Infectious diseases are responsible for more than 1/3 of mortality in people 65yrs and older. Timely detection in elderly is a challenge as initial signs and symptoms are quite subtle in this population. The usual signs and symptoms of an infective episode such as fever and leucocytosis are quite often absent and change in mental status and a decline of function may be the only manifestation of infection. Specifically the immunosenescence and an atypical presentation of infection associated symptoms with the subsequent delay of diagnosis and initiation of antimicrobial treatment are cornerstone in this dilemma.

In addition, co-morbidities and co-medication, a changing spectrum of pathogens with a higher percentage of multiresistant pathogens and more importantly an altered pharmacokinetics of antimicrobial drugs are further contributing factors to the adverse outcome of infections in elderly subjects.

**IMMUNE CHANGES IN THE ELDERLY**

Changes in the immune system, termed ‘immunosenescence’, contribute to the decreased ability of elders to overcome infections. Ageing changes occur in both cellular and humoral immunity. The proportion of memory T cells increases, whereas the proportion of naive T cells decreases. Naive cells are those that respond to new pathogens. The naive cells are responsible for appropriate effector responses and production of cytokines. In older individuals, there is significant decrease in the number of naive T cells. IgM memory B cells, which are responsible for protection against encapsulated bacteria such as S pneumonia diminish with ageing. Researches have shown, that function of spleen declines with ageing. It is suggested that smaller portion of the B cell pool is available to respond to newer challenges.

**Associated Diseases**

Diabetes Mellitus is very common in the aged, it creates havoc in body’s immune system. Urinary tract infection, skin and soft tissue infections, osteomyelitis occurs more commonly in diabetic patients. Prostatic Hypertrophy increases the incidence of urinary tract infection, malignancy like multiple myeloma, stomach, breast, prostate increase with age are also associated with increased incidence of infection.

**Respiratory Tract Infections**

Age related changes that pre-dispose elders to respiratory tract infections include reduced mucociliary clearance, lung elasticity, chest compliance, muscle strength and cough reflex. Change in elastin leading to impairment of elastic recoil of lung, decreased lung compliance; weakness of respiratory muscles lead to pooling of secretions and increased pre-disposition of pneumonia.

**PNEUMONIA**

Community acquired pneumonia is a major cause of morbidity and mortality in elderly. Etiology of pneumonia is as described below.

<table>
<thead>
<tr>
<th>Community acquired pneumonias</th>
<th>Pneumonia in long term care facilities</th>
<th>Pneumonia in hospitalized patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Streptococcus pneumoniae</td>
<td>Enteric gram negative bacilli</td>
<td>Enteric gram negative bacilli</td>
</tr>
<tr>
<td>Haemophilus influenzae</td>
<td>Oral aerobes and anaerobes(aspiration)</td>
<td>Oral aerobes and anaerobes(aspiration)</td>
</tr>
<tr>
<td>Enteric gram negative bacilli</td>
<td>Staph aureus</td>
<td>Staph aerues</td>
</tr>
<tr>
<td>Staph aureus</td>
<td>Streptococcus pneumoniae</td>
<td>Haemophilus influenzae</td>
</tr>
<tr>
<td>Mycoplasma pneumoniae</td>
<td>Haemophilus influenzae</td>
<td>Legionella pneumophilia</td>
</tr>
<tr>
<td>Chlamydia pneumoniae</td>
<td>Moraxella catarrhalis and other viruses</td>
<td>Moraxella catarrhalis</td>
</tr>
<tr>
<td>Legionella pneumophila</td>
<td>Influenza and other viruses</td>
<td>Acinetobacter baumannii and stenotrophomonas maltophilia (rarely)</td>
</tr>
<tr>
<td>Influenza and other respiratory viruses</td>
<td></td>
<td>Influenza and other viruses</td>
</tr>
</tbody>
</table>

COAD, heart disease, malignancy, malnutrition, congestive heart failure, and diabetes mellitus have implicated as risk factors leading to community acquired pneumonia in elderly.

**CLINICAL FEATURES**

The characteristic clinical features of pneumonia- fever, cough, and sputum production are often subtle and incompletely expressed in elderly patients. Only 33-63% of elderly patients present with a high fever. Instead, elderly patients with pneumonia may present with atypical manifestations, such as delirium, worsening of chronic confusion, weakness, lethargy, increased falls, and other non respiratory symptoms. Tachypnea and tachycardia may be
Prevention of Infection in Elderly

The diagnostic workup includes chest radiograph, sputum gram stain and cultures, blood cultures along with complete blood count, serum electrolytes with creatinine and pulse oximetry.

**TREATMENT**

Initial treatment depends on background of the patient. For community-acquired pneumonia third generation cephalosporin like ceftriaxone along with macrolide or respiratory fluoroquinolone may be used. For nosocomial pneumonia antipseudomonal beta lactam like piperacillin tazobactum or cefepime, imipenem or meropenem may be used. At centres with high incidence of MRSA, vancomycin or linezolid may be used.

**VIRAL PNEUMONIA**

Pneumonia can also be caused by RSV, influenza virus, parainfluenza virus and human meta pneumovirus

**PREVENTION**

Two types of pneumonia can be prevented - influenza and pneumococcal. A yearly influenza vaccine is highly protective. Even when the vaccine fails to prevent infection, the severity of disease and frequency of complications are reduced. In developed countries pneumococcal vaccine is recommended for all persons more than 65. There is 60% protection rate in immunocompetent adults. In healthy elderly persons protection is presumed to be lifelong thus re-immunization is unnecessary. In high risk elderly patients repeat doses may be required every 6-10 years.

Hand Hygiene – Common methods for transmission is by shaking hands. Every one should wash his/her hands before eating and after going outside. Ordinary soaps or waterless alcohol based gels may be used.

Daily diet should include food such as fruits and vegetable which are rich in antioxidant and help augment the immune system.

Deep breathing exercises and therapy to clear secretions also help in preventing pneumonia. Old people with their diminished cough reflex have an increased predisposition for aspiration.

Poor oral hygiene is common in elderly, increasing the bacterial load and the potential of colonization of the oral cavity. Oral care may be useful to some extent in elderly patients to prevent respiratory infection.

Sedative medication has been demonstrated to increase the risk of pneumonia in residents of long term care facilities and should therefore be avoided. The prescription of phenothiazines and haloperidol should be very carefully considered, as they reduce oropharyngeal swallow coordination, causing dysphagia. Medications that dry up secretions, including antihistamines and drugs with anticholinergic activity, make it more difficult for patients to swallow and should therefore be avoided.

In developed countries such as USA, routine administration of a single dose of Pneumococcal vaccine is recommended for all adults aged 65yrs or more. But in developing countries like India, where resources are limited, WHO states that evidence does not support routine immunization of elderly and high risk population with Pneumococcal vaccine.

**INFLUENZA**

Influenza causes significant morbidity and mortality in older adults. Of deaths resulting from influenza 80-90% occurs in adults 65yrs and older. It is well established that annual influenza vaccination goes a long way in prevention of influenza infection and associated morbidity.

**URINARY TRACT INFECTION**

Urinary tract infections are the most frequent bacterial infection and the most common source of bacteremia in older adults. Factors that predispose older adults to urinary tract infections include the use of urethral or condom catheters and neurogenic bladder with increased residual urine. Contributing factors specific to gender include prostate enlargement in men, and increase in vaginal pH, vaginal atrophy that is due to post menopausal estrogen depletion, and incomplete emptying of the bladder in women. These factors provide the opportunity for bacterial colonization and are likely to contribute to the higher rates of asymptomatic bacteriuria and urinary tract infections in the elderly.

Clinical feature such as dysuria, fever, urinary frequency and suprapubic tenderness may be absent or masked in elderly. Non specific symptoms like nausea, vomiting and decrease in urine output may be the only symptoms. Asymptomatic bacteriuria in women diagnosed by quantitative cultures showing 10⁵ CFU/ml of the same micro-organism in two consecutive urine specimen, where as in men only one time sample is required. Common uropathogenic bacteria are as follows.

<table>
<thead>
<tr>
<th>Gram negative bacteria</th>
<th>Gram positive bacteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. coli</td>
<td>Coagulase negative Staph</td>
</tr>
<tr>
<td>Proteus mirabilis</td>
<td>Group B streptococci</td>
</tr>
<tr>
<td>Klebsiella species</td>
<td>Enterococci</td>
</tr>
<tr>
<td>citrobacter</td>
<td>Group A streptococci</td>
</tr>
<tr>
<td>enterobacter</td>
<td>Staph aureus</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td></td>
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</tbody>
</table>

**Treatment**

Asymptomatic bacteriuria – It is generally recommended that antibiotics be withheld in totally asymptomatic patients. Neither short term nor long term adverse outcomes attributable to the high incidence and prevalence of asymptomatic bacteriuria have been shown in this population. Screening and treatment of asymptomatic bacteriuria should be undertaken in elderly undergoing invasive urologic procedures.
**Catheter-related UTI** — Catheters contain stagnant urine promoting development of biofilm on the interior surface, which can harbour a large number of microorganisms. In symptomatic patients with catheter, treatment should begin with removal of the catheter to rule out any obstruction followed by microbiologic and radiologic evaluation and initiation of broad spectrum antibiotics.

**Symptomatic UTIs** — In seriously ill patient with UTI, intravenous therapy with cephalosporins, carbapenems, aztreonam, piperacillin/tazobactum, fluoroquinolones and aminoglycosides may be used. Candiduria should be treated when candida is also seen from another site or in case of special situations like neutropenia, renal transplant and urologic procedures. Presumptive use of antibiotics for gram positive coverage with anti MRSA agents like vancomycin should be considered in seriously ill elderly patients. Management of urinary tract infection in the elderly may be complicated by organ dysfunction, concomitant chronic diseases and advanced age.

Urinary tract infections are preventable by limiting the use of urinary catheters and providing topical estrogen therapy for women and pharmalogical or surgical relief of prostatate hypertrophy for men.

**Bacterial Meningitis**

The most common cause of bacterial meningitis in elderly patient are pneumococci, meningococci and listeria monocytogens. Bacterial meningitis in this population is associated with high mortality.

Clinically findings of bacterial meningitis in elderly may not be typical. Patients may present with altered sensorium, dementia or possible stroke without classic findings of meningitis. Moreover elderly patients may have restricted neck mobility or nuchal rigidity resulting from cervical osteoarthritis which may be misleading and dissuade the clinician from diagnosing meningitis. The overall incidence of pneumococcal meningitis has decreased since pneumococcal vaccine was introduced. Although the overall effect of the vaccine remains substantial, a recent increase in meningitis caused by non PCV 7 serotypes including strains non susceptible to antibiotics is a concern.

**Tuberculosis**

Because of decrease cell mediated immunity, associated conditions like diabetes, malnutrition, elderly are more prone to tuberculosis. It is generally reactivation of previously acquired latent infection. Clinical features are usually non specific and atypical symptoms may include unexplained weight loss, cough, fever, night sweats, hemoptysis and failure to thrive. It may also present as impaired cognition and other nonspecific symptoms. Diagnostic studies include chest radiography, tuberculin test and microbiologic and histologic examination. Anti tuberculosis therapy is similar to younger patient with 2 months intensive face and 4 months consolidation phase. As with younger people, prolonged therapy and additional drugs may be given in failure and relapse cases.

**Skin and Soft Tissue Infection**

As people age they experience more illnesses particular to skin infections. The integrity of skin declines with age. The reasons for this are complex. Because of loss of collagen, dermal epidermal junctions are flattened, reducing dermal epidermal adhesions. With age, the function of sweat glands decreases, the skin thins and the ambient moisture content of the skin declines. Disorders such as hyperlipidemia, hypertension and atherosclerosis would lead to narrowing of blood vessels, leading to decreased blood flow to the skin and decreasing the ability of the elderly body to fight infection. Decreased blood flow slows healing, increases xerosis and allows pathogens to enter broken skin such as cut, sores, abrasions, erosions, ulcer and tissues.

The common skin infection in elderly are herpes zoster, onychomycosis, scabies, decubitus ulcers, cellulites and erysipelas, necrotizing fascitis, impetigo, folliculitis and furunculosis.

**HERPES ZOSTER (SHINGLES)**

Herpes zoster is caused by reactivation of varicella zoster virus infection, which remains dormant in the dorsal root ganglia and cranial nerve ganglia after primary infection.

**CLINICAL FEATURES**

Generally persists as unilateral dyesthesia and pain on one side of body almost localized to a single dermatome, followed after 1-3 days by erythematous macular rash which progresses to popular and vesicular stages in 1 to 2 days followed by ulceration and encrusting of lesions within a week. The plaques of zoster evolve and resolve over 3-4 weeks.

In immunocompromised patients, new lesions can appear even after one week and multiple dermatomes may be involved. In minority of patients, scattered lesions outside the affected dermatome may be seen, they are termed as satellite lesions. A few patients may also have pain without skin lesions termed as zoster sine herpetic. Complications include encephalitis, myelitis, zoster ophthalmicus, contralateral hemiparesis and VZV retinitis along with post herpetic neuralgia which is most common. Post herpetic neuralgia is defined as persistent pain beyond 90-120 days after the appearance of skin lesions. It is frequent and severe in elderly occurring 25-40% of patients over 60 years.

**TREATMENT**

The antiviral agents effective are acyclovir, valacyclovir, famcyclovir, along with foscarnet, cidofovir and sorivudine. Best results are seen if antivirals are started within 72 hours of appearance of rash. Antiviral treatment also reduce the duration of post herpetic neuralgia.

**PREVENTION**

Zoster vaccine is live attenuated VZV is available. It is administered as subcutaneous dose and two doses are recommended for
varicella seronegative person. It has shown to decrease zoster incidence as well as post herpetic neuralgia incidence.

CELLULITIS AND Erysipelas

Cellulitis and erysipelas are common infections in the elderly; generally caused by gram positive organisms. Potent complications of cellulitis and erysipelas include septicemia, thrombophlebitis, septic arthritis, osteomyelitis and endocarditis. Cellulitis and erysipelas are treated with systemic antibiotics. It has to be distinguished with allergic stasis eczema.

NECROTIZING FASCITIS

Necrotizing fascitis involves a particularly destructive infection causing rapidly advancing deep tissue necrosis. It is a polymicrobial infection including gram positive and gram negative bacteria along with anaerobes. Prior condition like diabetes, alcoholism, cancer, malnutrition may facilitate fascitis. Treatment includes antibiotics like gentamicin and clindamycin.

IMPETIGO, FOLLICULITIS AND FURUNCULOSIS

Staphylococcus aureus and beta hemolytic streptococci are the most common organisms causing cutaneous infections. Impetigo manifests with honey coloured crusted erosions. Sample of fluid or pus should be obtained for the causative organism and antibiotics prescribed according to sensitivity. The nasal culture may be helpful in assessing if nasal carriage of staph aureus is the source.

Bacterial infection of pilosebaceous follicles is folliculitis. It generally occurs on body surfaces with coarse hair like scalp, neck, beard, axilla, buttocks and limbs. The organism is mostly staph aureus. Antibiotics with or without surgical intervention is required. For penicillin resistant strains oral linezolid or intravenous vancomycin is required.

ONYCHOMYCOSIS

It is a skin disease of the elderly. Dermatophytes, most commonly Trichophyton rubrum are the most common cause. It is of four types: distal subungual, proximal subungual, white superficial and candidal. The most sensitive and specific diagnosis is by PAS stain performed on a nail clipping. Treatments include oral terbinafine, itraconazole, fluconazole, or topical ciclopirox or amorolfine.

SCABIES

It is caused by ectoparasite Sarcoptes Scabei. Scabies infection is especially common in elderly people living in confined spaces, secondary to declining cellular immunity, age, skin, overcrowding, and limited mobility.

The classic symptom of scabies infection is pruritus, especially at night time. The pathognomonic sign is the presence of burrows predominantly in interdigital webspaces, flexor surfaces of extremities and genital areas. Diagnosis is by microscopic examination of skin scraping using potassium hydroxide, saline or mineral oil. For treatment 5% permethrin cream, 1% lindane solution or oral ivermectin is recommended.

Diabetes mellitus, chronic steroid abuse, malnutrition are the predisposing factors for skin infection in elderly. Effective management of comorbidities along with proper skin care with emollients, antiseptics, topical and systemic antibiotics, dressings and biotherapy is required.

DECUBITUS ULCERS

These are necrotic areas between the bony points and skin surfaces. Their depth can vary from minor skin breaks to deep infections penetrating the bone.

Pressure ulcers can be classified into four stages:

Stage 1 non blanchable erythema of intact skin.
Stage 2 partial thickness skin loss involving epidermis or dermis.
Stage 3 full thickness skin loss extending to the fascia.
Stage 4 Full thickness skin loss involving muscle, bones and joints. Common complications of pressure ulcers include cellulitis of surrounding area, contiguous osteomyelitis and bacteremia with sepsis syndrome. The most common organisms are Proteus mirabilis, Staph aureus, Bacteroides fragilis and group A Streptococci. Management of pressure ulcers need to multidisciplinary. Complete management includes pressure relief, debridement, appropriate dressings and topical agents along with control of infection by systemic antibiotics.

INTRAABDOMINAL INFECTIONS

Intraabdominal infections are important cause of morbidity in elderly people. Theses infections are appendicitis, diverticulitis and biliary sepsis. Though appendicitis is less frequent in elderly the mortality is higher in elderly. The risk of developing diverticulitis gradually increases with ageing. In 20-25% of patients with diverticulitis, diverticulitis develops. Cholelithiasis is the disease of the elderly and its complications like cholangitis, perforation and ensuing biliary sepsis are higher in elderly. Again signs of perforation or acute abdomen in elderly may be masked and requires high index of suspicion for detection.

CLOSTRIDIUM DIFFICILE ASSOCIATED DIARRHOEA

Symptoms and signs typically occur 5-10 days after antibiotic treatment. Common symptoms and signs in elderly include diarrhea, abdominal cramping, fever and leukocytosis. Toxic megacolon may be an important complication of CDAD in elderly. For treatment offending antibiotics should be promptly discontinued and oral metronidazole given. In recurrent cases, oral vancomycin should be used. Strict infection control measures, including contact precautions, antibiotics stewardship and restriction of antibiotics may help control and prevent CDAD.
MULTIDRUG-RESISTANT INFECTIONS

**Methicillin-resistant Staphylococcus aureus (MRSA)**

Methicillin resistant Staphylococcus aureus presents a major problem for elderly, especially those in institutional settings. People colonized with MRSA are at increased risk for MRSA infection. They also have a higher risk of death from MRSA infection. The poor functional status of elderly make likely candidate for becoming MRSA carriers. Handwashing, isolation of infected patients and proper handling of body secretions are vital to prevent the spread of MRSA. The most common reservoirs of MRSA colonization are the nasal mucosa and the nasopharynx. Skin contamination from persons already colonized may also be a source for MRSA infection. While colonization does not require treatment, active infection is treated with glycopeptides — vancomycin or teicoplanin. In cases resistant to glycopeptides, linezolid and rifampicin may be used. Efforts should be made to locate the carrier in health care setting. As nasal mucosa is the most common colonization site nasal swabs may be taken and carrier needs to be actively treated with topical mupirocin (bactroban).

**Vancomycin resistant enterococci**

Vancomycin resistant enterococci is a major problem in elderly especially for nosocomial urinary tract and wound infections. Vancomycin use has been reported consistently as a risk factor for infection and colonization with VRE and may increase the possibility of the emergence of vancomycin-resistance. Because of the high level of antibiotic resistance, prevention of outbreaks and spread of VRE is crucial. The best way to prevent the outbreak of VRE is by handwashing and proper disposal of body fluids. The prudent use of vancomycin and limiting the use of oral and intravenous vancomycin will help control the outbreak of VRE epidemic.

**CONCLUSION**

There is no doubt that our elderly population is more prone to infections. Measures to prevent them leave many questions unanswered. Increased lifespan has led to a situation that geriatric population with associated comorbid conditions continuously provide challenge to medical science. Vaccines such as pneumococcal and influenza may help prevent & alleviate some infections but in a developing country like ours cost constraints as well as doubtful efficacy at times prove a hindrance. All the more, proper management of comorbid conditions like diabetes mellitus, chronic obstructive airway disease, renal failure will help in decreasing the incidence of infections as well as their proper control. The emergence of multidrug resistant organisms are proving a challenge for us. Role of nutrition for boosting over all immunity can not be over emphasized. But supplementation of multivitamins and minerals with all their antioxidant properties are still to be proved to be beneficial.

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