitals were established and staffed with mobile surgical units in **Vrlika, Potravlje, Sinj, Metković, Korčula…**

Help for Bosnia and Herzegovina

-autumn 1991 terrain assessment in Bosnia and Herzegovina
-28 places in BiH were selected
-Reserve secret medical stations with materials (medicines, medical supplies, inpatient care packages for: 5, 10, 25, 50 and 100 wounded were prepared and maintained)
-Permanent duty and supply from UH Split/24 hours

Help for Bosnia and Herzegovina

-In 1992, **150-170** wounded people from BiH were in the hospital every day

-In 1993, between **500-700** wounded men from Bosnia and Herzegovina were admitted/treated every month

Help for Bosnia & Herzegovina - dispersion

8 major war hospitals were organized and supported in B&H:
Livno, Tomislavgrad, Prozor, Grude, Mostar, Žepče, Kiseljak, Nova Bila

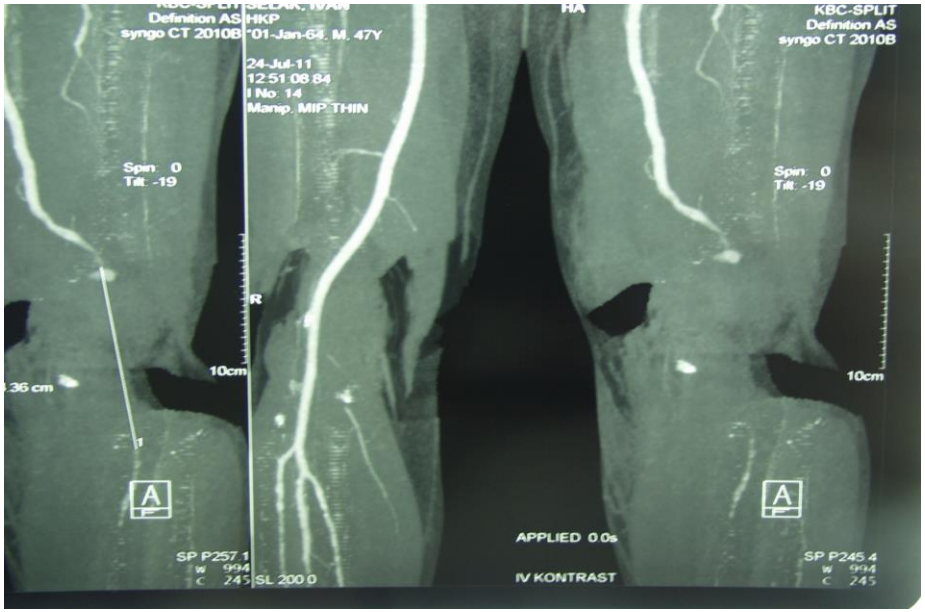
Quick and safe transport of wounded

The nature of war injuries

‘COMPLEX’ VASCULAR INJURIES OF THE EXTREMITIES

Military injuries to the popliteal vessels in Croatia, 1994
The Journal of cardiovascular surgery 35(1):27-32

V Radonić D Barić A Petricević D Andrić

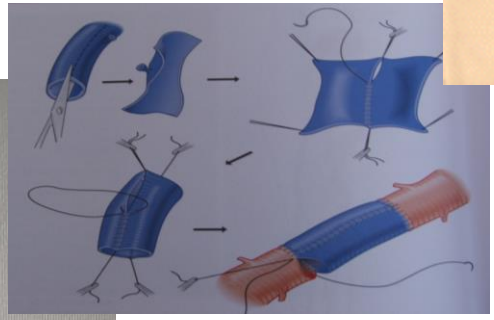


Complex surgical repair of different tissues

War injuries of the femoral artery and vein: a report on 67 cases

Cardiovascular SurgeryVolume 5, Issue 6,
December 1997, Pages 641-647

V Radonić*, D Barić*, L Giunio†, B Bill*, H Kovačević‡, D Sapunar§



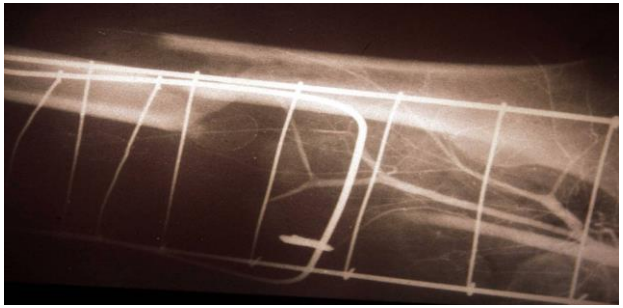
British Journal of Surgery 1995, 82, 777–783

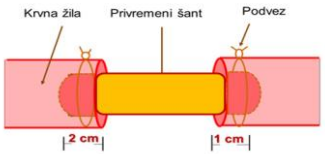
War injuries of the crural arteries

V. RADONIC, D. BARIC, A. PETRICEVIC, H. KOVACEVIC*, D. SAPUNAR† and M. GLAVINA-DURDOV‡

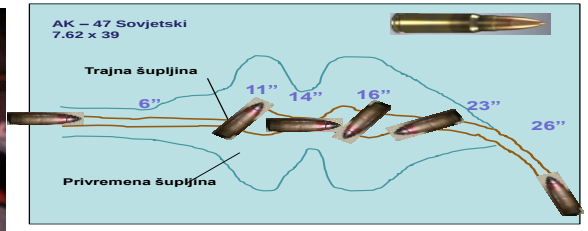
*Surgical Clinic and ‡Department of Pathology, Split Clinical Hospital Centre, †Department of Histology and Embryology, School of Medicine, and *Department of Underwater and Hyperbaric Medicine, Naval Medical Institute, Split, Croatia*
Correspondence to: Dr V. Radonic, Surgical Clinic, Split Clinical Hospital Centre, Spinciceva 1/II, 58 000 Split, Croatia

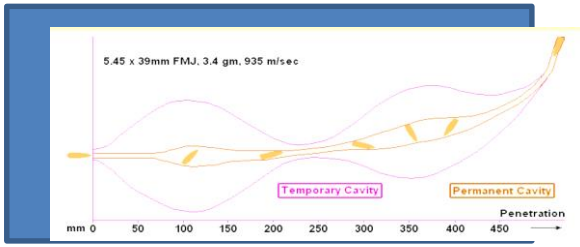
Twenty-eight patients with military crural vascular injuries are presented. In the group undergoing immediate repair (21 patients), the time interval between trauma and surgery was 20 min to 30 h (mean 8 h 30 min). In those receiving delayed repair (seven patients), the interval between trauma and surgery was 3–47 (mean 14) days. Hyperbaric oxygenation therapy was used in conjunction with surgery and antibiotic therapy in 13 of the 28 patients. Explosive injuries were found in 14 patients and high-velocity missile injuries in nine; associated fractures were present in 20. Twenty of the 28 patients with crural vascular injuries had combined arterial and venous injuries, while eight had isolated arterial injuries. Twenty-five patients with distal ischaemia required arterial repair; five late amputations resulted. Military crural vascular injuries should be treated with soft tissue debridement, removal of foreign material, and microvascular arterial and concomitant vein reconstruction. This should be followed by external skeletal stabilization for bony and/or soft tissue instability, with fasciotomy for any associated compartment syndrome. The wound should be left open, with delayed closure or split skin grafting. It was felt that hyperbaric oxygen therapy reduced the amputation rate following combat-related crural vessel injuries.

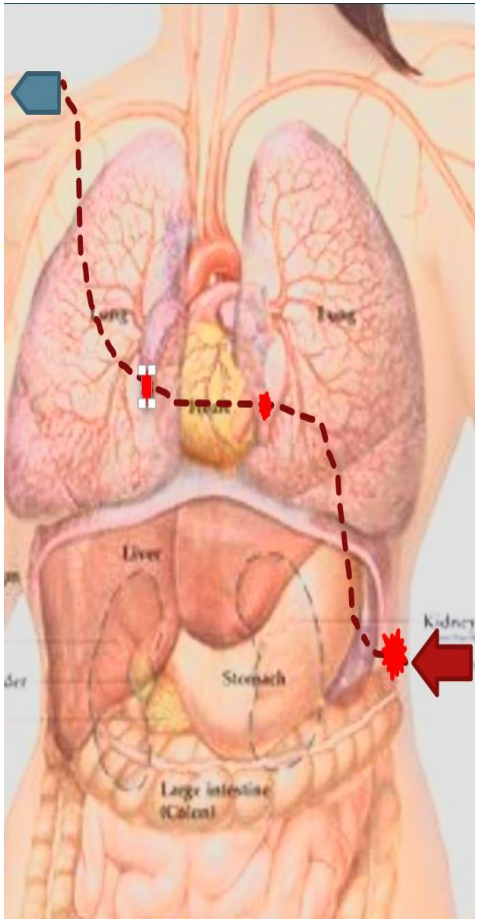




Not only limbs!







Ivica Boškić, twenty years old, in the battles in Uskoplje, was hit by a Muslim bullet that pierced the heart, then made a strange circle in the chest cavity, pierced the heart for the second time and stopped in the right shoulder. With such an injury, Boškić alone walked part of the way to the war hospital, where volunteer medics from Split performed a miracle in such conditions and saved Ivica's life with a complex surgical intervention.

split - kaštela - soli

MEDICINSKA ČUDA

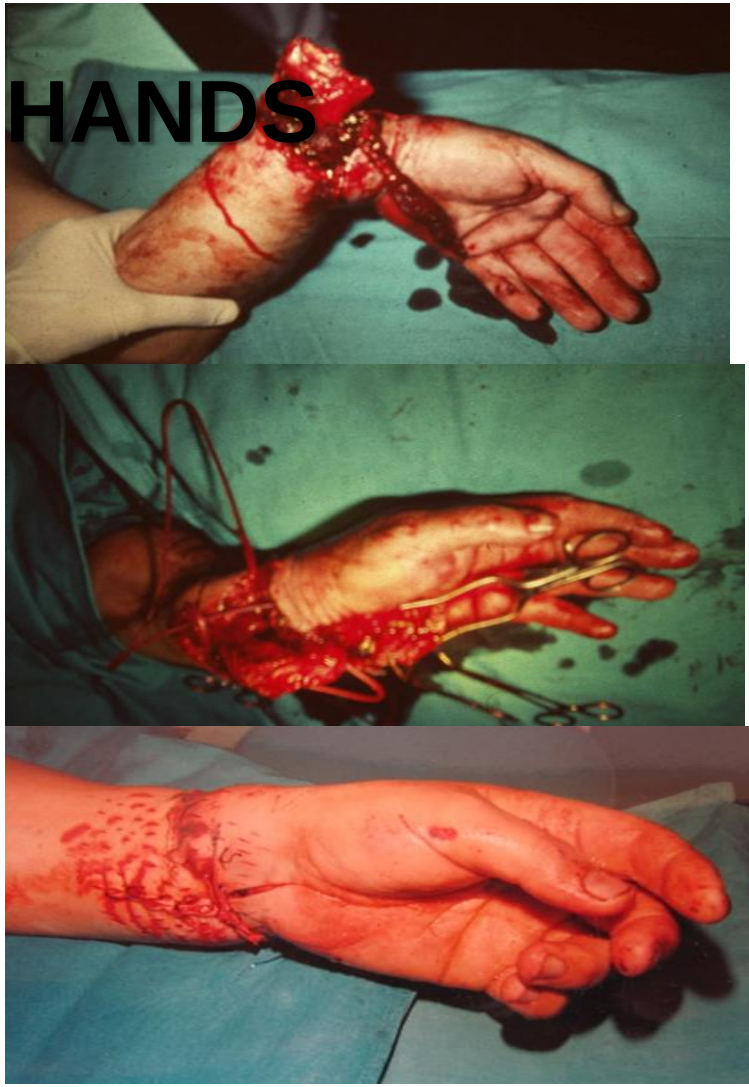
POTHVAT EKIPE RATNE BOLNICE U RAMI

OSTAO ŽIV - S METKOM KOJI JE DVA PUTA PROBIO SRCE!

Ivica Boškić, dvadesetogodišnjak, u borbama u Uskoplju pogoden muslimanskim metkom koji je probio srce, zatim u prsnoj šupljini napravio čudan krug, po drugi put probio srce i zaustavio se u desnome ramenu. S takvom ozljedom Boškić je sam, pješice, prošao dio puta do ratne bolnice, gdje su medicinari dragovoljci iz Splita učinili čudo u takvim uvjetima, te složenom kirur-

Disastrous injuries

REPLANTATION OF BOTH HANDS



When combined with delicate microsurgery, early intervention using adjunctive HBOT was effective in preserving partially viable tissue and restoring hand function in patients with a mutilated hand injury.

Multipart recompression barochambers in IPM HRM in Split

Hyperoxygenation: Delivery of 100% oxygen under pressure (1.5-3 ATA) in a hyperbaric chamber allows up to 20 times normal oxygen to all tissues in the body. This excessive oxygen saturation is in marked contrast to breathing room air (21% oxygen at 1 ATA).

HBO in war surgery

War injuries are characterized by extensive tissue destruction, haemorrhage, oedema, hypoxia, and traumatic hypovolemic shock. In modern war, all these features of injuries are particularly emphasized.

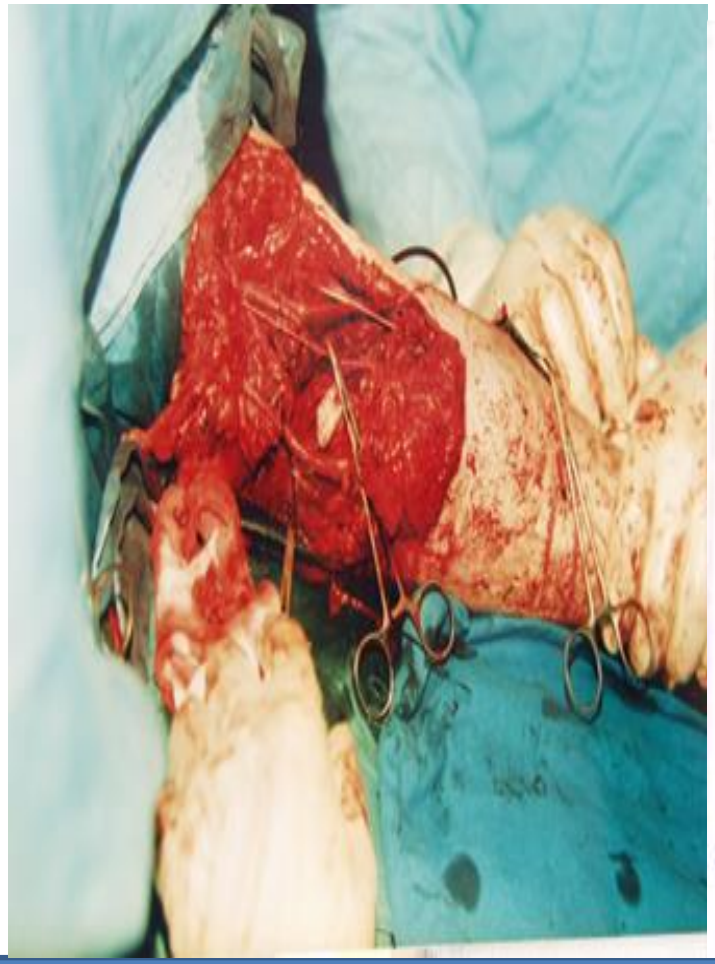
The central event in the pathophysiology of a war wound is hypoxia. Hyperbaric oxygenation (HBO) quickly and effectively corrects hypoxia and its consequences.

During the war in Croatia from 1991 to 1995, HBO therapy was used in the treatment of **200** civilian and military persons with an average age of 29, of which the largest number had severe injuries to the lower extremities (90%).

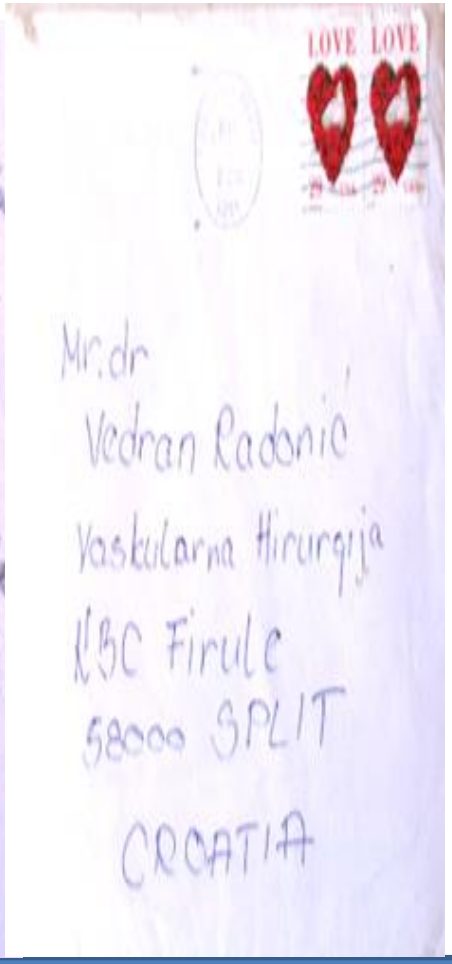
The most common reason for using HBO was extensive soft tissue and/or bone injuries with prolonged traumatic ischemia (n=72.36%).Two patients died, one due to clostridial myonecrosis, and others due to extensive injuries.

HBO in war surgery

Prolonged traumatic ischemia	72	36.0%
Prevention of infections after surgery	49	24.5%
Manifest infection suspected of anaerobes	20	10.0%
Frostbite	13	6.5%
Acute acoustic injury of the middle ear	10	5.0%
Endangered skin flaps	9	4.5%
Kompartman sindrom	8	4.0%
Osteomyelitis	5	2.5%
Wound infection caused by aerobic pathogens	3	1.5%
Morbus Südeck	3	1.5%
Suspicion of clostridial myonecrosis	2	1.0%
Clostridial myonecrosis	2	1.0%
Eyeball contusion with visual impairment	2	1.0%
Compartment syndrome	2	1.0%



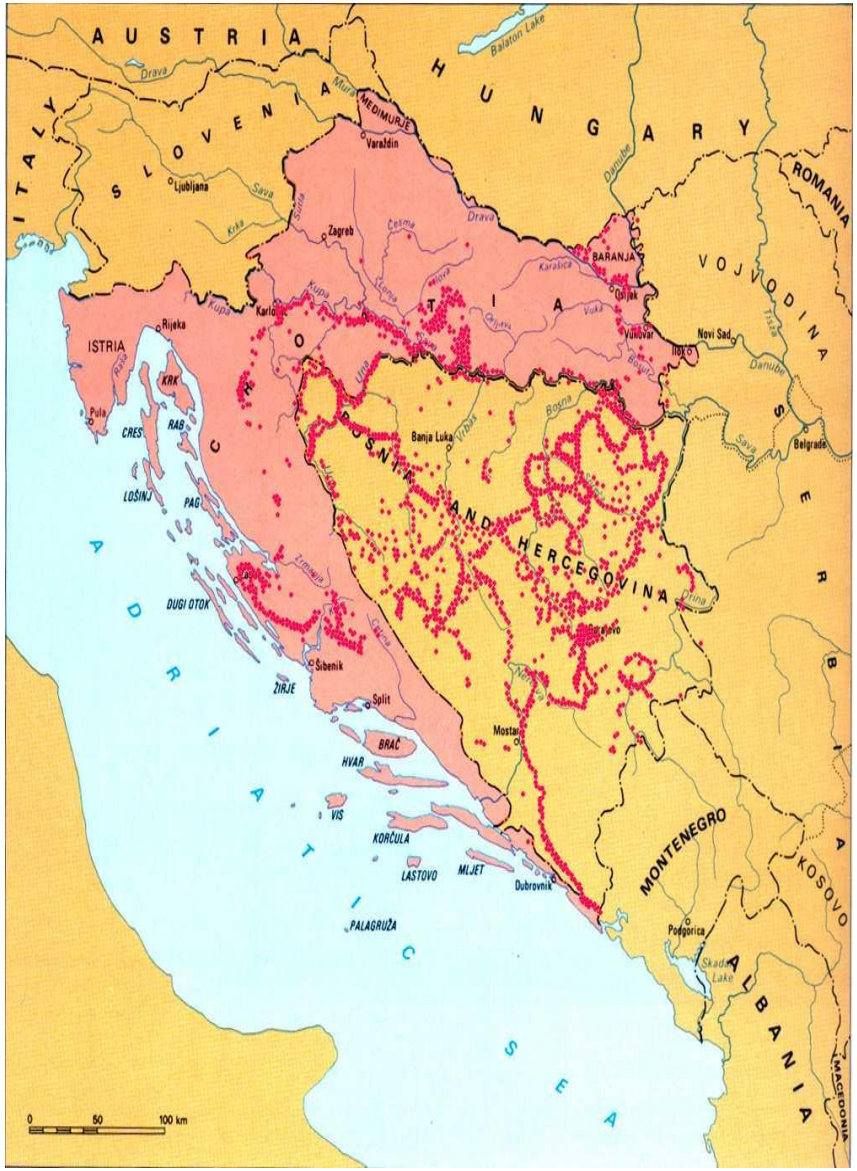
Mnogo sreće i zdravlja
Vama i Vašoj porodici, Rad
i cijelej ekipi na Vašem
odjelu u Novoj 1995 g.
Želi Gordana Klarić iz
Mostara.
Vaša pacijentkinja kojoj ste
spasili ruku, upravo pišem
tom rukom.



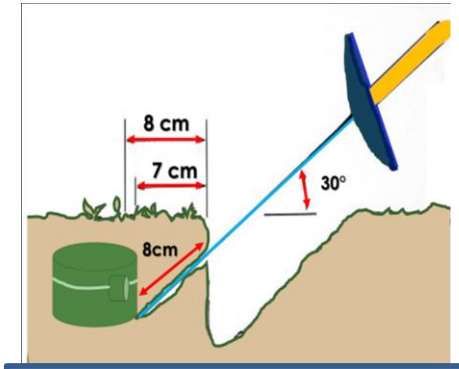
Mr.dr
Vedran Radonić
Vaskularna Hirurgija
KBC Firule
58000 SPLIT
CROATIA

A. Replantation of the forearm of a hairdresser whose hand was almost amputated by a grenade at the level of the forearm in a hairdresser's salon in Mostar. B. Thank you letter two years after the procedure from California.

The war goes on even after it finishes!



Map of minefields in Croatia and Bosnia-Herzegovina.



A probe for buried mines

Mil Med
. 2004 Aug;169(8):642-7. doi: 10.7205/milmed.169.8.642.
Mine clearance injuries in South Croatia
Vedran Radonić 1, Lovel Giunio, Vojko Vidjak, Vladimir Boschi, Dragan Barić, Radoslav Stipić

TABLICA 5-77.

PIROTEHNIČARI OZLIJEĐENI S PROTUPJEŠAČKIM MINAMA

Demineri	Suma slučajeva					Mortalitet			
	N	%	AIS skor	ISS skor	Dob(god.)	Smrt	AIS skor	ISS skor	Dob (god.)
Razminiranje vojarni	11	20.75	2.27 ± 0.67	12.09 ± 6.65	30.46 ± 7.49	0			
Razminiranje minskih polja	18	33.96	3.11 ± 0.84	24.44 ± 12.91	29.56 ± 6.44	2	6.00 ± 0.00	79.00 ± 2.00	
Razminiranje kod ofanzivnih akcija	10	18.87	3.10 ± 0.56	19.90 ± 5.70	28.00 ± 5.10	0			
Rukovaje s minama	4	7.55	2.75 ± 0.38	20.75 ± 6.25	38.25 ± 6.25	0			
Rukovanje s upaljačem	4	7.55	2.50 ± 0.50	14.75 ± 4.75	27.75 ± 3.75	0			
Polaganje mina	6	11.32	3.00 ± 0.00	20.67 ± 5.11	25.67 ±3.22	0			
Ukupno	53	100	2.79 ± 0.49	18.77 ± 6.90	29.45 ± 5.38	2	6.00 ± 0.00	79.00 ± 2.00	23.00 ± 2.00

Tijekom operacija minskog-čišćenja u Južnoj Hrvatskoj, 53 deminera je ozlijeđeno i dovedeno u Splitsku bolnicu. Od tih, 18 (34%) ih je ozlijeđeno tijekom čišćenja minskih polja, 12 (21%) ih je ozlijeđeno tijekom čišćenja baznog logora, a 10 (19%) ih je ozlijeđeno tijekom ofenzivnih vojnih akcija. Postojale su dva smrtna slučaja.

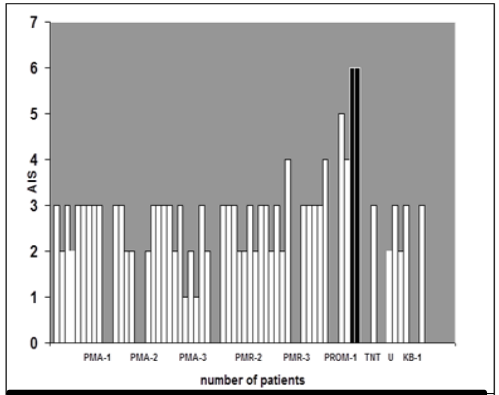


Chart 5-78. Injuries of deminers by type of mines, number of cases, and AIS (□ survivors, ■ non-survivors).

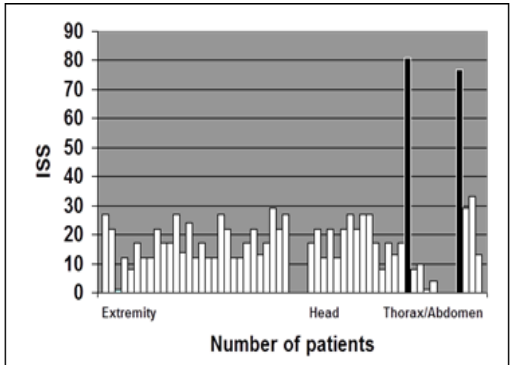


Chart 5-79. severity of deminer injuries according to body regions and ISS (□ survivors, ■ non-survivors)

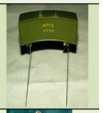
During demining operations in Southern Croatia, 53 deminers were injured and brought to the Split hospital. Of these, 18 (34%) were injured during minefield clearance, 12 (21%) were injured during base camp clearance, and 10 (19%) were injured during offensive military operations. There were two deaths.

Antipersonnel Mine Injuries in Southern Croatia

Vedran Radonić, MD, PhD, Lovel Giunio, MD, MSc, Teo Borić, MD, Željko Mimica, MD, PhD, Dubravko Furlan, MD, PhD, Marija Definis-Gojanović, MD, PhD

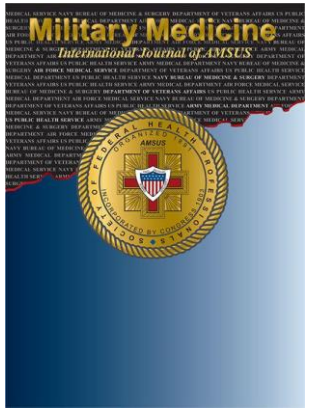
Military Medicine, Volume 169, Issue 4, April 2004, Pages 313–319, https://doi.org/10.7205/MILMED.169.4.313

Yugoslav anti-personnel mines are simple, adaptable, compatible, cheap and deadly

Mina	Tip	Dimenzije (l x w/dia x h) (mm)	Težina (kg)	Tijelo mine, eksploziv and charge weight (g)	Operativni pritisak (kg)	Svojstva	
PMA-1 (PAM-1)	Nagazna, blast, antimagnetska	142 x 67 x 34	0.4	Juvidur, TNT 200	Nagaz sa pritiskom 3 kg	Eksplozivni blast razara stopalo	
PMA-2 (PAM-2)	Nagazna, blast, antimagnetska	68 x 32	0.135	Plastični eksploziv, TNT 70	Nagaz sa pritiskom 5 kg	"	
PMA-3 (PAM-3)	Nagazna, blast, antimagnetska	103 x 36	0.148	Plastični eksploziv, Tetryl 35	Nagaz sa pritiskom 8 kg	"	
PMR-2A	Potezna, kolčić, fragmentacijska	66 x 132	1.7	Lijevani-čelik, TNT 10	Potez na zategnutu žicu	Letalni radijus 15-25 m, ranjavajući radijus 20-100 m	
PMR-3	Nagazna, Potezna, kolčić, fragmentacijska	78 x 134	2	Lijevani-čelik, TNT 41, Tetryl 13	Potez na zategnutu žicu, Nagaz sa pritiskom 12 kg	Letalni radijus 50 m, ranjavajući radijus 100 m.	
PROM-1	Nagazna, Potezna, kolčić, odskočna, usmjerena fragmentacijska	75 x 270	3	Čelik, TNT 42	Potez na zategnutu žicu, Nagaz sa pritiskom 9 kg	Letalni radijus 20-50 m, ranjavajući radijus 300 m, lansiranje u zrak; na visinu od 0.7-0.8 m	
MRUD	Vođena, usmjereni efekt, fragmentacijska	231 x 100 x 50	1.7	Plastični eksploziv, 650 x 5 mm čelične kuglice, TNT 90	Remote-control električno paljenje	Letalni radijus 60°(horiz.) i 3°(vertik.) na 50 m.	
KB-1	Kazetne bombice (punjenje za bojne glave raketnog sustava)	40 x 53	0.235	Čelik, 450 x 3 mm čelične kuglice, TNT 35	Mehanički-impakt-inercija	Probijajući efekt: 60 mm oklopljenog čelika	

Vojnici	Suma slučajeva					Mortalitet			
	N	%	AIS skor	ISS skor	Dob(Godište)	D	AIS skor	ISS skor	Dob(Godište)
Na rutinskom kretanju između kampova	13	3·76	3·23±0·70	22·77±11·15	27·54±5·74	2	5·50±0·50	59·00±9·00	33·00±0·00
Napuštena neprijateljska bazna vojarna	6	1·82	3·33±0·89	19·00±11·67	30·33±8·34	1	6·00±0·00	54·00±0·00	21·00±0·00
Manevriranje protiv neprijatelja	78	23·71	3·40±0·69	23·71±6·61	27·31±3·04	19	4·68±0·62	45·16±13·80	27·11±3·91
Minsko polje	8	2·43	3·25±0·36	19·25±4·38	29·75±4·50	1	4·00±0·00	36·00±0·00	20·00±0·00
Patroliranje	35	10·64	3·09±0·39	19·66±7·30	21·23±4·70	1	6·00±0·00	68·00±0·00	33·00±0·00
Zasjeda	44	13·37	3·43±0·81	25·68±12·79	28·30±6·34	6	5·67±0·55	66·00±11·67	27·33±3·44
Trajna vojarna	60	18·24	3·23±0·42	20·22±5·49	29·22±7·59	2	4·00±1·00	39·50±17·50	24·50±3·50
Privremeno boravište	26	7·90	3·08±0·29	18·89±4·71	29·42±10·64	0			
Proboj iz neprijateljskog okruženja	6	1·82	3·17±0·28	17·50±6·17	35·00±8·33	0			
Čišćenje baznog logora	11	3·34	2·27±0·67	12·09±6·65	30·46±7·49	0			
Upaljač	4	1·22	2·50±0·50	14·75±4·75	27·75±3·75	0			
Čišćenje minskog polja	18	5·47	3·11±0·84	24·44±12·91	29·56±6·44	2	6·00±0·00	79·00±2·00	23·00±2·00
Čišćenje mina	10	3·04	3·10±0·56	19·90±5·70	28·00±5·10	0			
Selfwounded by owerhauling	4	1·22	2·75±0·38	20·75±6·25	35·25±6·25	0			
Polaganje mina	6	1·82	3·00±0·00	20·67±5·11	25·67±3·22	0			
Ukupno	329	100	3·06±0·52	17·32±7·44	25·13±6·10	34	5·23±0·33	55·83±6·75	26·12±1·61

Table 5-61. Military personnel injured by anti-personnel mines. Abbreviations: N- Number of cases, % - Percentage, AIS - Abbreviated Injury Scale, ISS - Injury Severity Score, D - mortality.



- *1. Radonić V. Domovinski rat. Napadi na Hrvatske gradove I bolnička skerb stradalnika.Crkva u svijetu Hrvatsko katoličko liječničko društvo. Split, 2015; Str.290.*
- *2. V Radonić , D Barić, L Giunio, B Bill, H Kovacević, D Sapunar. War injuries of the femoral artery and vein: a report on 67 cases. Cardiovasc Surg. 1997 Dec;5(6):641-7.*
- *3. Radonić V, Kukoc M, Barić D, Ilić N, Tripković A, Grandić L. Splenorrhaphy and partial splenectomy as an alternative to splenectomy in trauma--overview. Acta Chir Iugosl. 1990; 37(2): 239-49.*
- *4. Radonić V, Barić D, Petricević A, Andrić D, Radonić S. Military injuries to the popliteal vessels in Croatia. J Cardiovasc Surg (Torino). 1994 Feb;35(1):27-32.*
- *5. Radonić V, Koplić S, Giunio L, Bozić I, Masković J, Buća A. Popliteal artery entrapment syndrome: diagnosis and management, with report of three cases. Tex Heart Inst J. 2000;27(1):3-13.*
- *6. Radonić V. Injuries of the popliteal artery. Acta Chir Iugosl. 1980; 27 Suppl 1: 457-63.*
- *7. Koplić S, Masković J, Radonić V. Musculotendinous pressure on the arteries of the knee observed in a patient with obstructive entrapment syndrome of the popliteal artery and vein.*
- *Acta Chir Iugosl. 1982;29 Suppl 2:189-93.*
- *8. Radonic V , Baric D, Petricevic A, Kovacevic H, Sapunar D, Glavina-Durdov M. War injuries of the crural arteries. Br J Surg. 1995 Jun; 82(6): 777-83.*
- *9. Radonić V, Barić D, Petricević A, Koplić S, Giunio L, Radonić S. Advances in diagnostics and successful repair of proximal posttraumatic superior mesenteric arteriovenous fistula.*
- *J Trauma. 1995 Feb;38(2):305-12.*
- *10. Radonić V, Giunio L, Borić T, Mimica Z, Furlan D, Definis-Gojanović M. Antipersonnel mine injuries in Southern Croatia. Mil Med. 2004 Apr;169(4):313-9.*
- *11. Radonić V, Giunio L, Biocić M, Tripković A, Lukcić B, Primorac D. Injuries from Antitank mines in Southern Croatia. Mil Med. 2004 Apr;169(4):320-4.*
- *12. Radonić V, Giunio L, Vidjak V, Boschi V, Barić D, Stipić R. Mine clearance injuries in South Croatia.*
- *Mil Med. 2004 Aug; 169(8): 642-7.*
- *13. Radonić V, Budimir D, Bradarić N, Luksić B, Sapunar D, Vilović K. Envenomation by the horned viper (Vipera ammodytes L.). Mil Med. 1997 Mar;162(3):179-82.*
- *14. Referenca Radonić V , Aras N, Pavić A. Organization and functioning of the front-line surgical station at Rama in Bosnia and Herzegovina. Mil Med. 1993 Dec;158(12):763-6.*
- *15. Petricevic A, Radonic V, Ilic N, Petricevic M, Zelic Z, Ferenca J, Sapunar D. Surgical experience at the Rama war hospital in Bosnia and Herzegovina. Isr J Med Sci. 1995 Oct;31(10):630-4.*

Innocent victims of the war - children

-From August 1991 to December 1995, **94 wounded children** (ages 3-16) were treated at the Paediatric Surgery Department of UHS
- 16 children from Croatia
- 78 children from B&H

-300 wounded children were treated in 8 small war hospitals in B&H

-**4200 wounded and sick children** from B&H were treated in UHS

-**4493 children from B&H were born** in Split maternity hospital

-**975 newborns required neonatological care**

UH Split – war time figures

From 1991-1996.
Total hospitalisations of sick and wounded: **261,435**

-**31,086 (11.9/%)** from Bosnia & Herzegovina

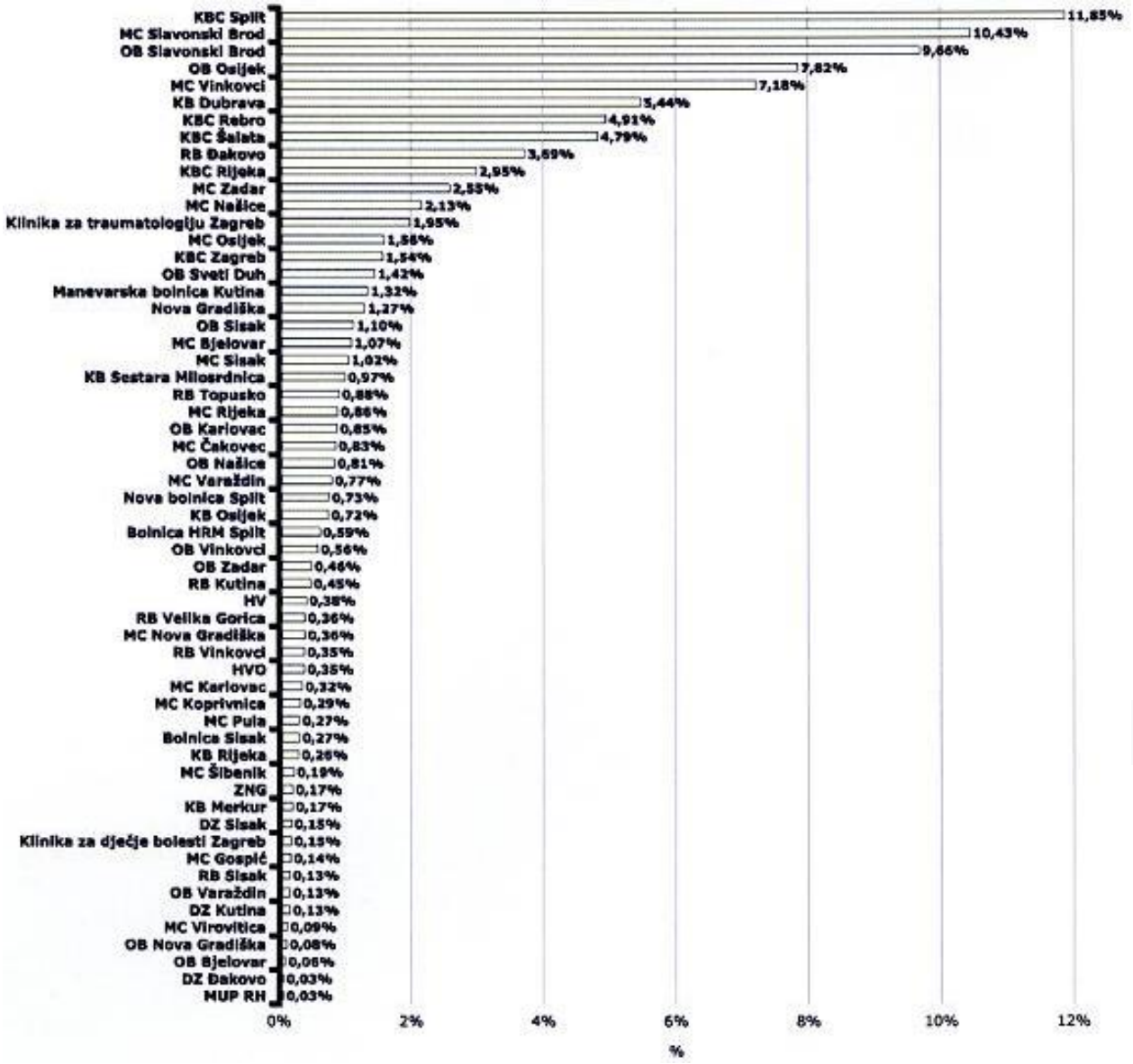
-About **30%** of them were Muslims, considerable number of enemy soldiers

-**6307 wounded** were treated in small military hospitals within Croatia by 373 medical staff members (6011 days),

-**15,754 wounded** were treated in small military hospitals in B&H by 316 medical staff members (7648 days),

TOTAL FOR WAR HOSPITALS (CRO and B&H):
689 PEOPLE SPENT 13659 DAYS TREATING WOUNDED/INJURED/SICK

UH Split – war time figures



BRAVE WOMEN AND MEN !

Prof Biočić:

We treated everyone in need!

We never denied professional help to anyone!!!

We worked under shells, in the heat of battle...
To get to the war hospitals and checkpoints, we passed through mountains, forests and dangerous war zones where no one guaranteed anyone’s safety

I especially admire our female colleagues (doctors, nurses, laboratory assistants) who, just like men, went through the same dangerous situations and coped with the same professional, physical and mental burdens.

Let’s hope it will never happen again..

November 15, 1991.