Wars

The Sarton lecture

Disasters

Kidneys

Norbert Lameire, MD, PhD
Em prof Interne Geneeskunde
Universitair Ziekenhuis, Gent

February 13, 2014
Faculty Club
University Gent
Nephrology – the essentials in 3 minutes
2 miljoen nefronen

Filtratie: 180L/24 h ≈ 120ml/min = 100%

**Terminale nierinsufficientie**: filtratie: 5-6 ml/min (≤ 5%) opstapeling van uremische toxische stoffen met gestoorde stofwisseling: uremisch syndroom

**Acute** nierinsufficiëntie

**Chronische** nierinsufficientie

**Bij ernstige acute nierinsufficientie**
tijdelijke peritoneale dialyse
Tijdelijke hemodialyse of kunstnier

**Bij terminale chronische nierinsufficientie**: Chronische peritoneale dialyse
Chronische hemodialyse
Niertransplantatie
“He who wants to become a surgeon should join an army and follow it”

Hippocrates of Kos, cc 460-370 BC
Historical examples of military surgery

Claudius Galenus (AD 129 – c. 200/c. 216), (according to emperor Marcus Aurelius, the first under the physicians and the most prominent of the philosophers) learned his skills on trauma and wound care not only in the sanctuary of Aesclepius, the god of cure, but mainly as physician of the gladiators of Pergamon.

“a good doctor is also a philosopher”- Galenus

“The only victors of a war are the young surgeons “
Ambroise Paré –(1510-1590)

Our present ambulance system is the successor of the “flying ambulances”(carts drawn by horses) by Dr Dominique Jean Larrey to transport wounded soldiers in the armies of Napoleon.
Historical examples of impact of wars on humanitarian initiatives before World War

Florence Nightingale (1820-1910)
Founder of modern nursing
‘The lady with the Lamp’.

Krim wars: 1853-1856
Lived in Scutari hospital (Istanbul);
November 1854 - August 1856

Jean Henri Dunant (1828-1910)
Founding father of the Red Cross, 1863

Battle of Solferino (June 24, 1859)-
38,000 wounded and dying—“tutti fratelli”

Book “Un souvenir de Solferino”
je ne veux rien recevoir, ni du pouvoir actuel, ni d'aucun autre pouvoir politique quel qu'il soit. C'est donc avec la plus grande fermeté que je refuse cette médaille (Légion d'honneur)“.
On n'est pas forcément content d'être reconnu par des gens qu'on n'estime pas", Le Figaro, 2013

Jacques Tardi (Valence, 30 augustus 1946)
Vervoer van een gewonde Brit tijdens de Slag bij Ieper in 1917
WW1- Ratcatcher with his catch from the trenches during First World War. From L'Illustration, 1916.
Trench nephritis (1)

WW 1:

**Flanders and France**: from March 1915: acute epidemic nephritis in British Expeditionary Force; by the end of June 1915: 1062 cases noted. According to Official History of the War – Medical Services, there were approximately 35 000 admissions for trench nephritis in the BEF during the conflict. The majority of the patients were in active duty in the trenches, “trench nephritis”.

**French Army**: “néphrite de guerre” diagnosed from November 1915. Peak incidence: the summer of 1916: > 1% of the men who appeared on sick call. Again, the majority in those who served in the trenches.

**German-Austrian troops**: idem in the Spring 1915: “Feldnephritis or “Kriegsnephritis”

**US troops**: from 1917 on: on a total of 370000 American soldiers: 2002 cases of acute “war nephritis”
Trench nephritis (2)

WW 2:
German troops: the North Scandinavian campaign (Lapland): 16000 German troops suffer from “Kriegsnephritis”
Trench nephritis (3)

WW 2:
German troops: the North Scandinavian campaign (Lapland) : 16000 German troops suffer from “Kriegsnephritis”

Despite the most sophisticated investigations: no etiological agent found. Disease was almost completely forgotten
Trench nephritis (4)

WW 2:
German troops: the North Scandinavian campaign (Lapland): 16000 German troops suffer from “Kriegsnephritis”

Despite the most sophisticated investigations: no etiological agent found.
Disease was almost completely forgotten till 1978: prof Ho Wang Lee: isolation of a virus from the lungs of wild field mouse, a rodent very common in that region.
The virus was named Hantaan virus after the Hantaan River, which transsects the same endemic region and which runs in the Demilitarized Zone near the 38th parallel.
Demilitarised zone Korea- Hantaan River
Vectoren voor Hanta virus infecties

**Rattus rattus, black rat**

**Apodemus agrarius**

**Myodes glareolus of rosse woelmuis**

**Rattus norvegicus, brown rat**
Is Hanta virus infection cause of trench nephritis?

Rattus rattus, black rat

Myodes glareolus of rosse woelmuis

Apodemus agrarius

Rattus norvegicus, brown rat
WO 1 and medical organisation

“There are two groups of people in warfare – those organized to inflict and those organized to repair wounds – and there is little doubt but that in all wars, and in this one in particular, the former have been better prepared for their jobs” (Milit. Surg., 38:601, 1916).

Harvey Cushing*, (1869-1939), the founder of modern neurosurgery, a year before America’s entry into World War I.

* Colonel surgeon in the American Medical Corps in Europe (1917-1919)
## WO 1: Hospitals behind the frontline

<table>
<thead>
<tr>
<th>Name</th>
<th>Location</th>
<th>Opening</th>
<th>Closing</th>
<th>Admitted military</th>
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<tbody>
<tr>
<td>Belgian Field Hospital</td>
<td>Veurne</td>
<td>29-10-1914</td>
<td>6-3- 1915</td>
<td></td>
</tr>
<tr>
<td>Belgian Field Hospital</td>
<td>Hoogstade</td>
<td>6-2-1915</td>
<td>25-5-1916</td>
<td></td>
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<tr>
<td>Belgian Military Hospital</td>
<td>Hoogstade</td>
<td>25-5-1916</td>
<td>17-2-1920</td>
<td>6570</td>
</tr>
<tr>
<td>Rode Kruishospitaal L’Océan</td>
<td>De Panne</td>
<td>20-12-1914</td>
<td>15-10-1919</td>
<td>19375</td>
</tr>
<tr>
<td>Elisabethhospitaal</td>
<td>Couthove</td>
<td>21-5-1915</td>
<td>25-11-1918</td>
<td>1810</td>
</tr>
<tr>
<td>Militair Hospitaal Cabour chirurgisch</td>
<td>Adinkerke</td>
<td>26-4-1915</td>
<td>12-3 1917</td>
<td>2654</td>
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<tr>
<td>Militair Hospitaal Cabour medisch</td>
<td>Adinkerke</td>
<td>12-3 1917</td>
<td>17-2 1920</td>
<td>8246</td>
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<tr>
<td>Militair Hospitaal Beveren aan de Ijzer</td>
<td>Beveren aan de Ijzer</td>
<td>12-3-1917</td>
<td>17-2-1917</td>
<td>7986</td>
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<tr>
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<td>Vinkem</td>
<td>1-5-1917</td>
<td>15-10-1919</td>
<td>9440</td>
</tr>
</tbody>
</table>
Dr Antoine De Page (1862–1925)
Colonel-Surgeon in the Belgian Army
Chief surgeon in hospital l’Océan, De Panne

Five steps “ordre de triage”

1. Retrieval of the injured by stretcher
2. Application of dressings and determination of priority of evacuation, at a so-called clearing station
3. Transport by ambulance
4. Acute intervention in selected cases, at mobile surgery centers
5. In-hospital care, at centers in Paris, Compiegne, Versailles, La Panne, or other locations
One of his students in Hoogstade was Dr Norbert Goormaghtigh who later became prof of pathological anatomy at the faculty of the Gent University.
Norbert Goormaghtigh and his contribution to the histophysiology of the kidney

Hendrik Roels

doi: 10.1093/ndt/gfp303
Advance Access publication 25 September 2009

Historical Note

The juxtaglomerular apparatus of Norbert Goormaghtigh—a critical appraisal

Garabed Eknoyan¹, Robert Rubens² and Norbert Lameire³
Norbert Goormaghtigh (1890–1960).

Formal picture as Rector of the University of Gent (1947–1950).
Temporal breakdown of the publications of Norbert Goormaghtigh (1890-1960)

Rector University
THOMAS GRAHAM (1805-1869)

Graham ontdekte het principe van dialyse
PRINCIPLES OF DIALYSIS AND FILTRATION

HEMODIALYSIS

LOW FLUX MEMBRANE

DIFFUSION

CONVECTION

HEMOFILTRATION

HIGH FLUX MEMBRANE

middle molecule
Dialysis systems

A hemodialysis circuit

Peritoneal dialysis
History of dialysis


Stephen Hales described an irrigation of the abdomen with red wine (1744)

Georg Ganter was the first to use peritoneal dialysis to treat a patient with kidney disease (1923)
Dialysis on an adult, 1923

Re: J Benedum, Med Hist, 14:196 - 202 (1979)

Dialysed patients with ARF;
Dialysis time 15 min
Used collodium
Performed UF by increasing pressure in blood compartment
Treated 11 patients before he stopped his research
History of dialysis

“Dialysis is useless and even dangerous!”

Franz Volhard, Internist and Professor in Halle (1918) and Frankfurt (1927).
History of dialysis


Willem Kolff  1911-2009

Kolff rotating drum kidney (1943)
History of dialysis

Head nurse Maria ter Welle in 1942 stands in as wouldbe patient for a picture of Kolff's first artificial kidney, displayed in his consultation room in Kampen.
History of dialysis

Sophia Schafstadt (1945) (with acute kidney failure)

The first patient, owing her life to dialysis after having suffered from acute kidney failure. She was Kolff’s 17. patient
THE „ROTATING DRUM“ IN 1945 CLINICAL-BIOCHEMICAL REPORT OF PATIENT 17

The 4 first prototypes of the Kolff “rotating drum” kidneys - Kampen September 1944
Gordon Murray—stationary drum artificial kidney in Toronto 1945/1946
Mobile Army Surgical Hospital
Mobile Army Surgical Hospital

1972-1983

FIVE STAR COLLECTION

M*A*S*H

RESTORED, UNCUT ORIGINAL VERSION!

DIGITALLY MASTERED FOR SUPERIOR SOUND AND PICTURE QUALITY

OTTO F. APPEL JR., M.D.
& PAT APPEL

Colonel med Paul Teschan performing acute dialysis during the Korean War (1952)
2002 Albert Lasker Award for Clinical Research together with Willem Kolff

Clyde Shields, the first patient with the Scribner Shunt (1960). Shields survived his kidney failure by 11 years and died from heart failure in 1971.
First Scribner shunt
1962: Requested upfront payment for 3 years of dialysis therapy 30,000,- US-$
AV-fistula for hemodialysis
The nephrological pioneer’s time in the university hospital Gent (1959-1969)

- Dr S. Ringoir - medical studies UG 1949-1956 - magna cum laude
- Training Int Med Prof P. Regniers: 1957-1961
- Important milestones in the nephrological evolution
  - International study times Dr Ringoir in:
    - Paris Hôtel Dieu: Prof Dérot en M. Legrain - 1959 acute PD en HD (Kolff-Merill nier) - mémoire assistant étranger 1960
    - Genève – service Prof Mach 1961: electrolyte metabolism – clinical nephrology
    - Houston (Texas) Baylor College: 1964: chronic hemodialysis-creation of Scribner shunt-training kidney transplantation
Prof Ringoir during Laudatio for Prof Galetti, Providence, USA

doctor honoris causa, UGent
Mémoire d’assistant étranger

S Ringoir, years 1959-1960
Creation of first shunt june 1963
First chronic hemodialysis patient UG 1963
First group of home hemodialysis patients
Former students and fellows of Severin Ringoir
### Status at moment of retirement Prof Ringoir-Oct 1996

<table>
<thead>
<tr>
<th>Service</th>
<th>Count</th>
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<tr>
<td>Hospital dialysis UZ Gent</td>
<td>80</td>
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<tr>
<td>CAPD patients UZ Gent</td>
<td>40</td>
</tr>
<tr>
<td>Number of transplantations /year UZ Gent</td>
<td>40</td>
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<tr>
<td>Low care dialysis ASZ</td>
<td>40</td>
</tr>
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</table>

### Actuel status -end 2013

<table>
<thead>
<tr>
<th>Service</th>
<th>Count</th>
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<tbody>
<tr>
<td>Hospital hemodialysis UZ Gent</td>
<td>92</td>
</tr>
<tr>
<td>Low Care UZ Gent-night hemodialysis</td>
<td>22</td>
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<tr>
<td>Hemodialysis Low Care ASZ + ZH Geraardsbergen</td>
<td>117</td>
</tr>
<tr>
<td>Hemodialysis</td>
<td>11</td>
</tr>
<tr>
<td>CAPD UZ Gent + low cares</td>
<td>33</td>
</tr>
<tr>
<td>Number of transplantations/ year UZ Gent</td>
<td>86</td>
</tr>
</tbody>
</table>
The history of dialysis

THE ARTIFICIAL KIDNEY & HEMODIALYSIS PATIENTS TODAY

- Experimental Therapy
- Standard Therapy
- Routine Therapy

Japan** 76,758 HD-Pts >10 years therapy
2010 11,233 HD-Pts >25 years therapy

World* 2012
- 2,164,000
- Europe* 2012
- 614,000
- USA* 2012
- 436,000
- Japan** 2010
- 312,000
- Belgium* 2012
- 7,900

Re: *S Moeller, FMC Annual Survey 2012 (2013)
** S. Nakai et al., Ther Apher & Dial, 16:11-53 (2012)
FAMOUS PEOPLE ON DIALYSIS

Ferdinand Marcos
Joeri Andropov
Kim-Jong il
Leonid Brezhnev
Bruno Kreisky
General Franco
FAMOUS PEOPLE ON DIALYSIS

Ferdinand Marcos

Joeri Andropov

Kim-Jong il

Leonid Brezhnev

Bruno Kreisky

General Franco

Osama Bin Laden
Acute renal failure and the crush syndrome
A case of "traumatic" nephropathy during World War I (1914-18) is also described in this article. The renal arteriolar changes in the anuric crush syndrome are discussed.

N. Goormaghtigh, from the Department of Pathology, University of Ghent, Ghent, Belgium, reports that the patient's blood pressure was initially 145/70 mm. Hg, but decreased to 60/50 mm. Hg by the third day. Hemodilution and hemolysis were noted, with hemoglobin levels dropping from 3,900,000 to 2,100,000 red blood cells per mm. Shortly before death in uremic coma on the sixth day, kidneys were fixed in Bouin's and Flemming's fluids. This case is designated as no. 76.
A case of "traumatic uremia" observed by me during the war of 1914–18 is also included. The clinical data in this instance are summarized as follows: V. d. B., 23 years old; wounded in the shoulder by a shell splinter; left axillary artery torn with formation of a large hematoma, accompanied by hemorrhagic shock. Ligature of the left axillary artery and vein was performed and a blood transfusion was given. Incipient ischemic gangrene of the left arm appeared on the fifth day. Oliguria became notable (urinary output: maximum, 285 cc.; none on the sixth day). Urine: clear, albumin in small amount; uremic symptoms included vomiting. Blood pressure: 60/50 mm. of Hg on admission; 130/70 on the second and third days; 145/70 on the fourth; 140/60 on the fifth; 170/60 on the sixth day. Hemodilution was shown in the erythrocyte counts, which fell from 3,900,000, 5 hours after trauma, to 2,100,000 red blood cells per mm. shortly before death in uremic coma on the sixth day. Kidneys were fixed in Bouin’s and Flemming’s fluids. This case is designated as no. 76.
Definitions

 Crush injury: Direct injury by collapsing material and debris causing muscle swelling and/or neurological disturbances in the affected parts of the body.

 Crush syndrome: Crush injury combined with systemic manifestations, including AKI, sepsis, ARDS, DIC, bleeding, hypovolemic shock, cardiac failure, arrhythmias, electrolyte disturbances.

 Rhabdomyolysis: Damage to striated muscle resulting in the systemic release of intramuscular components.

 Fasciotomy:
Compartment syndrome

- Compartment: space restricted by the rigid fasciae surrounding the muscles

Compartment syndrome

- Increased pressure in the compartments due to traumatic tissue swelling

Disrupts perfusion/hinders muscle function
Massive swelling of the calf compartment due to rhabdomyolysis after ischemia-reperfusion
Results after fasciotomy
Crush Syndrome History

First described in German literature in victims of Messina earthquake of 1909

WW I Germans noted traumatic rhabdomyolysis

Minami in 1924 linked rhabdomyolysis and renal failure
More than one million London houses were destroyed or damaged, and more than 40,000 civilians died.
“Victim buried several hours with pressure on a limb....good condition on admission... later shock...diminution of arterial pulsations in affected limb...incipient gangrene...signs of renal damage...blood urea and potassium become progressively higher...death usually within a week.”

Description by Bywaters of trapped victims in the London Blitz, 1941
Mechanism of ARF following crush injury to skeletal muscle, an example of ischemia-reperfusion.

Clinical outcome in 15 patients with extensive traumatic rhabdomyolysis

<table>
<thead>
<tr>
<th>Year</th>
<th>Patient (n)</th>
<th>Duration of trapping (h)</th>
<th>Delay (h)</th>
<th>ARF</th>
<th>Fasciotomy</th>
<th>Fluid balance (kg/60 hrs)</th>
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<tr>
<td>1979</td>
<td>7</td>
<td>12</td>
<td>6-10</td>
<td>7</td>
<td>5</td>
<td></td>
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<tr>
<td>1982</td>
<td>7</td>
<td>12.3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>+ 12.5</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>5.5</td>
<td>24</td>
<td>1</td>
<td>0</td>
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</table>

Better OS  
Nephron 55,97,1990
1988: THE ARMENIAN EARTHQUAKE

• Death toll: 25,000 ?
• Crush cases: 600 ?
• Many crush pts. died due to lack of dialysis

Help not effective

Need for preplanned logistic organisation

RENAL DISASTER RELIEF TASK FORCE
Supplementation of MEDICAL MATERIAL and PERSONNEL

International relief \neq functional help

- Guatemalan e.1976 $\Rightarrow$ 90% drugs useless (unsorted) \cite{Seaman, Injury, 1990}
- Armenian e.1978 $\Rightarrow$ 70% useless (expired or damaged) \cite{Auiter, Lancet, 1990}

International personnel support $\Rightarrow$ useful or harmful

Local / Global integrated responses are mandatory !
International dialysis aid in earthquakes and other disasters


University of Alberta Hospitals, 5B4.02 W.C. Mackenzie Health Sciences Centre, Edmonton, Alberta, Canada; Guy's Hospital, London, England, United Kingdom; Hennepin County Medical Center, University of Minnesota, Minneapolis, Minnesota, and Baylor College of Medicine, Houston, Texas, USA; Chaim Sheba Medical Center, Tel-Aviv University, Tel-Hashomer, Israel; A.V. Vishroosby Surgical Institute, Moscow, Russia; University of Alberta Hospitals, Edmonton, Canada; University Hospital, Ghent, Belgium; Long Island Kidney Institute, Freeport, New York, UCLA School of Medicine, Los Angeles, California, and The Johns Hopkins Hospital, Baltimore, Maryland, USA; Centre Hospitalier Universitaire Vaudois, Lausanne, Switzerland; Nippon Medical School, Tokyo, Japan, and for the ISN Commission on Acute Renal Failure
Dr Reginald Moreels

1986 - 1994: president of Physicians without borders Belgium
Founded in 1971 by Drs Bernard Kouchner en Max Reclamier, After experiences as Red Cross physicians in the Biafra war -1968-1971

1999: Nobelprize for Peace
“For their humanitarian pioneering work in many continents"
THE MARMARA EARTHQUAKE (1999)

Intensity: 7.4; deaths: 17,480; injured: 43,953

Sever et al. Kidney Int. 2001;60:1114-23
General outcome of the Marmara earthquake (1999)

• Mortality : 425 patients of the 5302 hospitalized patients died (=4.3%)
• Total mortality of patients with “renal problems”: 98 out of 650 patients ( = 15%)
• Total mortality of patients with dialysis: 98 out of 476 patients (=20.5%)
• Recovery renal function : all surviving patients
MEDICAL INTERVENTIONS AT THE DISASTER FIELD (FOR PROPHYLAXIS OF CRUSH SYNDROME)

EARLY FLUID ADMINISTRATION IS OF VITAL IMPORTANCE!

Better and Stein, NEJM, 1990
Vanholder et al, Kidney Int, 2000
Earthquakes associated with mortality > 5000 since 1985

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Magnitude</th>
<th>Deaths</th>
<th>Crush syndrome</th>
<th>Dialysis</th>
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<tr>
<td>Michoacan, Mexico</td>
<td>1985</td>
<td>8.0</td>
<td>9500</td>
<td>Unknown</td>
<td>Unknown</td>
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<tr>
<td>Spitak, Armenia</td>
<td>1988</td>
<td>6.7</td>
<td>25,000</td>
<td>600</td>
<td>225-385</td>
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<tr>
<td>Western Iran</td>
<td>1990</td>
<td>7.4</td>
<td>50,000</td>
<td>Unknown</td>
<td>156</td>
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<tr>
<td>Latur-Killari, India</td>
<td>1993</td>
<td>6.2</td>
<td>9748</td>
<td>Unknown</td>
<td>Unknown</td>
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<td>Kobe, Japan</td>
<td>1995</td>
<td>6.9</td>
<td>5000</td>
<td>372</td>
<td>123</td>
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<td>Marmara, Turkey</td>
<td>1999</td>
<td>7.6</td>
<td>17,118</td>
<td>639</td>
<td>477</td>
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<td>Gujarat, India</td>
<td>2001</td>
<td>7.6</td>
<td>20,085</td>
<td>35</td>
<td>33</td>
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<td>Bam, Iran</td>
<td>2003</td>
<td>6.6</td>
<td>31,000</td>
<td>124</td>
<td>96</td>
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<td>Sumatra, Indonesia</td>
<td>2004</td>
<td>9.1</td>
<td>227,898</td>
<td>Unknown</td>
<td>Unknown</td>
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<td>Kashmir, Pakistan</td>
<td>2005</td>
<td>7.6</td>
<td>86,000</td>
<td>118</td>
<td>65</td>
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<td>Sumatra, Indonesia</td>
<td>2006</td>
<td>6.3</td>
<td>5749</td>
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<td>Unknown</td>
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<td>Sichuan, China</td>
<td>2008</td>
<td>7.9</td>
<td>87,587</td>
<td>229</td>
<td>113</td>
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<td>Port au Prince, Haiti</td>
<td>2010</td>
<td>7.0</td>
<td>316,000</td>
<td>Unknown</td>
<td>79</td>
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<tr>
<td>Tohoku, Japan</td>
<td>2011</td>
<td>9.0</td>
<td>20,896</td>
<td>Unknown</td>
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GLOBAL SEISMIC HAZARD MAP

- Californian fault
- The whole Mediterranean
- South-East Asia
- The Far-East
- Tehran

Heightened Odds of Large Earthquakes Near Istanbul: An Interaction-Based Probability Calculation

Tom Parsons,1* Shinji Toda,2 Ross S. Stein,1 Aykut Barka,3 James H. Dieterich1

Science, 288: 661-5; 2000
Management of Crush-Related Injuries after Disasters

Mehmet Sukru Sever, M.D., Raymond Vanholder, M.D., Ph.D., and Norbert Lameire, M.D., Ph.D.

Special Feature: Nephrology Roles and Responsibilities in Natural Disasters

Kidney Patient Care in Disasters: Lessons from the Hurricanes and Earthquake of 2005

Jeffrey B. Kopp,* Lynda K. Ball,† Andrew Cohen,‡ Robert J. Kenney,§ Kenneth D. Lempert,‖
Thanking words

• Dr Jan Clement
• Prof Garabed Eknoyan
• Prof em Severin Ringoir
• Prof Raymond Vanholder
Special thanks to

Prof. em Google and...

his master PhD thesis Wikipedia