Adult Immunization in India

O P Sharma[1]

ABSTRACT

Indians are enjoying a longer life and better living conditions as a result of increased life expectancy, increased standard of living as well as medical advancement. However there are many infectious diseases to which elderly population is prone for. Because of effective vaccination strategies in newborn and pedietric population, many vaccine preventable diseases like tetanus are seen more commonly in adult population. Further elderly population is also prone for infections like H1N1, Community acquired pneumonia etc.because of compromised immune function. Inspite of these facts awareness regarding adult vaccination is lacking not only amongst general public but also amongst clinicians. This review article summarises importance of vaccination amongst adult population

Introduction :

The world is greying and so is India. Currently pegged at around 8% of our population, the Indian elderly are projected to constitute around 12.17% of our population by 2026[1]. Considering our population size, these projected percentages of the elderly population translate into large numbers. For the developing countries including India, the ageing population may pose mounting pressures on various socio economic fronts including health care expenditures. As our population ages, infectious disease in this segment is becoming a serious public health concern. The increased risk of infections observed with aging may be due to physiologic changes of 'homeostasis', that accompany "normal" ageing, age-associated diseases and the interventions for them.

Immunosenescence contributes to the increased prevalence of infections in the elderly population. Pneumonia, Influenza, Tetanus & lately recognized Diphtheria, Pertussis & Herpes Zosterare a group of Vaccine preventable diseases which otherwise cause considerable morbidity & mortality in older adults. Considering the inadequate medical & health infrastructure, vaccination for above diseases is a good cost effective preventive strategy to achieve positive health.

[1]Senior Consultant, Geriatric Medicine
Indraprastha Apollo Hospitals, New Delhi
National Professor, Geriatrics

Address for Correspondence -
Dr. O. P. Sharma
E-mail : opsharma.gsi@gmail.com

Immunosenescence in elderly

As one grows old, the immune system undergoes age-associated changes. The decrease in immune response due to age is termed as immunosenescence. As the age advances there is mild immune deficiency. The action of T cells is affected and duration of memory in them gets reduced. There is involution of thymus gland leading to its progressive loss of function. Thymus produces less number of T naïve cells. This makes the elderly more prone for infections; show poor response to vaccines. There is a progressive deterioration of innate and adaptive immune systems leading to immunosenescence in elderly. Though the number of neutrophils remains same, their phagocytic capacity and antigen-presenting function are decreased. The cytotoxic effect of natural killer (NK) cells and production of cytokines are decreased. Memory B cells production in the bone marrow is also decreased and it forms the basis for failure of effect of secondary vaccination e.g., influenza vaccine. In addition there is reduction in number and function of dendritic cells in blood and decrease in pool of naïve T and B cells, decrease in number of memory and effector T and B cells, decrease in ratio of T helper / T suppressor cells. Resistance to apoptosis, short telomere length and increase in immature T cells. Effects of immunosenescence on infection in elderlyare atypical presentation, more frequent occurrence, prolonged duration, recurrence & increased

morbidity and mortality. Immunosenescence does not affect vaccine response equally for all vaccines. Influenza vaccine response is reduced while tetanus vaccine response is robust in elderly.

PNEUMOCOCAL PNEUMONIA

Pneumococcal infections continue to be a major cause of morbidity and mortality, despite sophisticated diagnostic techniques and the availability and use of effective antimicrobials. *Streptococcus pneumoniaeis* the single most important bacterial agent causing pneumonia, otitis media, sinusitis, bronchitis, and invasive pneumococcal disease (IPD) comprising bacteraemic pneumonia, bacteraemia and meningitis. It has 90 different serotypes, out of which 10 most common forms are responsible for 62% of all infections throughout the world. Using official mortality rates compiled by the world health organization (WHO) in 2003[2], the global alliance for vaccines & immunization (GAVI) determined that pneumococcal disease was the leading cause of death in all age groups analysed. Invasive disease from *streptococcus pneumoniaeis* a major cause of illness and death in the United States, with an estimated 43,500 cases and 5,000 deaths among persons of all ages in 2009[3].

Indian scenario

In India the size of the elderly population is fast growing. Several studies in India[4], (Bansal et al in Shimla, Shah et al in Sri Nagar, Capoor et al in New Delhi, and DGHS data[5] have shown alarming incidence of pneumonia in civilian population.

Vulnerable segments[5]

- *Extremes of age*
- Co-morbid conditions such as diabetes mellitus, CHF, cardiomyopathy, bronchiectasis, bronchial asthma, COPD, hepatitis C infection, cirrhosis of liver, chronic renal failure are vulnerable to pneumococcal infections. The smokers too exhibit an increased risk for development of pneumonia.
- *Immunocompromised states*
- *Influenza.*
- *Prolonged stay in nursing homes*
- *Mass gatherings*[6]

Pnemococcal Vaccines

There are two types of vaccines namely pneumococcal polysaccharide vaccine (PPSV23) and pneumococcal conjugate vaccine (PCV13).

`PPSV 23[7]

A tetravalent pneumococcal polysaccharide vaccine was introduced in 1945. It was derived from a capsular polysaccharide of killed *streptococcus pneumoniae.* The polysaccharide antigen was capable of inducing type-specific antibodies that enhanced opsonisation, phagocytosis and killing of pneumococci by phagocytic cells. The introduction of a vaccine was a landmark in medical history, however its usefulness was masked in presence of newly introduced antibiotics in the treatment. In 1983 it gave way for the production of a 23-valent formulation of a polysaccharide pneumococcal vaccine (PPSV23). It was reported to be beneficial in elderly in whom the incidence of IPD was high.

PCV13[8-12]

A new pneumococcal conjugate vaccine (PCV7) was introduced in 2000. Vaccine has caused significant reduction in the rates of pneumococcal disease in USA and Italy. Later PCV7 has been modified with addition of more serotypes. It was improved as a decavalent vaccine containing ten serotypes. During 2010 it was further modified into a triskavalent vaccine containing capsular polysaccharides from 13 serotypes of pneumococcus where bacterial polysaccharides are covalently conjugated to an immunogenic carrier protein containing nontoxic variety of diphtheria toxin (PRENAVAR 13, PCV13). It was found to be highly effective for prevention of invasive pneumococcal disease (IPD) in children caused by the 13-pneumococcal serotypes included in vaccine. The success has renewed interest in evaluating PCV in adults for prevention of invasive pneumococcal disease and pneumonia.

PCV 13 has been approved by US-FDA in 2011 for use in adults 50 years of age or older to prevent pneumonia and invasive disease by *streptococcus pneumoniae.*

In a study of 13-valent pneumococcal conjugate vaccine done on adults aged 50 years to compare the immune response to that induced by the 23-valent pneumococcal polysaccharide vaccine that has been the standard vaccination over the past 30 years, it was found that adults who are naïve or previously vaccinated with the polysaccharide vaccine, exhibited an overall superior antibody response when vaccinated with the conjugate vaccine. The nature of the response indicates a t-cell dependent response that elicits immunological memory, thus priming the immune system. The conjugate vaccine, which has been proved successful inproviding children with extraordinary protection against pneumococcal diseases, has provided a new approach to prevent pneumococcal disease including cap in adults.

The community-acquired pneumococcal immunization trial in adults (capita) was carried out in Netherlands during 2008 and 2012[13]. The efficacy of 13-valent polysaccharide conjugate vaccine (PCV13) was evaluated in a randomized, double-blind, placebo-controlled trial involving 84,496 adults 65 years of age or older in preventing first episode od serious pneumococcal disease. The results have shown that PCV13 has significant efficacy for the prevention of vaccine type cap andvaccine - type invasive pneumococcal disease among adults 65 years of age or older. The efficacy persisted for at least 4 years.

Schedule of vaccination

PPSV 23 is given only once as a single dose to elderly persons. One dose of (0.5 ml) of the vaccine

Vaccine	Advantage	Disadvantages
PPSV23	• Long experience (licensed 1983) • Not expensive • At present, relatively high serotype Coverage for IPD in elderly (60-70%) • Considerable efficacy proven against IPD (50-70%) in immunocompetent elderly • Cost-effective proven for elderly people even if it only prevents IPD	• T cell-independent immune response (IgM antibody produced, response declines in 3-5 years and no anamnestic response at revaccination) • Decrease in memory B cell frequency after PPV23 • Weak immunogenicity in some individuals • Unclear (null to small) efficacy against Nonbacteremic pneumococcal • Pneumonia. No effect on nasopharyngeal carriage • No efficacy demonstrated in reducing nasopharyngeal carriage • No impact proven in reducing overall pneumococcal disease burden
PCV13	• T cell-dependent immune response (larger duration and boosting effect at revaccination) • High efficacy (80-90%) against vaccine type IPD proven in children • Significant efficacy against pneumococcal pneumonia (CAPiTA study) • Potential efficacy in reducing nasopharyngeal carriage • Considerable impact in reducing all pneumococcal disease burden shown by prior PCV7	• Short experience (approved in 2011) • Expensive • At present, relatively small serotype coverage for IPD in the elderly (30-40%) • Future reduction of vaccination impact in adults / elderly (because of probable indirect effects from PCV13 pediatric use)

contains 25 micrograms of each capsular polysaccharide antigen dissolved in isotonic saline solution with 0.25% phenol as a preservative.

Revaccination may be recommended for persons exhibiting an increased risk for pneumococcal infection and to those who are likely to have a rapid decline in pneumococcal antibody levels provided that 5 years have elapsed since getting the first dose of pneumococcal vaccine.

Common adverse events reported are pain, redness and swelling at the injection site, limitation of movement of the injected arm, fatigue, headache, chills, muscle ache and joint pain. These manifestations are short-lived. *PCV13* is administered in a dose of 0.5 ml intramuscularly. The preferred site is the deltoid muscle of the upper arm.

INFLUENZA

Influenza or flu is an acute, contagious viral respiratory illness, mostly ignored. It can cause mild to severe illness, and when complicated with bacterial infection, particularly in high-risk population, can lead to serious consequences including death. It is estimated that all over the world, 3-5 million people suffer with seasonal influenza and 3,00,000 to 5,00,000 die each year. Children & elderly people suffer more.[14-15]

Seasonal influenza & pandemics

Seasonal human influenza outbreaks / epidemics are due to circulating influenza type A & B viruses undergoing drift in the virus. The seriousness of the disease & outbreak depends on the amount of the drift. Influenza outbreaks have been reported in Mongolia, Japan, Republic of Korea, China, India, Thailand, Singapore, and Australia & New Zealand[16].

Epidemiological survey suggests the presence of influenza virus during all the 12 months of the year with two peak seasons; one, in and around rainy season and another during the winter months when there is sudden fall in the atmospheric temperature.

Minor drift in the surface antigen of influenza virus (H&N), are the reason for the yearly outbreak of the disease. Whenever there is a shift in the surface antigenicity, pandemic results. Notables in the past 100 years are pandemics of 1918-19 (H1N1); 1957 (H2N2); 1968 (H3N2); (H1N1 1977) and 2009 (P H1N1). Influenza pandemics have a singular disease credit that over 50 - 100 m people died a fact unknown to have taken place due to any other human disease, in a century. This Figure is scary and makes one to think about influenza, which is even today, ignored as common cold. Influenza is not a common cold but much serious infection.

India, has distinct seasonality that might be related to latitude and environmental factors. While cities with temperate seasonality will benefit from vaccination in September-October, cities with peaks in the monsoon season in July-September will benefit from vaccination in April-May[17].

The world including India, was anticipating influenza pandemic, for almost a decade, due to bird flu (H5N1), but in 2009 swine flu virus (H1N1), a triple re-assorted virus antigenically (material received from swine, bird & human virus) appeared in Mexico and spread fast to assume the first influenza pandemic of the decade &century. There have been 15,174 deaths reported from 209 countries till February 2010. In India during this period 1,135 deaths were reported.

Vulnerable segment[18]

As such the entire population may be vaccinated; however, some people who are more prone to influenza infections should be specially vaccinated. These include :

1. Children < 5 years, but especially younger than 2 years' old & adults 65 years of age and older
2. Pregnant women
3. People who have following medical conditions like :

   Asthma Neurological and neurodevelopment conditions, Chronic lung disease & chronic heart disease, Blood disorders (such as sickle cell disease, Endocrine disorders (such as diabetes mellitus), Chronic kidney disorders and Chronic liver disorder, Inherited metabolic and mitochondrial disorders, immunocompromised

host, morbidly obese persons, People younger than 19 years of age who are receiving long-term aspirin therapy.

4. People who live in nursing homes and other long-term care facilities.
5. People who live with or care for the high risk population for complications from flu, including :
   - Health care workers
   - Household contacts and caregivers of children younger than 5 years of age with particular emphasis on vaccinating contacts of children younger than 6 months of age (children younger than 6 months are at highest risk of flu-related complications but are too young to get vaccinated)

Vaccination

There are two types of vaccines : killed and live attenuated vaccine.

The "trivalent inactivated influenza vaccine (TIV) and the live attenuated influenza vaccine (LAIV)", are good and are recommended for use by the advisory committee on immune practice (ACIP) for prevention of influenza.

The TIV is recommended in pregnant women are advised to avoid complications during the second and third trimesters and for women who get pregnant during the influenza outbreak season.

The seasonal influenza vaccine (LAIV) is a trivalent vaccine containing two influenzas A strains : one H1N1 type, one H3N2 strain and one influenza type B strain (each 15 mg) decided by who on the epidemiologic and antigenic analysis of the currently circulating strains.

The annual influenza vaccination (LAIV) is advised to cover any mutation, which the circulating virus undergoes over the time scale. Seasonal influenza vaccine is prepared annually to include the most likely strain for the season.

If an antigenic shift in the virus takes place, pandemic results. There is no pandemic virus vaccine available.

Post vaccination, antibodies develop in about two weeks' time, which protects against influenza virus infection.

The latest up-date by ACIP for 2015-2016 published in the 6 August 2015 issue of the morbidity and mortality weekly report suggests and re-confirms, "all people above 6 months' age should annually vaccinate in influenza season with influenza vaccine unless contraindicated." India being in the northern hemisphere the vaccination should be done by October, if possible. Vaccination should continue as long as influenza viruses are circulating. As a matter of fact, India today has two peaks of influenza, although the virus is circulating all the 12 months of the year, 365 days of the year; the vaccine could be given any time if available.

"The new guidelines update the 2014 ACIP recommendations concerning use of seasonal influenza vaccines. The antigenic and the virus composition of the 2015 to 2016 influenza vaccines, with changes in the influenza a (H3N2) virus and the influenza b virus compared with the 2014 to 2015 season". (Quote : ACIP updates influenza vaccine recommendations. Laurie Barclay; August 07, 2015.)

Indications

Annual vaccination against influenza is recommended for any adult who wants to reduce the risk of becoming ill with influenza. Vaccination is also recommended in :

- Persons aged > 50 years.
- Women who will be pregnant during the influenza season.
- Persons who have chronic pulmonary diseases; cardiovascular, renal, hepatic, hematological or metabolic disorders (including diabetes mellitus).
- Persons who have immune suppression Residents of nursing homes and other chronic-care facilities.
- Health-care personnel.
- House hold contacts and caregivers of children aged < 5 years, adults aged > 50 years and persons with comorbid medical conditions.

Schedule of vaccination[19]

TIV is given only once as a single dose to elderly persons. It is available as 0.5 ml liquid in prefilled syringe. This is given as intramuscular injection in the deltoid muscle. Yearly flu vaccination should begin in September, or as soon as vaccine is available, and continue throughout the flu season, which can last as late, as May. This is because the timing and duration of flu seasons vary. While flu season can begin as early as October, most of the time seasonal flu activity peaks in January, February or later.

LAIV is not indicated in persons ≥ 50 years. CDC has recommended not to use LAIV during 2016-17 influenza season.

Revaccination : influenza vaccine is recommended to be administered annually.

Common adverse events

Influenza vaccine is by and large very safe. The most common side effects of the injectable variety include soreness, redness, or swelling at the site of the injection. These reactions are temporary and occur in 15% - 20% of recipients. Less than 1% of vaccine recipients develop symptoms such as fever, chills, and muscle aches for 1 to 2 days following the vaccination. These symptoms are more likely to occur in persons who have never been exposed to the influenza virus or vaccine. Rarely side effects like include life-threatening allergic reactions do occur.

TETANUS

Tetanus is an acute, often fatal, disease caused by an exotoxin produced by the bacterium *clostridium tetani.* Neonatal tetanus has been the more prevalent form of the disease in the past. However, with the increasing practice of maternal immunisation and clean delivery practices ("three cleans"), the incidence of neonatal tetanus has shown a sharp decline in the last two decades.

The overall age distribution of tetanus has changed considerably particularly in age groups covered by routine immunization in developed countries. Its incidence has greatly decreased in adults, with the highest incidence rate among adults of 60 years[20] of age and older. In the united states, during the period from 2001-2008, a total of 233 cases and 26 deaths from tetanus were reported. Out of these, 30% were in persons aged 65 years or older. The risk of dying from tetanus was five times greater in patients > 65 years. Data from a national population-based serosurvey conducted in the united states during 1988-1994 indicated that the prevalence of immunity to tetanus, defined as a tetanus antitoxin concentration of > 0.15 iu/ml, was > 80% among adults aged 20-39 years and declined with increasing age. Forty-five percent of men and 21% of women aged > 70 years had protective levels of antibody to tetanus. These findings led ACIP (advisory committee on immunization practices) to recommend tetanus vaccination for adults older than 65 years.

INDIAN SCENARIO

In India, however, tetanus is an important endemic infection[21]. Routine immunisation and clean delivery practices have helped in reducing the burden of tetanus especially neonatal tetanus in the country. The incidence of neonatal form of the disease in India has shown progressive decline in the last decade. In the years 2013 and 2014, less than 500 cases were reported and on May 15, 2015 India was finally declared free of maternal and neonatal tetanus (www.unicef.org).

There is no official data available on the age specific incidence of non-neonatal tetanus in India. In an epidemiological study published by Chavada *et al* in 2010, posttraumatic tetanus was found to be the most common cause, and patients more than 50 years of age constituted 13.6% of the total patients included in the study. In a study on serological immunity to diphtheria and tetanus in healthy adults in Delhi published by Saxena *et al* in 2009, 47% of subjects were found to be susceptible to tetanus. In a similar study by Kulkarniet al (published in 2011), only 74% of adults had long-term protection against tetanus. Both the studies clearly demonstrate a need for tetanus vaccination in Indian adults, especially those who were never immunized.

Vaccine[22-23]

Vaccine available for active immunisation against tetanus is tetanus toxoid, an inactivated tetanus toxin.

Immunological basis of tetanus vaccination

Tetanus toxoid induces the formation of specific antitoxins. Immunity to tetanus is antibody-mediated and depends on the ability of antitoxins to neutralize tetanus toxin. Tetanus antitoxins, like diphtheria antitoxins, belong to the igg class; they easily pass through the placenta and are distributed throughout the bloodstream and extravascular spaces. Antitoxin in tissues can neutralize toxin produced in an infected wound. Antitoxin, which passes to the foetus through the placenta following active immunization of the mother, can prevent neonatal tetanus. Immunity to tetanus toxin is induced only by immunization; recovery from clinical tetanus does not result in protection against further attacks. Therefore, all patients with clinical tetanus should be immunized with tetanus toxoid, either at the time of diagnosis or during convalescence.

Vaccine types

Tetanus toxoid consists of a formaldehyde-treated toxin. Types of toxoid available are Adsorbed (aluminium salt precipitated) toxoid. & fluid toxoid. Although rates of seroconversion are almost about equal, the adsorbed toxoid is preferred because the antitoxin response reaches higher titres and is longer lasting than that following the fluid toxoid.

Tetanus toxoid is available as

- A single-antigen preparation
- Tet-vac (Serum International), sii tetanus toxoid (Serum Institute of India Ltd.), tetanus toxoid (Haffkine institute), tetanus toxoid (Bioe).
- Suspension of tetanus toxoid adsorbed on aluminium phosphate and suspended in isotonic sodium chloride solution

Each dose of 0.5 ml human dose contains

Tetanus toxoid ≥ 5 lf Adsorbed on aluminium ≤ 1.5 mg, Phosphate, Thiomersa l0.01% as preservative

Combined with diphtheria toxoid as paediatric diphtheria-tetanus toxoid (DT) or adult tetanus-diphtheria (Td).

- With both diphtheria toxoid and acellular pertussis vaccine as DTaP or tdap

As combined dtap-epb-ipv and dtap-ipv/hib

DIPHTHERIA

Diphtheria is a localised infection of mucus membranes of the throat caused by bacteria called *corynebacteriumdiphtheriae.* The infection is potentially fatal and the lethal effect occurs through its toxin. Any person who has not been immunized against diphtheria when exposed to a person infected with diphtheria becomes susceptible to diphtheria.

Since the time there is vaccination coverage against vaccine-preventable diseases that include diphtheria in the childhood, the incidence of the disease has decreased dramatically in the country. However, it has been observed that in some countries including developed areas have witnessed re-emergence of diphtheria due to waning immunity among adolescents and adults. The other added factors may be decreased immunization coverage amongst infants and children, and movement of people from one place to another thus losing an opportunity to immunize the children. India is also witnessing the changing epidemiology. Though vaccination is being carried out routinely for this condition during infancy, it is increasingly felt that there is a need to protect adolescents and adults by administration of booster doses of diphtheria vaccine.

Vaccine

Diphtheria vaccine protects against the disease. A vaccine is recommended as part of routine immunisation in infants in their first year of life and is administered as a combined vaccine with tetanus toxoid and pertussis vaccines (DPT). Diphtheria vaccine contains a toxoid (a modified vaccine of the diphtheria toxin) and it is not given as a single injection. It is given in the form of DPT vaccine is included in Universal immunization program.

Immunity against diphtheria is achieved after vaccination. Diphtheria stimulates the production of antitoxin, which protects against the toxin produced by the organisms. The absolute contraindications to diphtheria vaccine are anaphylaxis following a

previous dose of vaccine or anaphylaxis following any component of vaccine. A booster dose of diphtheria toxoid along with tetanus toxoid (dt) is given at 5 years of age.

Adolescent / adult vaccination

Another booster dose of diphtheria vaccine is recommended at the age of 15-17 years. Booster vaccine against diphtheria is recommended to all adults if they have not received booster dose of diphtheria vaccine in preceding 10 years. Booster vaccine is useful to the adults since the benefits of the vaccine decrease with age without constant re-exposure. All diphtheria immunisation for children are given in the form of an injection combined with tetanus toxoid and pertussis vaccine. Adults and adolescent receive diphtheria toxoid combined with tetanus toxoid, and pertussis acellular vaccine as a booster. Adolescent vaccine contains a small amount of diphtheria and tetanus toxoid, which are modified to make them harmless and small amounts of purified components of pertussis acellular vaccine and aluminium salt. After the vaccine has been given, it generally takes about 2 weeks to build immunity in the body.

The adolescent / adult TDaP vaccine is recommended on a single occasion to those who have previously completed a course of the vaccine. Such a booster vaccination is recommended to adults before planning pregnancy or for both parents as soon as possible at birth and to adults working with or caring young children. The vaccine is safe and well tolerated. Occasionally there can be side effects such as mild fever, tenderness and soreness at the site of injection. Drinking extra amount of fluids, by applying a cold wet cloth to the sore injection site and by taking paracetamol to reduce any discomfort and fever can reduce these side effects. A high vaccination rate in the country protects the population from resurgence of diphtheria.

Diphtheria in adult

Immunisation has led to a marked decrease in the incidence of the disease and also has reduced the size of the reservoir of toxigenic *corynebacteriumdiphtheriae* organisms. But a high proportion of adult cases of diphtheria have been reported from former Soviet Union. Before vaccination became widespread, exposure to toxigenic strains of diphtheria organisms was common and it provided natural boosts for development and maintenance of immunity against diphtheria. Children were susceptible and most adults remained immune to the disease. As immunization has become widespread, diphtheria has become rare, and concomitantly exposure to the organism (natural boosts of immunity) has become uncommon. With neither natural exposure to the bacteria nor booster dose of the vaccine, vaccine-induced immunity wanes and adults become susceptible to the disease. This has necessitated the need for maintenance of immunity in adults.

Since diphtheria infection can occur among previously vaccinated persons, regular diphtheria booster should close the immunity gap observed among adults. A single booster vaccine is sufficient to provide long-term protection for those in the risk group[24].

Prevention

Adults and adolescents receive diphtheria toxoid combined with tetanus toxoid, and pertussis acellular vaccine as a booster. Such vaccine contains a small amount of diphtheria and tetanus toxoid, which are modified to make them harmless and small amounts of purified components of pertussis a cellularvaccine and aluminium salt (TDaP). After the vaccine has been given, it generally takes about 2 weeks to build immunity in the body. The adult/adolescent TDaP vaccine is recommended as a one-time vaccine to those who have previously completed a schedule of the immunization. Such a booster vaccination is recommended to adults before planning pregnancy or for both parents as soon as possible at birth and to adults working with or caring young children. The vaccine is safe and well tolerated. Occasionally there can be side effects such as mild fever, tenderness and soreness at the site of injection. Drinking extra amount of fluids, by applying a cold wet cloth to the sore injection site and by taking paracetamol to reduce any discomfort and fever can reduce these side effects. A high vaccination rate in the country protects the population from resurgence of diphtheria[25].

PERTUSSIS

Pertussis or whooping cough or '100 days' cough is a highly contagious infection of the respiratory tract caused by the bacterium, *bordetella pertussis*. A person is highly infectious in the early stages of illness and can continue to spread the disease for up to 21 days after appearance of symptoms. A mother's antibodies do not provide new-born babies with reliable protection against infection.

Adolescent / adult vaccination

Infection with pertussis induces temporary natural immunity. Immunization against pertussis does not confer life-long immunity. While adults rarely die if they contact pertussis after the effects of their childhood vaccine get worn off, they may transmit the disease to people at much higher risk of death. The duration of protection by the vaccine is between 5 to 10 years. Outbreaks of pertussis have been noted with waning immunity in older children and adolescents. A booster dose of adult formulation of pertussis vaccine combined with diphtheria and tetanus toxoid is recommended for all adults planning pregnancy, for both parents as soon as possible after delivery of an infant and for grandparents and other carers of young children, and infants less than 12 months of age.

In industrialized countries, there is need for administration of the fifth injection of pertussis vaccine during adolescence at 15-17 years of age. The vaccine consists of adult formulation, which has lower concentrations of pertussis antigens (ap) than childhood vaccine (ap). This will prevent them from suffering from whooping cough and becoming a source of infection to infants[6]. The recommended course of pertussis vaccination involves five injections. It must be noted although infants remain the most at risk for severe life threatening disease, it is adolescents and adults that require a booster immunisation and it is critical for prevention of disease outbreak. In India, a sixth dose as TDaP vaccine at 10-12 years of age is now recommended. The only contraindication to pertussis vaccine is anaphylaxis following a previous dose of an acellular pertussis vaccine or anaphylaxis following any vaccine component[26].

Need for vaccination of adolescents and adults

With improved immunization coverage of children, pertussis is increasingly seen in adolescents and adults and is responsible for considerable morbidity among them. This group of adolescents and adults also serves as a reservoir for disease transmission to unvaccinated or partially vaccinated infants. Approximately 600,000 cases are reported annually among adults globally[27]. In India, data on incidence of pertussis in adults is not available but is thought to be high in states where childhood immunization coverage is good because reduced natural circulation of pertussis leads to infrequent adolescent boosting.

Objectives & Rationale

1. To protect the vaccinated persons against pertussis.
2. To reduce the reservoir of pertussis in the population and thus reduce exposure of persons at increased risk for complicated infection such as young infants and will help to protect young infants not covered by current vaccination recommendations.

Tdap vaccine

Immunity against pertussis following primary or booster DTP vaccination wanes over the next 6-12 years. Thus a routine booster immunization of adolescents and adults with TDaP (standard quantity of tetanus and reduced quantities of diphtheria and acellular pertussis) should be advised instead of TD. The dose is 0.5 ml intramuscularly. Antibody response to a single dose of TDaP booster in previously vaccinated child / adult is similar to 3 doses of full strength dtp or dtap vaccine.

Efficacy of the vaccine against clinical disease exceeds 90%. The commonest side effect with TDaP is pain at the local injection site in 70% of vaccines, followed by redness and swelling locally. Systemic side effects like fever, headache and fatigue are rarely seen. Serious side effects have not been reported with TDaP. The contraindications are serious allergic reaction to any component of the vaccine or history of encephalopathy, which cannot be attributed to an underlying cause within 7 days of

administration of a vaccine containing pertussis component.

Global experience with tdap[28,29]

Many developed countries have recommended routine booster immunization of adolescents and adults with tdap instead of td in their national immunization program. In spite of current evidence of effectiveness of WP vaccine for priming, the industrialized world will not take the risk of reverting back to WP vaccine considering the low public acceptance.

The CDC ACIP recommended tdap booster for adolescents in 2005 but even in 2012 only 56% of adolescents and 8.2% of adults were vaccinated. The Indian academy of pediatrics (iap) has also recommended a single, one-time booster dose of tdap to adolescents aged 10-12 years of age. There is no Indian data in adults as tdap is only used in the private health sector.

Efficacy and effectiveness of tdap[27]

In 2007, a study evaluated effectiveness of tdap booster among adolescents and found effectiveness of 68.3% against laboratory confirmed pertussis.10 A recent unpublished study found the effectiveness to be 55.2% at preventing pcr confirmed pertussis among adolescents and adults in California. ACIP data presented in 2013 showed that tdap effectiveness ranged from 66-78% in field observational studies and it wanes within 3-4 years. It does not provide herd immunity.

Current status of pertussis vaccination in India

Pertussis is still a serious public health problem in India. Currently in India only WP vaccines are used in the national immunization program since 1978. Acellular pertussis vaccines are licensed and available but used only in the private sector, which is responsible for offering vaccination to 9% of the population. In India outbreaks have not been reported because of underreporting or may be WP vaccines are providing adequate protection.

Coverage of primary immunization is not very high thus pertussis continues to be a problem of young children in most of India. However, states with good immunization rates have reported a frequent disease in adolescents and adults. Wp vaccines are still safe without higher rates of aefi and public acceptance is not a major concern in India.

HERPES ZOSTER[30,31]

Herpes zoster is caused by the varicella zoster virus (vzv), the same virus that causes chickenpox. After a person recovers from chickenpox, the virus stays dormant (inactive) in the dorsal root ganglion of sensory nerves. For reasons that are not fully known, the virus can reactivate years later, causing shingles. The risk of shingles increases with age and about half of all cases occur in men and women 60 years old or older. Herpes zoster is an illness of public health concern. Pain and suffering from herpes zoster is greatest for elderly people who are often least able to access medical care or tolerate the medications used to manage the symptoms.

Shingles is not contagious, and it cannot be passed from one person to another. However, a person who has never had chickenpox or received chickenpox vaccine could get chickenpox from someone with shingles. Advanced age, immunosuppression, female gender, surgery in affected dermatome are risk factors for herpes zoster

Shingles vaccine[32] (Zostavax)

A vaccine for shingles was licensed in 2006. The vaccine is presented as a lyophilized powder with a diluent.

- A single dose of shingles vaccine is indicated for adults 60 years of age and older.

  Zostavax, the vaccine to prevent herpes zoster consists of attenuated (oka-strain) varicella virus at a concentration at least 14 times that found in varivax®

- The vaccine is available as 0.65 ml dose containing a minimum of 19,400 plaque-forming units (ffu) of oka/merck strain of *varicella zoster* virus.

Efficacy of shingles vaccine

In a clinical trial involving thousands of adults 60 years old or older, zostavax reduced the risk of shingles by about half (51%) and the risk of post-

herpetic neuralgia by 67%. While the vaccine was most effective in people 60-69 years old it also provided some protection for older groups.

Vaccination for age 50 to 60 years

In 2011, FDA expanded the age indication for zostavax® to include adults 50 through 59 years old for preventing herpes zoster. For them the risk of getting shingles and having prolonged pain after shingles is much lower than for people 60 years and older.

Administration of vaccine

The vaccine is administered subcutaneously as a single dose of 0.65 ml in deltoid region.

- The vaccine should be administered immediately after reconstitution to minimize loss of potency. Any unused vaccine should be discarded if not used within 30 minutes.
- Persons with chronic medical conditions may be vaccinated unless a contraindication or precaution exists for their condition.

Precautions

The vaccine should be administered with caution in those with thrombocytopenia and other bleeding disorders

- zostavax is a live virus vaccine. It can be administered concurrently with all other live and inactivated vaccines, such as influenza and pneumococcal vaccines.
- the vaccine has to be stored in freezer.

Side effects of vaccination

The most commonly reported side effects are erythema (36%), pain or tenderness (35%), swelling (26%), and pruritus (7%) at the injection site.

Who should not get shingles vaccine

- History of life-threatening or severe allergic reaction to gelatin, the antibiotic neomycin, or any other component of shingles vaccine.
- Weakened immune system because of HIV / aids or another diseases or chronic steroid use
- Radiation or chemotherapy for cancers
- Bone marrow or lymphatic system malignancies, such as leukemia or lymphoma.
- Woman who is pregnant, or might be pregnant. Woman should not become pregnant until at least 4 weeks after getting shingles vaccine.
- Lactating mother
- Someone with a minor illness, such as a cold, may be vaccinated. But anyone with a moderate or severe illness should usually wait until they recover before getting the vaccine. This includes anyone with a temperature of 38.5°c or higher.

Conclusion : In spite of it's great importance in preventing vaccine preventable diseases, adult vaccination is grossly underutilised. It's need of hour to create awareness about adult vaccination not only in public but also in clinicians.

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