Vaccination of Health Care Workers

Kent A. Sepkowitz, MD
Memorial Sloan-Kettering Cancer Center
“Following the report, we received several inquiries from hospital personnel anxious about their risk of contracting AIDS... Association was only temporal... We therefore question the significance of the needlestick injury... Hospital workers should be re-assured that, although cases of AIDS have been described in hospital staff, none have had a history of caring for an AIDS patient.”

_Lancet June 2, 1984_
# Available Vaccines Recommended

<table>
<thead>
<tr>
<th>Dead</th>
<th>Alive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Influenza</td>
<td>MMR</td>
</tr>
<tr>
<td>HBV</td>
<td>Varicella</td>
</tr>
<tr>
<td>Tetanus</td>
<td>Smallpox (+/-)</td>
</tr>
<tr>
<td>Diphtheria</td>
<td></td>
</tr>
<tr>
<td>Pertussis</td>
<td></td>
</tr>
<tr>
<td>Available Vaccines</td>
<td>Not Recommended</td>
</tr>
<tr>
<td>--------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td><em>Dead</em></td>
<td></td>
</tr>
<tr>
<td>• Pneumococcus</td>
<td></td>
</tr>
<tr>
<td>• Hepatitis A</td>
<td></td>
</tr>
<tr>
<td>• Polio</td>
<td></td>
</tr>
<tr>
<td><em>Alive</em></td>
<td></td>
</tr>
<tr>
<td>• BCG</td>
<td></td>
</tr>
<tr>
<td>• Polio</td>
<td></td>
</tr>
</tbody>
</table>
Live Vaccines

• Concern about long-term untoward effects:
  – Autism
  – Multiple sclerosis
  – Encephalitis

• No study has demonstrated a problem, but…
Occupationally-Acquired Infections in HCW

• **Bloodborne**
  - HIV, hepatitis B and C, CMV, Ebola

• **Airborne**
  - TB, measles, varicella, influenza, RSV
  - parvovirus B19, rubella, pertussis, variola

• **Fecal-Oral**
  - salmonella, hepatitis A, helicobacter, Norwalk

• **Direct**
  - scabies, herpes simplex
Occupationally-Acquired Infections in HCW

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## Annual Deaths “On The Job” By Occupation, U.S.

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Year</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policemen, 1994</td>
<td></td>
<td>157</td>
</tr>
<tr>
<td>Firemen, 1994</td>
<td></td>
<td>106</td>
</tr>
<tr>
<td>HCW (hepatitis B), 1990</td>
<td></td>
<td>125-190</td>
</tr>
<tr>
<td>Condition</td>
<td>Prevalence</td>
<td></td>
</tr>
<tr>
<td>-----------------</td>
<td>------------</td>
<td></td>
</tr>
<tr>
<td>Hepatitis B</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>HBsAg</td>
<td>0.5%</td>
<td></td>
</tr>
<tr>
<td>Hepatitis C</td>
<td>1-2%</td>
<td></td>
</tr>
<tr>
<td>HIV</td>
<td>0.4%</td>
<td></td>
</tr>
<tr>
<td>Transmission Rates</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Hepatitis B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e-Ag-positive</td>
<td>30%</td>
<td></td>
</tr>
<tr>
<td>e-Ag-negative</td>
<td>3%</td>
<td></td>
</tr>
<tr>
<td>• Hepatitis C</td>
<td>3%</td>
<td></td>
</tr>
<tr>
<td>• HIV</td>
<td>0.3%</td>
<td></td>
</tr>
</tbody>
</table>
How Long Does HBV Vaccine Work?

• US does not recommend re-vaccination except dialysis workers
• Many countries re-vaccinate every 5-10 years or when titers fall below a certain level
What About Non-Converters?

- Excellent data from Eskimo/Inuit cohort followed since 1981-2 after vaccine
- Hyperendemic for HBV
- Non-converters had no serious cases of acute HBV, though 3 had new HBcAb over 10 years
- Non-converters may be protected
Who Does Not Seroconvert?

• Overall rate about 90+%  
• Overweight smoking older males have lower rates -- 60+%  
• Repeat 3-dose series X 1 adds 30-50% conversion
Hepatitis C

- 70%% progression to chronicity
- 5% risk of cancer or cirrhotic death per lifetime
- No vaccine forthcoming
- IVIG probably not effective (HCIG)
TREATMENT OF ACUTE HEPATITIS C WITH INTERFERON ALFA-2b

ELMAR JAECKEL, M.D., MARKUS CORNBERG, M.D., HEINER WEDEMEYER, M.D., TERESA SANTANTONIO, M.D., JULIKA MAYER, M.D., MYRGA ZANKEL, D.V.M., GIUSEPPE PASTORE, M.D., MANFRED DIETRICH, M.D., CHRISTIAN TRAUTWEIN, M.D., AND MICHAEL P. MANNS, M.D., FOR THE GERMAN ACUTE HEPATITIS C THERAPY GROUP

ABSTRACT

Background In people who are infected with the hepatitis C virus (HCV), chronic infection often develops and is difficult to eradicate. We sought to determine whether treatment during the acute phase could prevent the development of chronic infection.

Methods Between 1998 and 2001, we identified 44 patients throughout Germany who had acute hepatitis C. Patients received 5 million U of interferon alfa-2b subcutaneously daily for 4 weeks and then three times per week for another 20 weeks. Serum HCV RNA levels were measured before and during therapy and 24 weeks after the end of therapy.

Results The mean age of the 44 patients was 36 years; 25 were women. Nine became infected with HCV through intravenous drug use, 14 through a needle-stick injury, 7 through medical procedures, and 10 through sexual contact; the mode of infection could not be determined in 4. The average time from infection to the first signs or symptoms of hepatitis was 54 days, and the average time from infection until the start of therapy was 89 days. At the end of both therapy and follow-up, 43 patients (98 percent) had undetectable levels of HCV RNA in serum and normal serum alanine aminotransferase levels. Levels of HCV RNA became undetectable after an average of 3.2 weeks of treatment. Therapy was well tolerated in all but one patient, who stopped therapy after 12 weeks because of side effects.

Conclusions Treatment of acute hepatitis C with interferon alfa-2b prevents chronic infection. (N Engl J Med 2001;345:1452-7.)

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**Table 1. Base-Line Characteristics of the 44 Patients.**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age — yr</td>
<td>36±11</td>
</tr>
<tr>
<td>Female sex — no. (%)</td>
<td>25 (57)</td>
</tr>
<tr>
<td>Icterus — no. (%)</td>
<td>30 (68)</td>
</tr>
<tr>
<td>Mode of infection — no. (%)</td>
<td></td>
</tr>
<tr>
<td>Intravenous drug use</td>
<td>9 (20)</td>
</tr>
<tr>
<td>Needle-stick injury</td>
<td>14 (32)</td>
</tr>
<tr>
<td>Medical procedure†</td>
<td>7 (16)</td>
</tr>
<tr>
<td>Sexual contact with HCV-positive partners</td>
<td>10 (23)</td>
</tr>
<tr>
<td>Unclear</td>
<td>4 (9)</td>
</tr>
<tr>
<td>Viral load — copies of HCV RNA ×10⁻⁶/ml</td>
<td>0.42±0.93</td>
</tr>
<tr>
<td>Alanine aminotransferase — U/liter</td>
<td>885±554</td>
</tr>
<tr>
<td>HCV genotype — no. (%)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>27 (61)</td>
</tr>
<tr>
<td>2 or 3</td>
<td>12 (27)</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Unclear</td>
<td>5 (11)</td>
</tr>
</tbody>
</table>

*Plus–minus values are means ±SD.

†The medical procedures consisted of dental surgery, aortic-valve replacement, gynecologic laparoscopy, tonsillectomy, resection of sigmoid colon, skin surgery, and varicose-vein surgery.
HCV: Response to Exposure

• Clean area
• Draw appropriate bloods (baseline HCV, LFTs)
• “Counsel the patient/health care worker”
Occupationally-Acquired Infections in HCW

• **Bloodborne**
  HIV, hepatitis B and C, CMV, Ebola

• **Airborne**
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  parvovirus B19, rubella, pertussis, variola

• **Fecal-Oral**
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• **Direct**
  scabies, herpes simplex
Pertussis

- 20% of adult population estimated to susceptible
- Our immunity is waning: outbreaks in vaccinated populations
- How long does vaccine work?
- What about acellular vaccine?
Pertussis

• 12-30% of all prolonged coughing illnesses in adults are pertussis
• Rates increasing among young adults and adults
• Delay in diagnosis common
  – non-specific symptoms
  – not all labs set up for culture: need special plates
Pertussis

- Cincinnati outbreak of 1993: 2% of all HCW’s (87 total) at peds hospital developed pertussis
  
  Christie et al, ICHE 1995;16:556

- Prospective study in 145 MD’s: 5 with pertussis at 1 year
  
  Wright et al, ICHE 1999;20:120
Pertussis

• Prospective study in 51 HCW’s: 90% with serologic evidence of new infection over 5 years

• Pertussis in adults is “common, endemic, and usually unrecognized”

DeVille et al, CID 1995;21:639
Measles

- Live attenuated vaccine
- Waning immunity resulted in additional vaccine for young adults/older children
- By EHS records at MSKCC, about 8% of new workers remain measles antibody negative
Influenza: Model for the Worst Possible Vaccine

- Needs to be given annually
- Covers anticipated strains only
- Only 80%+ effective against selected strains
- Hurts but does not cause influenza
- Does not prevent all other earthly forms of URI
Influenza

- HCW vaccination effectively decreases respiratory morbidity in long-term care facilities
- Most programs succeed at 30-50% rate
- Bringing vaccine to worker helps, education helps, but little really helps
- Canadians have 70%+ vaccination rates
Smallpox

• Current program mostly a dud
• Myopericarditis an unexpected problem
# How Contagious is Smallpox?

<table>
<thead>
<tr>
<th></th>
<th>Close Contacts</th>
<th>Naïve</th>
<th>Vaccinated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chickenpox</td>
<td>60-80%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Measles</td>
<td>75-90%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Smallpox</td>
<td>55-60%</td>
<td>4%</td>
<td>-</td>
</tr>
</tbody>
</table>
How Durable is Immunity from Previous Vaccination?

- No one knows
- Monkey pox experience
- Liverpool experience
Smallpox in Liverpool During Ten Years 1902-1911
Showing the Relative Severity of the Disease As It Affects Vaccinated and Unvaccinated Persons, Based on the Records of 1,163 Cases

Persons Unvaccinated (N = 220)

Smallpox in Liverpool During Ten Years 1902-1911
Showing the Relative Severity of the Disease As It Affects Vaccinated and Unvaccinated Persons, Based on the Records of 1,163 Cases

Persons Vaccinated in Infancy (N = 943)

Myocarditis
Military and civilian experience

- About 1 per 1500 vaccinations
- All male primary vaccinees in military
  - Rate at 1 in 800
- Mostly female revaccinees in civilian program
- All recovered
- Long-term consequences not known
- Case definition remains very difficult
Myocardial Infarction

- 10 MI’s (3 fatal) in military/civilian population
- No evidence of vaccinia in 1 autopsy
- Most had underlying cardiac risk factors
- Most occurred within first weeks post vaccination in revaccinees
- New questions to exclude those with underlying coronary artery disease has been effective
VIG

• Used for eczema vaccinatum and generalized vaccinia
• Possibly useful for ocular vaccinia
• No treatment benefit in encephalitis
• ? Benefit in progressive vaccinia
• Narrow window for collection (4 to 10 weeks post-vaccine, max at 6 weeks)
• US supply is too small
Nosocomial Spread Literature Review

- Twelve reports (7 in English, 2 in German and 1 each in Swedish, Italian, and French)
- 85 secondary cases including 23 due to direct contact
- About 75% in children
- Mortality rate: 9 (11%) of 85
Nosocomial Spread
Who Starts It?

- Eczema vaccinatum source case: 5 (all children)
- Generalized/disseminated vaccinia: 2 (both adults)
- Burn patient: 1
- Urinary catheter: 1
- Community vaccination program: 2
- Unknown: 1
Nosocomial Spread

Who Gets It?

• All secondary cases had an underlying skin disorder:
  – Eczema (most common)
  – Pemphigus foliaceous (adults)
  – Burns
  – Mycosis fungoides
  – Scabies, secondary lues, impetigo
  – Acne, scrapes also described
Nosocomial Spread

What is the Presentation?

- Eczema vaccinatum
- Inoculation vaccinia
- Possible secondary case of generalized vaccinia
- **No** secondary case of progressive vaccinia
- **No** secondary case of encephalitis, except among those with overwhelming eczema vaccinatum
Italy, 1953

- Infant with dysuria receives urinary catheter
- Catheter removed and placed into pan with other catheters
- 23 additional children catheterized for various reasons developed secondary genital vaccinia, some with hematuria, viruria
Brooklyn, 1947

- City-wide vaccination
- 16 secondary cases of eczema vaccinatum cared for in children’s infectious disease hospital
- 3 were nosocomial
- No known exposure but thought by investigators to be due to exposure to HCWs
Glasgow, 1936

- Infant with eczema vaccinatum admitted to ward of children with skin disorders
- All 11 children on the same ward developed eczema vaccinatum
- Four children from the ward far down the hall also developed disease
- Three nurses became ill with sore throat and one with “pustular bullae” on forearm
Palo Alto, 1975

• Source case was recently vaccinated adult with disseminated vaccinia who was hospitalized and isolated immediately
• 3 hours before discharge, walked hall in street clothes (80-90% scabs had separated)
• 63 yo woman already hospitalized for management of mycosis fungoides cared for in room 75 feet away
Palo Alto, 1975 (con’t)

• She walked in hall on same day that the source case walked in it but they did not talk (both were later interviewed)
• Developed disseminated vaccinia 10 days later
• Investigation included paired sera on close contacts (unrevealing), culture of vaccinia on inanimate surfaces (lasted 78 hours)
• Likeliest route: patient to HCW to patient
US Experience
Military

• Vaccinated to date
  -> 450,000 military

• 10-40% ‘screen out’ for personal or home health reasons

• 70% primary vaccinees

• 13% women

• Median age: 26 years
# Military Experience

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sick leave, overall</td>
<td>3% of vaccinated people</td>
</tr>
<tr>
<td>Average length of sick leave</td>
<td>1.5 days</td>
</tr>
<tr>
<td>Auto-inoculation (inadvertent infection)</td>
<td>48 cases, none severe, mostly primary vaccinations, mostly outpatients</td>
</tr>
<tr>
<td>Transfer of vaccinia virus to contacts</td>
<td>19 cases, none severe, 18 treated as outpatients and 1 as inpatient</td>
</tr>
<tr>
<td>Generalized vaccinia</td>
<td>36 cases, all mild, mostly outpatients</td>
</tr>
<tr>
<td>Treatments with vaccinia immune globulin (VIG)*</td>
<td>2 cases</td>
</tr>
<tr>
<td>Severe reactions (e.g., eczema vaccinatum, progressive vaccinia)</td>
<td>0 cases</td>
</tr>
<tr>
<td>Deaths due to smallpox vaccination</td>
<td>0 cases</td>
</tr>
</tbody>
</table>
US Experience
Civilian

- Vaccinated to date
  - 37,000 HCWs
  - 1 president
- 25% primary vaccinees
- 65% women
- Median age: 48 years
Overall Experience

- Secondary vaccinees: 96% take
- Primary vaccinees: 96% take
- Many non-specific rashes
- 1/1000 women with ‘occult pregnancy’
- A few cases of possible encephalitis
- Cardiac issues
- No other surprises
HCW Vaccine Needs

- CMV
- Pneumococcus
- RSV
- Variola
- HIV
- HCV
Conclusions

- Hospitals remain slightly unsafe places to work in
- Healthcare workers do not avail themselves of useful vaccinations
- Smallpox would crush the healthcare system