CHARLES UNIVERSITY

FACULTY OF PHYSICAL EDUCATION AND SPORT UK

DEPARTMENT OF PHYSIOTHERAPY

PHYSIOTHERAPEUTIC APPROACHES FOR CYSTIC FIBROSIS

BACHELOR THESIS

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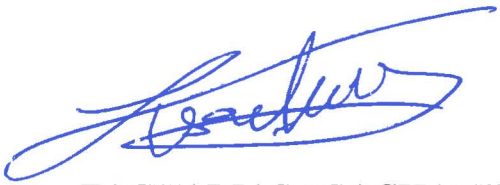
Declaration

This bachelor thesis is based on my practice at F.N.Motol that was from 12nd of January until 27th of February, under the supervision of Doc.Paed. Libuse Smolikova and on the bibliography that I note.



ZACHARIAS TSACHAKIS

Acknowledgement

I would like to thank Paed.Dr.Smolikova, who is an expert in C.F. physiotherapy, for providing me with many information on Cystic Fibrosis and sharing with me her experiences. Her guidance was and will be very useful for me! I also wish to thank her for supervising my Bachelor Thesis and by this contributing to its realization.

Dedication

I would like to dedicate this Bachelor Thesis to my family and especially to my little boy Vasileios! In addition, I would like to dedicate it to my parents and to my sister who supported me in the most difficult times in my life and to my supervisor Paed.Dr.Smolikova who gave to me the opportunity to meet another useful piece of physiotherapy!

CONTENTS

PART 1

1. PREFACE

My name is Zacharias Tsachakis and for my Bachelor Thesis I had practice at the University Hospital Motol.

I was assigned to the Pediatric Departments and specifically to children with Cystic Fibrosis.

I selected a patient and through her and with the assistance of my supervisor Paed.Dr. Libuse Smolikova I understood many things about this disease and its development as well.

Furthermore, I learned the therapy and physical exercises performed to these patients and also other patients with pulmonary problems.

I realized how important is for the physiotherapist to have good communication and cooperation with the patient and also with its the family for the best results.

After the end of my 2-week practice I had new knowledge and experience which I gathered to compose my Bachelor Thesis.

PART 2: GENERAL PART

2. 1 .CF Introduction

Just 10 years ago, cystic fibrosis (CF) a life-threatening disorder that causes severe lung damage and nutritional deficiencies was a genetic mystery, and most people with the disease didn't live beyond their teens. Since then researchers have made real progress in unraveling the genetic basis of CF, which has led to earlier detection. Because of this and improved and more consistent treatments for the disease, many people with CF now live into their 30s and have fuller and more comfortable lives. CF is an inherited (genetic) condition affecting the glands that produce mucus, tears, sweat, saliva and digestive juices. Normally, these secretions are thin and slippery, but in CF, a defective gene causes the secretions to become thick and sticky. Instead of acting as a lubricant, the secretions may plug up tubes, ducts and passageways, especially in the pancreas and lungs. Respiratory failure is the most dangerous consequence of CF.

Each year approximately 3,200 white babies are born in the United States with CF. The disease is much less common among black and Asian-American children. Two-thirds of the infants born with CF will be diagnosed in the first year of life. In all, about 30,000 American adults and children are living with this disorder. Although there's still no cure, the emerging field of gene therapy may someday help correct lung problems in people with CF.

2 .1 .2 : ETIOLOGY - A FAMILYS RISK FOR CF

The main cause of CF is a defect in the CF gene which codes for the "cystic fibrosis Trans-membrane regulatory protein" (CFTR). There may also be other genes involved and yet unknown environmental factors. This protein is an ionic channel, which regulates the transport of chloride ions across the epithelial cell membrane. Mutation in this protein leads to a defect in chloride and hence, waters transport, with secondary desiccation of surface secretions.

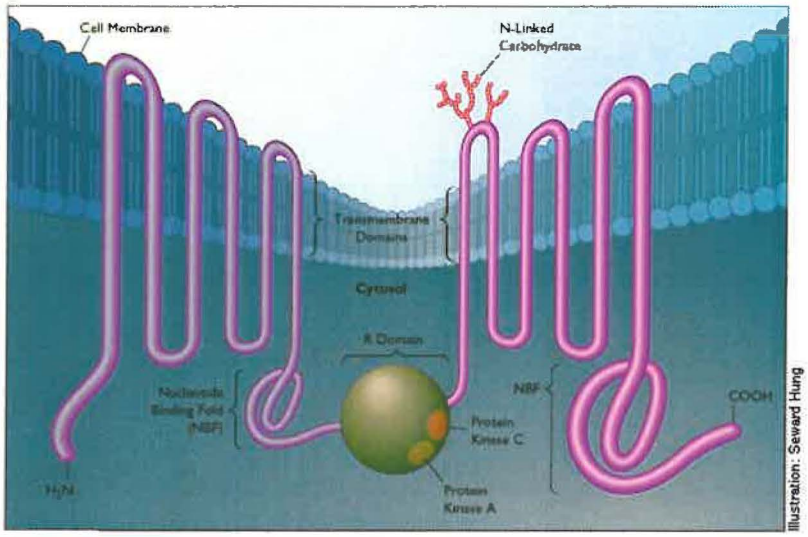
Of all ethnic groups, Caucasians have the highest inherited risk for CF, and Asian Americans have the lowest. In the U.S. today, about one of every 3,000 Caucasian children is born with CF. This compares with one of every 17,000 African Americans and only one of every 90,000 Asian Americans. Although the chances of inherited

risk may vary; CF has been described in every geographic area of the world among every ethnic population.

It takes two copies of a CF gene, one inherited from each parent, for a child to show symptoms of CF. Persons born with only one CF gene (inherited from only one parent) and one normal gene are CF carriers. CF carriers do not show CF symptoms themselves, but can pass the problem CF gene to their children. If two CF carriers have a child, there is a one in four chance that the child will have CF.The CF gene is found on chromosome number 7 (humans have 23 pairs of chromosomes made of the inherited genetic chemical called "DNA"). Right now, scientists have identified at least 600 different mutations in the CF gene that are capable of causing symptoms of CF. Some mutations cause milder symptoms than others do. The most common mutation, called the Delta F508, causes about 90% of cases of CF and can be detected by genetic testing. This testing can be done in children, both before and after birth, and in adults who are thinking about starting or enlarging their family.(13, 14)

2.2 PATHOGENESIS

While CFTR (Cystic Fibrosis Transmembrane Conductance Regulator) has never been viewed directly, its predicted amino acid sequence suggests that it consists of two homologous structural units, each including a transmembrane domain and a nucleotide-binding domain, connected by a central regulatory domain rich in phosphorylation sites. The tertiary structure suggests, and experimental data confirm, a transmembrane transport function with likely regulatory roles for adenosine triphosphate (ATP) binding and phosphorylation.



...he amino acid sequence of CFTR suggests that it consists of two homologous structural units, each including a transmembrane domain and a nucleotide-binding fold, connected by a central regulatory (R) domain rich in phosphorylation sites. Experimental data confirm a transmembrane transport function with likely regulatory roles for adenosine triphosphate (ATP) binding and phosphorylation.

The 800 or so genetic mutations associated with cystic fibrosis have been divided into five broad classes based on their influence on CFTR manufacture and function. Class I mutations, which affect fewer than 7% of cystic fibrosis patients, are stop mutations that directly interfere with CFTR protein production, either by introducing a premature signal for termination of RNA translation or by altering mRNA but leaving the reading frame intact. Class II mutations disrupt the trafficking mechanism that takes CFTR from its point of origin on the endoplasmic reticulum to its site of operation on the apical membrane. Approximately 85% of cystic fibrosis patients have at least one copy of the primary class II mutation, delta-F508 (deletion of 3 bp coding for phenylalanine at amino acid position 508), which blocks this internal highway.

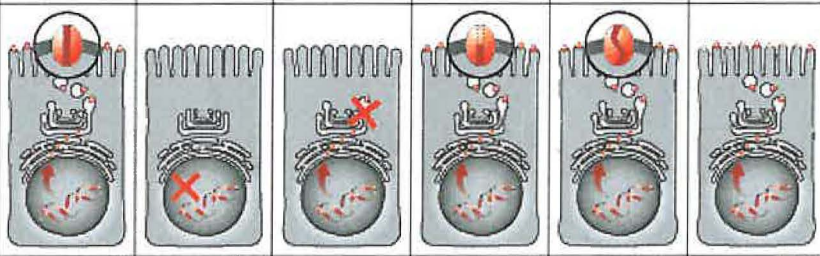
Defect Classification	Normal	I	II	III	IV	V
						
Defect Result		No synthesis	Block in Processing	Block in Regulation	Altered Conductance	Reduced Synthesis
Types of Mutation		Nonsense; Frameshift	Missense; Amino Acid Deletion (ΔF508)	Missense; Amino Acid Change (G551D)	Missense; Amino Acid Change (R117H) (R347P)	Missense; Amino Acid Change (A445E) Alternative Splicing
Potential Therapy		Gentamicin, Gene Transfer	Butyrates, Gene Transfer	Genistein, Gene Transfer	Milrinone, Gene Transfer	Gene Transfer

Illustration: Seward Hung

The 800 or so genetic mutations associated with cystic fibrosis have been divided into five broad classes based on their impact on the CFTR transporter molecule. An impressive number of corrective agents are in or approaching clinical trials; however, only gene transfer represents a potential cure. (Adapted from Zielenski and Tsui, 1995)

Class III mutations, which affect fewer than 3% of patients, cause defective ATP- or phosphorylation-dependent regulation of CFTR. The protein has reached the apical membrane, but it does not become activated and inactivated in the normal fashion. Class IV mutations disrupt conductance through CFTR ion channels, despite normal placement and regulation of the molecule. Finally, class V mutations result in reduced synthesis of functional CFTR. Prevalence of class IV and V mutations is difficult to assess because the effects tend to be mild and not associated with early lung or gastrointestinal problems. Patients may not even be diagnosed with cystic fibrosis unless they happen to seek care for a related condition, such as male sterility. (The vas deferens is extremely sensitive to changes in CFTR function. Even a slight decline in conductance is thought to impede ion transport and reduce fluid content, leading to excessive viscosity, epithelial obstruction, and progressive obliteration of the vas. Consequently, nearly 100% of male cystic fibrosis patients are sterile. Until recently, few patients lived long enough for fatherhood to be an option, so the mere fact that we are facing this issue indicates how much progress has been achieved. If a couple is unwilling to adopt, sperm can be removed via microsurgical epididymal aspiration for in vitro fertilization, and the fertilized egg tested for cystic fibrosis prior to implantation.)

Implications for New Drug Design

The ability to zero in on the molecular and cellular consequences of cystic fibrosis mutations has prompted a massive effort to design drugs that specifically address each problem. For class I mutations, it was quickly learned that a number of common antibiotics, including gentamicin, can reverse the process in a test tube. Whether they will work equally well in patients with cystic fibrosis is now being tested in clinical trials.

Class II intracellular trafficking problems are also remarkably easy to correct in vitro. Just dropping the temperature of the affected cells by three or four degrees Celsius will override the delta-F508 defect. Unfortunately, the challenge is much greater in humans: All prototype agents developed to date have proved to be too toxic or required excessive concentrations to achieve a therapeutic effect. Nevertheless, there is growing confidence that a safe and effective agent will be found. While an anticlass II drug would not benefit every patient with cystic fibrosis, it could significantly reduce morbidity and mortality in the large majority of patients who have at least one copy of delta-F508.

Ion Channel Modifiers. When CFTR reaches the cell membrane, it acts as a chloride channel, allowing passive transport of ions in and out of the cell along electrochemical gradients. Disruption of this activity plays a major--if poorly understood--role in the chronic dehydration of airway secretions characteristic of the disease. Consequently, an aggressive search is underway for compounds that can promote alternate chloride channels, either in the absence of or with minimal CFTR stimulation. ATP analogs such as uridine triphosphate (UTP) have been shown to induce chloride secretion from the airway cells of both healthy persons and patients with cystic fibrosis through such alternate channels. While UTP metabolizes too rapidly to be clinically useful, some of its analogs have been processed into aerosols that are currently in clinical trials. Additional drug classes that stimulate CFTR chloride transport include certain aminoglycosides (for class I defects) and butyrates, which upregulate the so-called molecular chaperones (for class II defects). Drugs active in increasing non-CFTR chloride channel activity are under development as well.

CFTR also regulates the function of other ion channels--particularly the sodium channel, which is overactive in patients with cystic fibrosis. Whether the underlying problem is excessive airway surface salt concentration or increased dehydration remains unclear. Reduction of airway surface water thickens respiratory mucus, while

the increased salt inactivates salt-sensitive antibiotic defensin peptides that normally protect the airway against infection. Drugs that block the sodium channel would be expected to have a beneficial effect, and indeed an aerosolized version of the sodium channel blocker amiloride has shown limited benefit. A combination of amiloride plus the UTP analog INS365 is currently being tested, to see whether the two agents work synergistically to redress the salt-water imbalance. Research is also in progress with hypertonic saline, which temporarily brings additional water into the airway, provoking cough and improving mucus clearance.

CFTR Regulation and Conductance Modifiers. Getting CFTR to the cell membrane is one thing; having the protein follow physiologic commands and carry out its assigned tasks is another. CFTR is regulated or "gated" by protein kinase A-mediated phosphorylation at its regulatory domain and by ATP binding and hydrolysis at its two nucleotide binding domains. Candidate drugs with activity in these areas include genistein (for regulatory class III defects) and phosphodiesterase inhibitors such as milrinone (for class IV conductance defects).

Infection and Inflammation

Impressive as these developments have been, there remains a serious lack of understanding concerning the relationship between CFTR dysfunction at the cellular level and the persistent infection and inflammation that characterize cystic fibrosis. Infection of the airways with a restricted spectrum of bacterial pathogens--*Pseudomonas aeruginosa* strains in particular--is patho-gnomonic of the disease. But most of the bronchiectasis and progressive deterioration of pulmonary function seen in these patients is not caused by infection but by the massive influx of neutrophils associated with dysregulation of local host inflammatory pathways. Excessive production of the chemokine interleukin (IL)-8 and deficient production of the anti-inflammatory cytokine IL-10 and the pleiotropic cytokine gamma-interferon have been reported as potential endogenous mediators of this response in CF airway and immune cells activated by infectious or physical stimuli.

The concentration of neutrophils in airway surface fluid, even in patients with mild cystic fibrosis, is hundreds of times that of healthy persons. During exacerbations, additional migration of neutrophils from the pulmonary vasculature occurs--probably triggered by IL-8 in response to the adherence and exoproducts of *P. aeruginosa.* Once neutrophil migration into the airway is initiated, the process is self-perpetuating, with neutrophil degranulation products--including elastase and free radicals--

attracting other neutrophils both directly and indirectly (through increased IL-8 production by respiratory epithelial cells and by the neutrophils themselves). Despite their numbers, the short-lived neutrophils are unable to ingest the volume of bacteria presented to them. As they begin to die, they release not only toxic proteolytic enzymes and oxidants but also DNA and actin, which clog the airways and contribute to the thickness and tenacity of the sticky mucus. Coughing increases, the patient becomes feverish, and appetite and exercise tolerance drop. Simple activities like sitting in a classroom or visiting friends become overwhelmingly difficult.

Why do the airways of cystic fibrosis patients bind bacteria so vigorously? As mentioned, high airway salt content may inactivate the defensin shield that protects healthy persons from infection. But current estimates of airway salt content in cystic fibrosis vary widely--not all studies have shown the abnormality--and many investigators feel that loss of defensins alone cannot account for the bacterial colonization seen in this disease. An alternative to the high-salt hypothesis (which does not rule out a secondary role for loss of defensins) stems from the observation that *P. aeruginosa* strains preferentially bind to glycolipid receptors lining the airways of cystic fibrosis patients. The abnormal binding is confined to the airway lumen; *P. aeruginosa* rarely invades the lung parenchyma or disseminates systemically. Do the airways of cystic fibrosis patients have an overabundance of cell-surface receptors for these bacterial strains? Or, as one group of investigators has speculated, does the CFTR molecule itself normally function as a selective bacterial receptor, diverting bacteria into pulmonary epithelial cells that are then sloughed off--creating an innate form of host defense? And does the malfunctioning of CFTR somehow encourage *P. aeruginosa* to multiply in the extracellular mucus, triggering the damaging cycle of neutrophil entry and decay? That certainly is the end result. But how that result is achieved remains frustratingly unclear. (5, 17, 20)

2. 2 .2:CF signs and symptoms

The specific signs and symptoms of CF can vary, depending on the severity of the disease. For example, one child with CF may have respiratory problems but not digestive problems, while another child may have both. In addition, the signs and symptoms of CF may vary with age. In some newborns the first sign may be a blockage of the intestines (meconium ileus). This occurs when meconium tarry, greenish-black stools normally passed by an infant in the first day or two after birth

becomes so thick it can't move through the intestines. Other signs in newborns may include a failure to grow, bulky and greasy stools (steatorrhea) and frequent respiratory infections.The signs and symptoms of CF in children and young adults may include:

Salty taste to the skin. People with CF tend to have two to five times the normal amount of salt (sodium chloride) in their sweat. This may be one of the first signs parents notice because they taste the salt when they kiss their child.

Blockage in the bowel.

Foul smelling, greasy stools.

Delayed growth.

Thick sputum. Infants and young children tend to swallow their sputum, and parents may not be aware of it.

Chronic coughing or wheezing.

Frequent chest and sinus infections with recurring pneumonia or bronchitis.

Growths (polyps) in the nasal passages.

Enlargement or rounding (clubbing) of the fingertips and toes. Although clubbing eventually occurs in most people with CF, it also occurs in some people born with heart disease and other types of lung problems.

Cirrhosis of the liver due to inflammation or obstruction of the bile ducts.

Displacement of one part of the intestine into another part of the intestine (intussusception) in children older than age 4.

Protrusion of part of the rectum through the anus (rectal prolapse). This is often caused by stools that are difficult to pass or by frequent coughing.

CF affects a number of organs.

Lungs

It is common for people with CF to encounter some difficulties with their lungs. To find out how lungs work, click here. A combination of physiotherapy and medication can help control lung infections and prevent lung damage. See the treatment/medication section of this site for further information. To avoid the risk of cross infection, people with CF need to ensure they do not come into close contact with others with CF.

The Digestive System

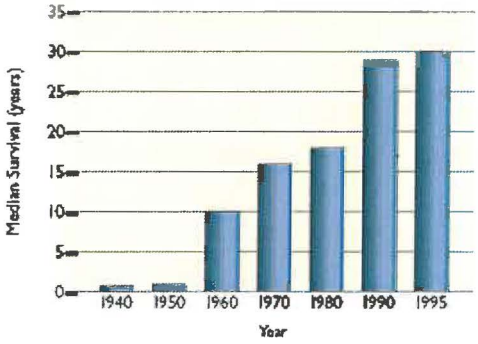
CF affects the pancreas, which makes it difficult for people with CF to digest food. This can cause malnutrition, which can lead to poor growth, physical weakness and

delayed puberty. There is medication that can compensate for the failure of the pancreas.See the treatment/medication section of this site for further information.
In older patients, insulin production can become deficient due to increasing pancreatic disease. Some develop diabetes mellitus and their blood sugar levels are no longer controlled. However, this rarely happens to children with CF.
Common symptoms of diabetes include thirst, hunger, weight loss and excessive need to urinate, but some people do not show obvious symptoms of diabetes. For more information about diabetes mellitus, click here
Other Affected Organs
In every ten babies born with CF, one is ill in the first few days of life with a bowel obstruction called meconium ileus. In these cases, the meconium (a thick black material present in the bowels of all newborn babies) is so thick that it blocks the bowel instead of passing through. Babies with meconium ilius often need an urgent operation to relieve and bypass the blockage.
People with CF are prone to osteoporosis (thin, brittle bones) due to the nutritional and other problems involved with the disease. Adults with CF are at an increased risk of osteoporosis because of the adverse effects of steroids taken to control lung disease.
Although Cystic Fibrosis does not cause sexual impotency it can lead to fertility problems. In most men with CF, the tubes that carry sperm are blocked, which causes infertility. Because underweight women are more likely to have irregular menstrual cycles, the nutritional problems associated with CF may affect fertility. However, women with CF do produce healthy, fertile eggs so effective contraception is necessary.
CF can cause the blockage of small ducts in the liver. This only happens to approximately 8% of people who have CF. However, this is a serious health risk and may necessitate a liver transplant. (5, 13)

2 .2. 3.: THE GENETICS OF CF

To understand why one person gets CF and another doesn't you must go back to your high school biology class and basic Mendelian Genetics. Gregor Mended was a monk who lived in the mid to late 1800s and established the foundation of genetics as we know it today. But the "modern age" of management really began in 1989, with the cloning of the gene encoding the cystic fibrosis transmembrane conductance regulator

(CFTR) and the beginning of genuine understanding of the molecular pathogenesis of the disease.

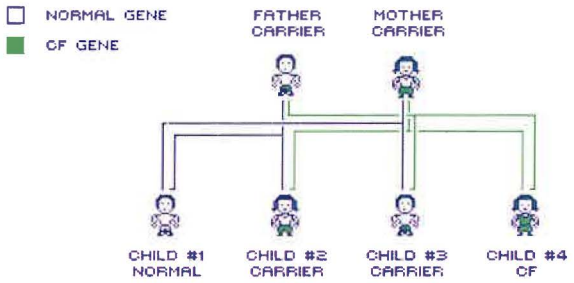


1. Prior to 1940, children with cystic fibrosis rarely survived to their first birthday. By 1995, increasingly effective treatment of infection and other secondary manifestations had raised median survival to 30 years or more. (Adapted from Cystic Fibrosis Patient Registry, National Cystic Fibrosis Foundation, Bethesda, Md, 1997)

Cystic fibrosis is caused by a defect in a single gene, which regulates the passage of chloride and sodium in and out of cell membranes. It occurs in about 1/3,300 white births, 1/15,300 black births, and 1/32,000 asian-american births. But why do some children get CF while their brothers or sisters don't? To answer that question you must understand the interaction of dominant and recessive genes, the basis of Mendel's genetic theory.

Human beings have two matching sets of 23 chromosomes within the nucleus of our cells. Each chromosome has thousands of genes. Genes regulate every thing about our bodies; how we look, how our bodies function, and what traits we pass on to our children. Having two sets of matching chromosomes lets some genes express their instructions (dominant) while suppressing the instructions of the matching gene (recessive). Let's take eye color for example. Brown eyes are a dominant trait while blue is recessive. If a person has the dominant gene for brown eyes, even if they also have the recessive gene for blue, they'll still have brown eyes. The only way they can have blue eyes is to have both genes for blue eyes. The CF gene works in the same way. The CF gene is a recessive trait. The parents of a CF child each carry one CF gene and one normal gene. When they have children they pass on one gene each, it's the combination of these genes that determine if the child will have CF or not. The possibility of having a child with CF is 1 in 4 or 25%. The possibility of having a child without the CF gene is the same 25% and the possibility of having a child as a

"carrier" of the CF gene without the disease is 50%. A carrier of the CF gene doesn't have the disease but can pass the gene on to their own children.



Cystic Fibrosis is an inherited genetic disorder. 1 in 25 people in the UK carry the CF gene, usually without knowing it. If a baby is born with CF, it means that both parents carry the faulty CF gene. Even if they do, there is no guarantee that the child will be born with CF. If both parents are carriers, the child has:

A one in four chance of being born with CF.

A two in four chance of being a carrier, but not having the disease.

A one in four chance of neither having CF nor being a carrier of the faulty gene. (15, 16)

2.3.DIAGNOSIS - TESTS

2.3.1 New born testing

About a third of babies in the UK are tested for CF at birth using a heel prick blood test. The government recently announced its intention to have all babies tested at birth, enabling treatment to begin immediately.

2.3.2 Antenatal testing

This determines early on in pregnancy whether a baby will have CF. Antenatal testing is only offered in cases where there is a high chance of CF.

2.3.3 Genetic testing

A sample of cells is obtained by gently rubbing the inside of the cheek with a brush. This specimen can be used to find the CF gene. It can also determine which family members may be CF carriers.

2.3.4 Carrier testing

A simple mouthwash test can tell if you are a carrier. This is advisable if a relative has CF or is a carrier. It is particularly important if your partner is a known carrier and you are considering having children.

2.3.5 Chest X-ray

The chest X-ray allows your doctor to look inside the lungs. It gives more information about how the disease may be affecting the lungs and helps to guide treatment decisions.

2.3.6 Pulmonary function tests (breathing tests)

The doctor may want to do one or more of these to measure how well the lungs are working. They provide information about any blockage of the bronchial tubes, and show how fast air can get in and out of the lungs. They also help the doctor evaluate changes in the lungs over a period time. Pulmonary function tests are especially useful in making decisions about treatment, and measuring the success of treatment. However, it is difficult to do these breathing tests on infants and young children.

2.3.7 Sputum cultures (phlegm cultures)

These cultures check the sputum for evidence of an active infection in the lung sample of mucus is placed in a dish that germs like staph and pseudomonas grow and multiply. Some time later, the dish is checked for these and other germs that can cause lung infections.

2.3.8 Blood tests

These are done periodically to identify other possible CF-related problems early on, so they can be treated before they become big health problems small sample of blood is usually taken with a syringe and then sent to a laboratory for testing.

2.3.9 Sweat Test

The sweat test is an accurate, safe, and painless way to diagnose CF. In the sweat test, a small electric current is used to carry the chemical pilocarpine into the skin of the forearm. This stimulates sweat glands in the area to produce sweat. Over a period of 30 to 60 minutes, sweat is collected on filter paper (or gauze) and tested for chloride. A chloride reading of more than 60 mEq/L point to CF. Children with CF have more salt in their sweat than normal. If the baby is diagnosed with CF, the other children in your family should have a sweat/genetic test.

2.4. CLINICAL FEATURES

There is a broad spectrum of presenting signs and symptoms and cystic fibrosis and this may be a reflection of many gene variants. Over 400 mutations have been identified. Many patients are diagnosed early in life with signs and symptoms related either to the respiratory or gastrointestinal systems.

In the neonate, meconium ileus is the most common presenting feature occurring in about 10-15% of cases. Signs of intestinal obstruction may occur within 48 hours of birth. The infant fails to pass meconium after birth because the bowel is obstructed by sticky inspissated intestinal contents, but in milder cases there may only be delay in the passing of meconium.

Another common presenting sign in infants and young children is a voracious appetite and failure to thrive due to malabsorption from the alimentary tract.Gastro-oesophageal reflux is a problem in some patients.

Abnormalities in ion transport in the pancreas lead to inflammation and later to fibrosis of the acinar portion of the gland and to hyposecretion of the major digestive enzymes secreted by the pancreas. The presenting symptom is steatorrhoea; abdominal discomfort and distension often accompany the passing of characteristically fatty. In some patients steatorrhoea is not a presenting features or may be mild.

The complication of diabetes mellitus in the older patient may possibly result from progressive fibrosis of the pancreas and is thought to be associated with a decline in the patient's clinical condiiton. Another feature occurring in adults is liver damage,

which starts as focal biliary cirrhosis and may in a few patients progress to portal hypertension and occasionally hepatic failure.

Meconium ileus equivalent is a form of small intestinal obstruction occurring in some adults with cystic fibrosis. It causes abdominal distension and discomfort, vomiting and constipation, and should not be confused with appendicitis.

Most women with cystic fibrosis have normal or near normal fertility, but puberty may be delayed. Most males are subfertile because of development defects of the vast deferent, epididymis and seminal vesicles. Possible methods of reproduction may be discussed with the specialist.

Approximately one-third of adult patients with cystic fibrosis develops rheumatic symptoms. The two most common forms are an episodic and recurrent arthritis and hypertrophic pulmonary osteoarthropathy. They are characterized by joint pain, tenderness, swelling and limitation of movement, usually symmetrical and affecting particularly the knees, ankles and wrists.

The respiratory signs and symptoms vary. Some patients may be asymptomatic for many years, other may have a dry cough and later a persistent cough with purulent sputum. The respiratory pathogens most commonly isolated in 1990 were Pseudomonas aeruginosa, Staphylococcus aureus, Haemophilus influenza and Pseudomonas cepacia. Staphylococcus aureus used to be the most frequently isolated organism, but it is now only in-patients of less than 1 year of age in which this is the case. Colonization with Burkholderia cepacia and Pseudomonas aeruginosa. Mucus hypersecretion, impaired mucociliary clearance and inflammation create an environment in which bacteria will thriven patients with cystic fibrosis there is in addition a market attraction between Pseudomonas aeruginosa and the airways.

Haemoptysis is common and usually mild, although episodes of frank haemoptysis may occur wheeze is sometimes present, and patients may be breathless on exertion. With increasing breathlessness appetite becomes poor and the patient loses weight. Chest pain may be associated with an exacerbation of a bronchopulmonary infection, a pneumothorax or musculoskeletal dysfunction. Most patients develop finger clubbing and with more severe disease may become cyanosed.

The chest radiograph is usually normal at birth but an early change is bronchial wall thickening, particularly in the upper zones. As the disease progresses, overinflation of the lungs may occur with ill-defined nodular shadows, numerous ring and parallel line shadows indicating bronchial wall thickening and bronchiectasis. Crackles and

wheezes may be heard on auscultation. Some patients develop nasal polyps; these may grow rabidly and are frequently recurrent. They may be related to chronic sinus infection.

Pulmonary function tests initially show signs of obstruction, but with advanced disease a restrictive pattern may be superimposed on the obstructive defect and a diffusion abnormality will also become apparent. Pulmonary function measurements have been shown to be predictors of mortality's the disease progresses ventilation/perfusion imbalance occurs leading to hypoxaemia, pulmonary hypertension and cardiac failure.

Asthma is a common in-patient with cystic fibrosis as it is among the normal population. Many cystic fibrosis patients have a positive skin test to Aspergillus fumigatus. This is often seen in the sputum, but allergic bronchopulmonary aspergillosis is less common occurring in approximately 11% of patients. Recurrent wheezing, deteriorating chest symptoms and fleeting fluffy shadows on the chest radiograph recognizes ABPA.

Investigations for cystic fibrosis are similar to those for bronchiectasis, but may also include pancreatic function studies, tests for fecal fat, examination of the liver, spleen and gall bladder, and screening for diabetes mellitus.(1, 2, 3, 4, 7, 15, 20, 21, 22)

2.5. MANAGEMENT

1) Physical therapy for the clearance of the bronchial airways from the sticky mucus.
2) Administration of drugs for the prevention of infections and alterations in lung soft tissues.
3) Specific diets and additional supplies of pancreatic enzymes to maintain proper nutritional abilities.

It is the knowledge of the condition and understanding of the treatment for cystic fibrosis, which influence patient compliance and treatment outcomes. The presenting problems of each patient will vary, and will fluctuate from a chronic stable state to an acute changing state. An exacerbation of a bronchopulmonary infection will produce changes, which can be detected by accurate assessment of the signs and symptoms. Physiotherapy may help in the treatment of patient's problems of excess bronchial secretions, reduced exercise tolerance, breathlessness and chest wall stiffness and pain

of musculoskeletal origin. Arthropathy, unstable diabetes and the abdominal pain of meconium ileus equivalent are examples of medical problems, which will affect the physiotherapist's treatment plan.

Throughout the world initially treatment was applied using standard techniques. But as knowledge has developed a wide spectrum of physiotherapy techniques influencing ventilation arose.

Such techniques are:

Gravity assisted positioning

Gravity assisted positioning is the use of different body positions to achieve:

Drainage of secretions from a particular area of lung, using gravity

Increased air flow to different parts of the lung

Chest physiotherapy techniques should be carried out in different positions, so that each lung segment is kept as clear of secretions – and as fully inflated – as possible. (13, 14, 18)

2.6. DRUG ADMINISTRATION.

Medication

Cystic Fibrosis affects the lungs and the digestive tract - these areas are likely to require medication.

Infections can be cleared or controlled by a variety of drugs. Here is a guide to the most commonly used medication for people with CF.

Lungs

Medication can be administered in various ways: inhaled into the lungs using nebulisers; taken orally or taken intravenously.

These drugs treat the lungs in the following ways:

Bronchodilator drugs open the airways by relaxing the surrounding muscle. They relieve tightness and shortness of breath. They widen the breathing tubes to take mucus removal and breathing easier. These are most often prescribed prior to chest physical therapy.

Mucolytics: thin the mucus, making it easier to drain.

Decongestants: reduce the swelling of the membranes that line breathing tubes.

Antibiotics: help control infection. These are most often taken after chest physical therapy.

Antibiotics help to treat or control persistent infection.

Antibiotics

Antibiotics is drugs that destroy infecting-causing bacteria. Respiratory infections can occur frequently in CF, and antibiotics are important part of the therapy. The type of antibiotic, hoe often is taken, and over how long time period it is taken varies for each person. Some people with CF need continuous antibiotics while others need only to control flare-ups of infection. Your doctor will adjust antibiotic treatment to your child's individual needs.

Oral antibiotics

Are often in tablets or capsules that are swallowed. Oral antibiotics are often used to treat mild flare-ups of lung infection. These are effective against staph and some more other infections, but are not always effective against pseudomonas. Although oral antibiotics have not worked well against pseudomonas, new antibiotics are being developed that work well. Your CF doctor will tell you if oral antibiotics are needed and which are best suited to your child's needs.

Intravenous antibiotics:

Are liquid solutions that are put directly into blood? More serious lung infections may require IV antibiotics, which work quite well against pseudomonas and staph. A stay in the hospital is often part of this treatment, but many CFF-accredited care centers recommend home IV antibiotics for some of their patients when appropriate.

Aerosolized antibiotics:

Are liquids turned into a mist and inhaled. Aerosolized antibiotics are generally those that do not work well when swallowed. An aerosol mist delivers the antibiotic directly into the airways. These antibiotics are still being studied to test the effectiveness of this type of treatment.

Steroids reduce inflammation in the airways.

Dnase breaks down mucus and makes it easier to clear

Digestive System

Cystic Fibrosis affects the pancreas, so enzyme pills should be taken with meals and snacks to replace pancreatic enzymes and enable people with CF to gain more energy from the food they eat.The dietician or doctor can advise on the appropriate type/dosage of enzyme supplement.

Nutritional supplements such as high-energy drinks can also help to compensate for ineffective digestion.
Anyone suffering from diabetes mellitus will need to balance food intake with appropriate diabetic treatment such as tablets or insulin.

Other Organs
Bones can be effected by a lack of minerals, which can cause osteoporosis (weak/brittle bones). Bisphosphonates, which are used to treat osteoporosis in post-menopausal women, have been shown to be beneficial for the treatment of osteoporosis in CF too. Research is being carried out to investigate the benefits of high doses of vitamin D and calcium.
If someone with CF is having liver problems, they will be treated in the same way as other people with this condition. Promising results have been reported following early treatment with ursodeoxycholic acid.(8, 12, 19)

2.7. AIRWAY SUCTION

Airway suction is usually necessary to clear secretions from the intubated patient with an endotracheal tube.
Infants are at particular risk of infection, so great care must be taken with hand washing and wearing gloves, etc.
The vacuum pressure should not be excessive but will need to be strong enough to draw secretions up very narrow bore catheters. Recommended values are 10-20 pa. Most commonly used catheters are 6 and 8 French gauge. Size 5 FG and below are usually ineffective in removing thick secretions. Size 10 FG and above should be reserved for use with older children. When suctioning artificial airways the external diameter of the catheter should not exceed 50% of the internal diameter of the airway. Diluents and mucolytics, e.g. saline in aliquots of 0.5 ml to 5 ml may be used to enhance secretion clearance. The efficacy of these is not conclusively proven and they should never be used routinely. Larger quantities of irritants are sometimes used as part of bronchoalveolar lavage procedures but this should only be undertaken by experienced personnel and with great caution.
Particular care should be taken with nasopharyngeal suction of neonates as reflex bradycardia and apnoea can occur.

Nasopharyngeal suction should be avoided if the child has stridor or has recently been extubated as is may precipitate laryngospasm.

Physical activity is an important part of the treatment process.

Exercise is particularly important for people with CF as it prevents deterioration of the lungs and improves physical bulk and strength. Children with CF should be encouraged to take part in as much physical activity as possible - ideally types of exercise that make you out of breath (i.e. running, swimming, football or tennis). It is important to inform teachers at school that exercise should be encouraged, as they may be unsure whether exercise is good for people with CF or not.

Posture and chest mobility

The spine, ribcage and shoulders should remain fully flexible as far as possible and good posture should be maintained.

Older children or adults may need to do stretching exercises to maintain full movement of the joints and muscles around the shoulders and chest.

Younger children can do the same by taking part in games or activities that involve moving and stretching the trunk and arms. Activities like wheelbarrow racing make good stretching exercises, as well as helping to drain secretions.(15)

2.8 DIET

Diet should be as normal as possible, provided rich in proteins should and calories should. CF patients should have pancreatic enzymes supplement and fat soluble vitamins (A, D, E, and K).(13)

2.9 TRANSPLANTATION

The success rate of Lung transplantation for CF patients is encouraging: 70% survive one or two years after transplantation and the longest surviving patients had their transplant operation 12 years ago. Like any other major surgery it carries considerable risks and is appropriate only for a patient who is severely ill and has tried all other forms of conventional treatment. To these patients, lung transplantation offers a better quality of life.

There is a shortage of donor organs available for those awaiting transplants. If more people carry donor cards, then more lives that can be saved in this way.

Transplantation doesn't remove all concern - the risk of rejection or infection still remains. Anyone considering transplantation should consult doctors or counsellors at a local CF clinic. For more information about transplantation, you can download the CF Trust's booklet here.

2.10.PREVENTION

If you have a family history of CF, you may want to consider genetic counseling before starting a family. In many cases carriers of this disorder can be identified through testing.

At this time, preventing CF is not possible. In babies with two abnormal CF genes, the disease is already present at birth in some organs, such as the pancreas and liver, but develops only after birth in the lungs. Someday, gene therapy may be used to prevent the lung disease from developing. Yet, CF might be prevented in the future. Since CF occurs only when both parents pass on a CF gene to a child, it could be prevented by identifying all carriers of CF genes. Genetic counselors might then persuade couples who are carriers not to have children. However, as noted, current tests can detect only some of the more than 400 gene mutations and so the tests are only 80-85 percent accurate.

Yet, progress in gene therapy and the realization that not all CF mutations are life-threatening should reassure couples. Potential parents who carry the defective gene may choose to have children.(21, 23)

3.1 ANAMNESIS

Schusterová Kateřina

Family history: mother, born 59 – healthy, her mother – sarkoidosis
Father, born 66 – polinosis, hypertension
Brother, born 87 – alergy,has different father, sister, born 98 – exzema

Personal history: She is born from the third physiological pragnancy, polyhydramnion, spontaneus delivery in the correct term, 3500grams / 51 cm length, she was not resuscitated, icterus 0, after the birth she had ileus – she had to undergo resection of 17 cm of jejunum because of atresia. She was not gaining the weight, she was coughing and there were found chlorides in the sweat //.114 mmol/l . These symptoms led to diagnosis of cystical fibrosis / heterozygocy delta F508 and del 21 kb CFTR.
At the age of 2 months she was taken to hospital / 1. children clinics/ to start with therapy. At the age of three months she was in hospital / 1. chldren clinics / because of obstructive dyspnoe / = breathlessness / . During the first two years she was getting Endobulin because of secondary hypogamaglobulinemia IgG / = low level of antibodies class IgG /, now the level of antibodies is normal.4/2003 IgG 7,26, IgA 0,4, IgM 1,3, IgE 18 , / only a little bit decreased IgA, the other classes of antibodies are normal./ She had repeatedly troubles with breathing, expiratory breathlessness – treated with Pulmicort. 7/2000 she was in hospital due to metabolical disballance and breathlessness, in the cultivation of mucus was found Burkholderia cepacia, control cultivation was allready negative – so it was evaluated as a contammination.8/2000 she was in a hospital for ileus and had the operation to disturbe adhesions, without any resection.7/2002 was treated for the prolapsus of rectum, was made reposition. She has been watched in the cardiac centre of Motol due to a not dangerous rhabdomyoma of the heart and in neurology because of possibility of tuberal sclerosis, but it seems not to be present.

Pseudomonas in the mucus of the airways was found for the first time in 13.9.2001, she was treated in 10/2002 and there is not anz presence of Pseudomonas in mucus at the moment
Hip joints are OK, she was breast-feeded for 6 months, then was adding normal food, but still continued breast feeding for another two years..

Vaccination according to vac. callendary, without any reactions.
Children diseases : 0
Operations:
1/2000 – KDCh Motol – resection of jejunum because of atresy
8/2000 – KDCh Motol -- ileus, operation to disturb adhessions, without resection

Injuries: 0
Watching: in cardail center of Motol for presence of rhabdomyoma in myocardium of heart and in neurology for possibility of tuberal sclerosis.

Alergies: 0

Permanent therapy: Colimycin inhalations 3x 1 MIU, Kreon 10000 16x per day, Ranisan 2x1/4 tbl., Lactobacilus 1x1, vitamin E 2x a week, vitamin A 4x a week, Vigantol 2 drops a day, Amilorid inhalations 2x a day, flutter 3x a day

State: she has a good appetite, eats 5 times a day, defecation 1-3 per day, not smelling, belly-aching only rarly, when coughing, she expectorates usually only white mucus, nowdays mucus is of a green colour the green colour, she is able to exercise without breathlessness / she participates dancing course. Presence of Pseudomonas aeruginosa in the mucus in 5.1.2004. Her weight and height are normal.

Present status :

In the last controll was found in her mucus Pseudomonas aeruginosa 10/ 6, Stafylococcus aureus, Haemofillus influenzea 10/6 , she had twice viral infection , first in 11/2003 – this time she was treated with Mucosolvan, second in 12/2003 / treated with antibiotic sirupi.

In the mucus from 5.1. 2004 was found again Pseudomonas aeruginosa, so she is coming to hospital to be treated with the combinated antibiotic therapy during her staz in hospital.

Status :

Without increased temperature, eutrofic / of the normal weight and proportions /, normal hydratation, skin clean, muscle tonus normal. Head is mesocefalic, not painfull for percussion, endings of nervus trigeminus are not painful, inervation from n. facialis is good, pupillas are izocoric, with fotoreaction, conjuntivas are pink, nose and ears are without secretion, tongue with a mild layer, throat is calm, tonsillas are hypertrofic / enlarged /, not painfull, without any pus on them, lymphatic nodes in neck are on both sides enlarged, breathing is vesicular and clear, she is coughing and expectorates viscous mucus of the green color, heart beat is regullar, without anz sounds, bellz is soft, under the level of thorax, not painfull, liver is not enlarged, scar after operation is calm, extremities are without swelling, female genital without secretion. Signs of meningeal iritation are negative.

Vysetfeni: FW:12/52(15.1.)CRP: 1,8...8 KO:

26.01.2004-16:02

WBC 10.4; RBC 4.74; HGB 12.8; HCT 0.387; MCV 81.6; MCH 27.0; MCHC 33.1; RDW 12.6; PLT 311; MPV 7.1;

PCT 0.220; PDW 16.8; Lymfo 0.408; Mono 0.054; Neutro 0.502; Eo 0.022; Bazo 0.014;

LY# 4.243; MO# 0.562; GR# 5.595;

15.01.2004-15:36

WBC 14.8; RBC 4.76; HGB 12.9; HCT 0.390; MCV 81.8; MCH 27.1; MCHC 33.1;

RDW 13.1; PLT 471; MPV 7.8;

PCT 0.365; PDW 16.5;Lymfo 0.254; Mono 0.061; Neutro 0.679; Eo 0.001; Bazo

0.005;

LY# 3.759; MO# 0.903;'GR# 10.138;

Biochemie:
26.1.
Na+ 138 MMOL/L [*], K+ 4.2 MMOL/L [*], Cl- 107 MMOL/L [*], CA-CELK 2.35 MMOL/L [*], OSM 290
MMOL/KG [*], ALP 3.31 UKAT/L [*], AST 0.46 UKAT/L [*], ALT 0.43 UKAT/L [*], CK 1.48 UKAT/L [*]
GMT 0.13 UKAT/L [*], BILI-CELK 4.9 UMOL/L [*], UREA 5.0 MMOL/L [*], KREA 54 UMOL/L [*],
CB 69.6 G/L [*]
21.1.
Na+ 139 MMOL/L [*], K+ 4.3 MMOL/L [*], Cl- 107 MMOL/L [*], CA-CELK 2.29 MMOL/L [*], AST 0.56
UKAT/L [*], ALT 0.39 UKAT/L [*], LD 5.9 UKAT/L [*], BILI-CELK 5.9 UMOL/L [*]
15.1.
Na+ 138 MMOL/L [*], K+ 4.1 MMOL/L [*], Cl- 105 MMOL/L f*], CA-CELK 2.45 MMOL/L [*], P 1.88 MMOL/L
[*], OSM 292 MMOL/KG [*], ALP 2.64 UKAT/L [*], AST 0.56 UKAT/L [*], ALT 0.50 UKAT/L [*] LD 8.2
UKAT/L [*], CK 1.12 UKAT/L [*], GMT 0.11 UKAT/L [*], AMS 0.86 UKAT/L [*], BILI-CELK 5.7 UMOL/L [*],
UREA 4.8 MMOL/L [*], KREA 54 UMOL/L [*], TRIGL 1.42 MMOL/L [*], CHOL 4.9 MMOL/L 0* CB 63.7 G/L
[*], ALB 42.9 G/L [*], IGF1 94 (-1,OOSD) UG/L
VIT A 1.5 UMOL/L [*], VIT E 10.50 UMOL/L [*]

Moc a sediment: Moc chemicky: SPEC.HMOTN 1.010 kg/1, pH 6.5 , LEUKOCYTY NEC , NITRITY NEC , BILKOVINA NEC , GLUKOSA NORM , KETOLATKY NEC , UROBILINOG NORM , BILIRUBIN NEC , KREV (ERY) NEC ,
Mocovy sediment: ERYTROCYTY nenalezeny pocet/z.p. , LEUKOCYTY 0-4 pocet/z.p. , VALCE nenalezeny pocet/z.p. , EPIT DLAZD nenalezeny pocet/z.p. , RUZNE hlen

Mikrobiologie: nos — bezna flora, PCR: B.cepacia obe kola NEG

sputum 16.1.2004
Str.viridans,Neisseria kvant. 10 exp.6, leuko,epi,g+koky,g-tycky3.

Staphylococcus aureus kvant. 10 exp.6
ATB :
OXACILIN citlivy
ERYTROMYCIN citlivy
GENTAMICIN citlivy
AMP.+INHIB. citlivy
RIFAMPICIN citlivy
VANKOMYCIN citlivy
COTRIMOXAZOL citlivy
LINKOMYCIN citlivy
TETRACYKLIN citlivy
CHLORAMFENIKOL citlivy
OFLOXACIN citlivy
TEICOPLANIN citlivy

Haemophilus influenzae kvant 10 exp.3
ATB:
AMPICILIN citlivy
CHLORAMFENIKOL citlivy
AMP.+INHIB. citlivy
AZITROMYCIN citlivy
COTRIMOXAZOL citlivy
TETRACYKLIN citlivy
CEFUROXIM citlivy

ORL : enlargement of palate tonsillas, without any focus of infection, ears, nose, lymfatic nodes normal.

Surgary: state after the prolapse of rectum, there are two little skin processes in perianal area,sfincterhas a little bit increased pressure. She can be ordered for operation in dr. Fric to take out processes. It will take max. 3 days to stay in hospital.

Antropology: 105,2 cm (55,8P), 16,9 kg(49.7P), circumference of arm 16,5 cm(32.99P), good state of nutrition, sticks 1/1,05

Immunology: IgG 7,13, IgA 0,44 - a little bit decreased, IgM 1,32, IgE 14, IgG1 4,39, IgG2 2,13, IgG3 0,304, IgG4 1,5, C3 0,82, C4 0,11 – a little bit decreased. It is necessary to control IgA during the next visit in hospital.
Virology: EBV – memory antibodies, CMV, HSV, VZV are negative

ECG : sinusal, axis of heart is + 60 degrees, PR 0, 12, QRS 0,07, STT normal, fyziological superiority of the left ventricle, normal fase of repolarization.

Course of stay in hospital:

4 years old girl was accepted to our department for the regullar ATB therapy due to a chronic

presence of Pseudomonas in airways. She is coming with the low inflamatory parametres and without any clinical signs of acute infection. In the mucus from 5.1. 2004 was found Pseudomonas.It has been started with intravenous antibiotic therapy Amikacin 3 x 180 mg a day and Fortum 3 x 1200 mg a day. According to the level of amikin was the dose of Amikin reduced to 3 x 140 mg. , but this was not effective, that is why the dose was increased to 3 x 160 mg, which is optimal. At the same time she is getting her usual therapy of Colimycin inhalations 3 x 1 MIU, Kreon 10000 17 x a day, Ranisan 2 x ¼ , Lactobacillus 1 x 1, vitamin E 2 x a week, vitamin A 4 x a week, Vigantol 2 drops a day, Amilorid inhalations 2 x a day, flutter 3 x a day.
During the whole stay in hospital was without increased temperature, was eating and drinking enough. Breathing is always clean, without any presence of mucus, she is expectorating finally only white mucus.
It was prrescribed recipi for Kreon 10000 80 pieces, Ranisan 75 mg 5 pieces, 2x mouthpiece.

Diagnosis: Cystical fibrosis with insuficciency of pancreas

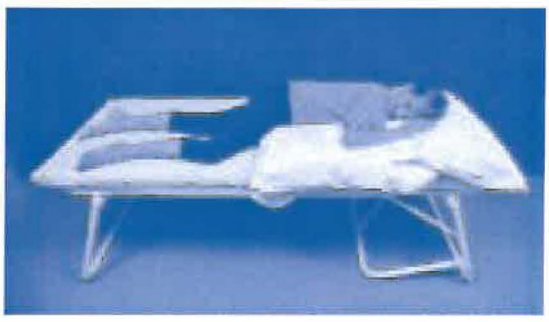
Therapy : Amikacin 3x 160 mg intravenous
Fortum 3x 1200 mg intravenous
Colimycn inhalations 3x 1 MIU, Kreon 10000 17x a day, Ranisan 2x1/4 tablett, Lactobacillus 1x1, vitamin E 2x a week, vitamin A 4x a week, Vigantol 2 drops a day, Amiloroid inhalations 2x a day, flutter 3x a day.

Recommendation.: Visit in the ambulance of cystic fibrosis in 3 months, if there is any acute problem, so immidately
Sample of mucous every month
Controlls of IgA
Visit in surgary to take out perianal skin processes

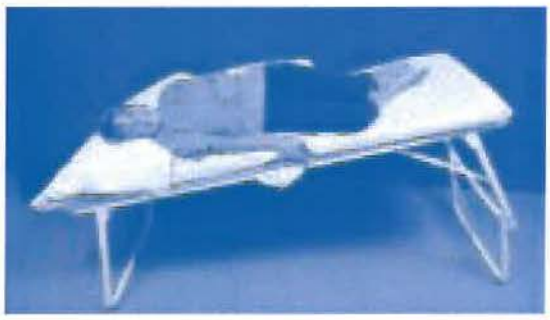
3.2 REHABILITATION – RESPIRATORY PHYSIOTHERAPY

The ultimate goal of the physiotherapy procedure during my practice at Motol hospital applied at my patient Katerina Schusterova and also for every other patient with respiratory problems or diseases was to help them remove the inflammatory sticky mucus from the bronchi, in order to assist the gas exchange which is interpreted, to help with the removal of particles and germs which are trapped in the alveoli and can cause various kinds of infections, to reduce the possibility of flare-up of an infection , to protect as much as possible the lungs structure and to minimize as much as possible the patients stay in the hospital.

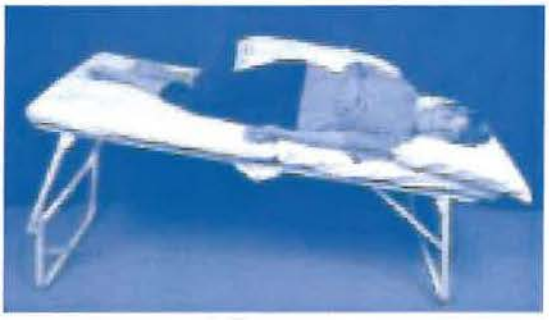
We can obtain all the above mentioned goals by applying different kinds of physiotherapeutic techniques. The administration of the drugs was done usually before the beginning of the physiotherapeutic exercises in a form of a mist. The time limit of the physiotherapeutic process was not more than 45 min. and always according to the daily status of my patient. Considering my patient's age the exercises were applied in the form of a game. It was very important for me and all the physiotherapists in general to be accepted by the infant in order to fulfill my task without problems (e g. child's cry)



Right upper lobe –posterior segment

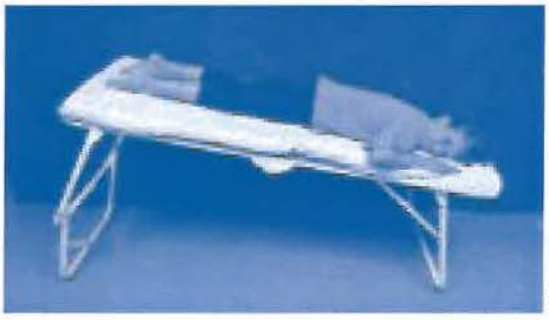


Lingula

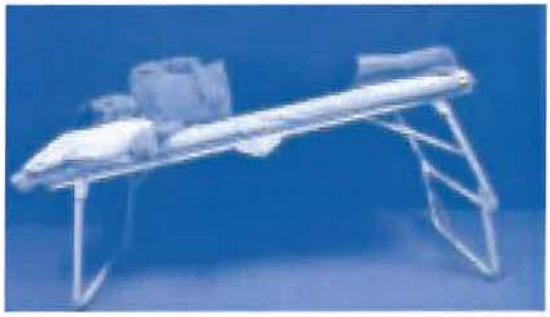


Right middle lobe

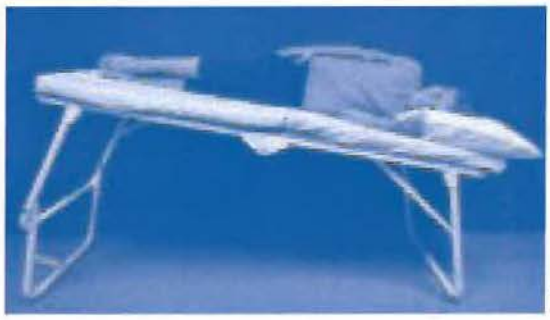
Lower lobes –apical segments



Lower lobes –posterior basal segments



Left lower lobe –lateral basal segment



Right lower lobe –lateral basal segment

Lower lobes –anterior basal segments

3.3 Position for draining different lung segments

Upper lobes –apical segments

Upper lobes –anterior segments

Left upper lobe –posterior segment

3.4 The Active Cycle of Breathing Techniques (ACBT)

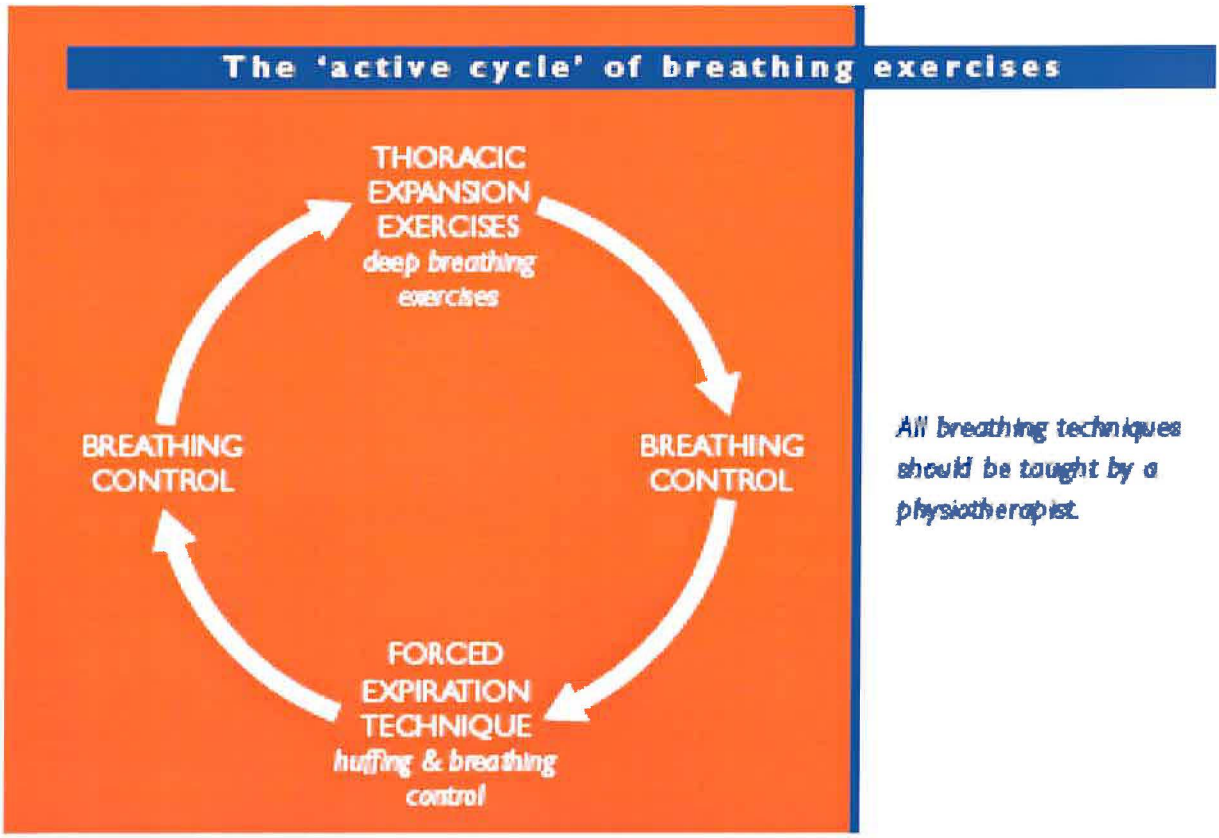
The ACBT is used to mobilize and clear excess bronchial secretions. It has been shown to be effective in the clearance of bronchial secretions and to improve lung function. It neither causes nor increases hypoxaemia, nor increases airflow obstruction.

In the management of children with cystic fibrosis in the Ukraine, the physiotherapy techniques used had been very uncomfortable. The introduction of the ACBT during a 6-month period led to subjective improvements and significant improvements in oxygen saturation.

The ACBT is a flexible method of treatment, which can be adapted for use in any patient, young, or old, medical or surgical, where there is a problem of excess bronchial secretions. It can be used with or without an assistant.

It is a cycle of breathing control, thoracic expansion exercises and the forced expiration technique (FET). The original studies on FET used this cycle of techniques,

but people began to use a regimen of huffing alone or other variations on the FET and the literature became confusing. In order to emphasize the use of thoracic expansion exercises and the periods of breathing control, in addition to the FET, the whole regimen was renamed the active cycle of breathing techniques. The regimen did not change in practice and the early studies on the FET were randomized controlled trials of the ACBT.



3.5 BREATHING CONTROL

All breathing techniques should be taught by a physiotherapist.

A i m s

to encourage relaxation and ease breathlessness

to reduce over inflation of the upper chest and encourage a more normal breathing pattern

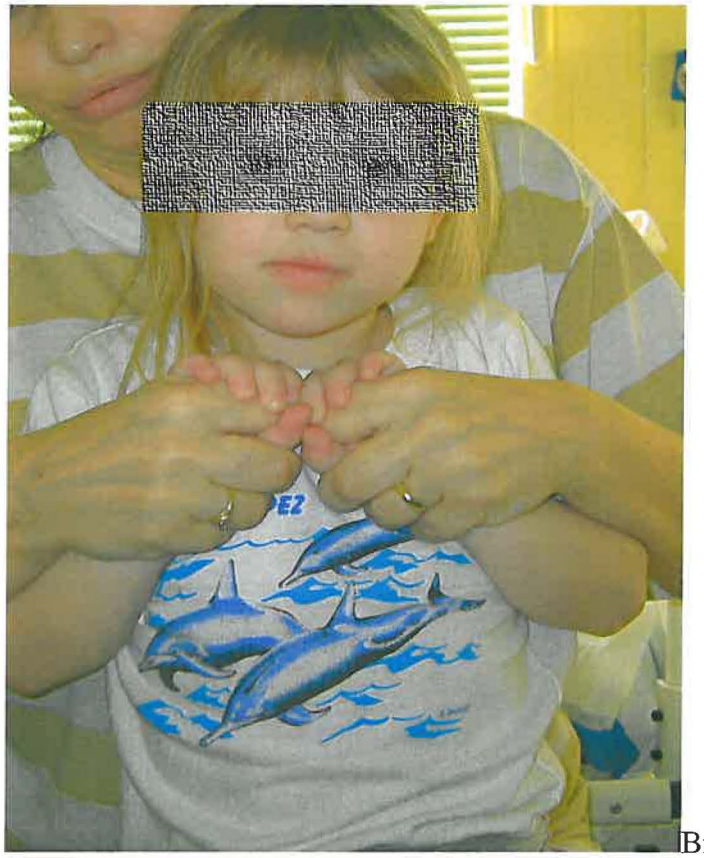
to allow "relaxation" of the airways so that secretions can be cleared more easily

M e t h o d

Rest your hand lightly on your tummy

Try to relax the muscles around the neck and upper chest

Breathe quietly and gently (as you breathe in, your tummy should swell slightly and, as you breathe out, sink down again). You should feel more movement around the waist and less around the upper chest



Breathing control in sitting position

3.6 THORACIC EXPANSION (DEEP BREATHING) EXERCISES

A i m s

to loosen secretions

to keep the chest mobile

M e t h o d

Relax the upper chest

Apply pressure with your hand to the lower part of the ribcage

Breathe in slowly and deeply, filling up the lungs with air and expanding the lower chest as much as possible

Release pressure with your hand and breathe out quietly

Thoracic expansion in sitting position

3.7 Forced expiration technique (huffing & breathing control)

A i m s

to move secretions from the smaller to the larger airways so that they can be cleared from the lungs more efficiently

M e t h o d

Stage 1: Huffing

Take a medium sized breath in

Squeeze the air out, contracting your tummy muscles and keeping your mouth and throat open. The huff should not be violent

The breath out should be prolonged but not continued until the lungs are completely empty. This may make you cough as secretions are moved. If secretions do not come up in one or two coughs, try to stop coughing or you will become tired

Stage 2

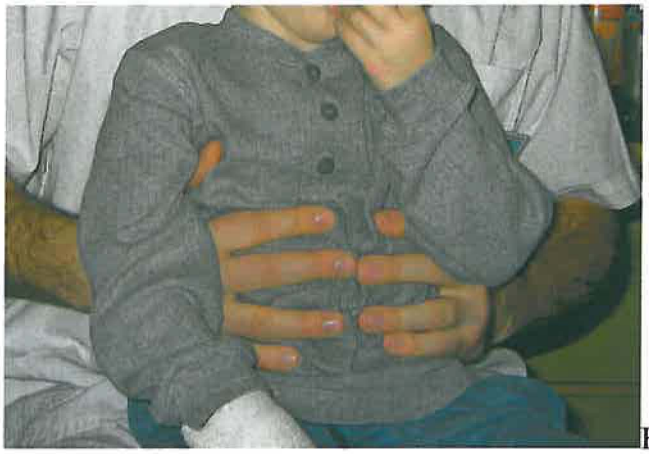
Do some breathing control

Stage 3

Stages 1 and 2 may be repeated until secretions can be felt high in the chest

Stage 4

When you feel secretions high in the chest, you should take in a deep breath and huff or cough to clear them


Huffing in sitting position

3.8 CHEST SHAKING

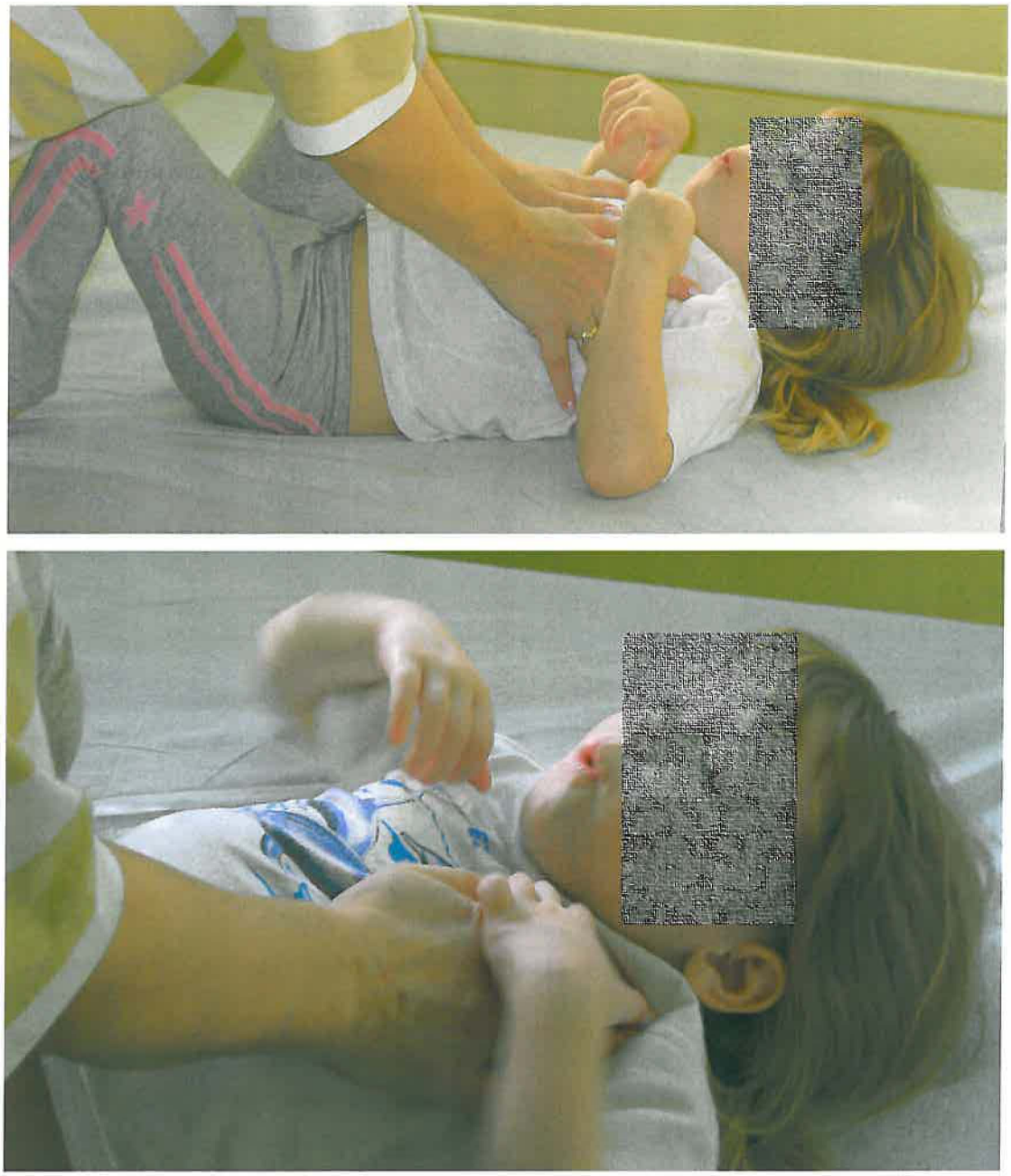
Some people find that this technique is especially helpful in moving secretions if used with breathing exercises, although the technique is effective when used on its own.

Method

Place your hands on the chest

On the 'out' phase of a deep breath, shake the chest firmly, squeezing out the air in short bursts and applying the pressure inwards

You may not be successful with this method at first but keep trying – it takes practice to do shaking comfortably and effectively.



Chest shaking on "out" phase of deep breath

3.9 TODDLERS AND YOUNG CHILDREN

Toddlers and young children aren't the easiest age group to deal with at the best of times – and this applies equally to treatment! However, although it's often difficult and frustrating to persuade a child to lie still and cooperate with treatment, it's well worth persevering. Co-operation with treatment in future years is very often dependent on how things are handled at toddler stage.

It's essential that a child learns from an early age that physiotherapy is something that has to be done every day. With patience and imagination, you can make physiotherapy a time that children enjoy and regard as a special time of day – a time when they have
the undivided attention of mum or dad. This can be considered a transitional stage, when children's treatment is changed and modified as they get older and can learn new techniques.


Practising breathing techniques through play

When children are too big to be treated comfortably on the knee, they can have their treatment lying over a foam wedge. l After children are two years old, treatment should
progress from 'passive' to a more 'active' form. In the next couple of years, children can learn new breathing techniques which should be introduced gradually into their physiotherapy programme. A variety of 'blowing games' can be started. For example:
– taking big deep breaths in and blowing little
pieces of tissue paper
– blowing bubbles
– breathing out and steaming up a mirror
Children can play these games whilst on the wedge during physiotherapy sessions, either during or
between short periods of chest clapping.

Steaming up a mirror

Using the power of the breath

3.10 Autogenic Drainage (AD)

Autogenic drainage (AD) aims to maximize airflow within the airways to improve the clearance of mucus and ventilation. Chevalier developed this concept in Belgium in late 1960s, but little was published until 1979. Autogenic drainage is breathing at different lung volumes and an active expiration is used to mobilize the mucus. Chevalier described three phrases: 'unstick', 'collect' and 'evacuate'. Breathing at low lung volumes is said to mobilize peripheral mucus. This is the first or 'unstick' phase. It is followed by a period of tidal breathing which is said to 'collect' mucus in the middle airways. Then, by breathing at higher lung volumes, the 'evacuate' phase,

expectoration of secretions from the central airways is promoted. A huff from the lung volume is now encouraged to clear the secretions from the trachea. Coughing is discouraged.

AD has been altered in Germany and is not split into the three phases as the patients were found to be uncomfortable breathing at low lung volumes. This technique is known as modified Autogenic drainage. The patient breathes around tidal volume while breath holding for 2-3 seconds at the end of each inspiration. Coughing is used to cleat the mucus from the larynx.

The flow-volume curve is frequently used to support an increase in airflow with the unforced expiratory maneuver of autogenic drainage. However. It must be remembered that it is only possible to go outside the flow-volume curve if pressure-dependent collapse exists.

Autogenic drainage is usually practiced in the sitting position. It takes 10-20 hours to teach the main principles and sessions of 30-45 minutes twice a day are necessary. Children under the age of about 8 years would find it difficult to concentrate for any length of time on the different levels of breathing involved.

In the long-term study of patients with cystic fibrosis AD was compared with 'conventional' percussion and postural drainage. AD was found to be at least as effective as the conventional treatment and patients had marked preference for AD.

3.11 Positive Expiratory Pressure (PEP):

Positive expiratory pressure is usually given through a mask to provide resistance to breathing out. This helps to keep small airways open and to loosen secretions. One of the benefits of PEP is that it's performed in the sitting position. This makes it convenient to use when

space is limited, as it may be at work, in school or when travelling. Treatment consists of breathing through a face mask with different sizes of resistors, for about ten breaths. The mask is then removed before the forced expiration technique (huff and breathing control) is performed to

clear secretions. It's important that a physiotherapist carries out a full assessment, so that the correct level of resistance can be chosen. This will be re-assessed regularly, particularly during a chest infection.


Using the positive expiratory pressure (PEP) mask

3.12 High Pressure PEP

High-pressure PEP is a modified form of PEP mask treatments describe for the treatment of patients with cystic fibrosis by Oberwaldner et al. By using high pressures of PEP secretions may be mobilized more easily in-patient holds the mask firmly against the face. Six to ten rhythmical breaths at tidal volume are followed by an inspiration to total lung capacity and then a forced expiratory maneuver against the resistance to low lung volume, which usually results in the expectoration of sputum. An individuals optimum expiratory resistance is carefully determined by spirometry. It is the resistance that allows the patient to expire to a volume greater than his usual forced vital capacity. The technique is only recommended for use where full lung function equipment is available for regular reassessment of the expiratory resistance for each individual. Meticulous care must be taken as an incorrect resistance can lead to deterioration in lung function.

3.13 Oscillating PEP-Flutter Therapy:

The Flutter is a small, simple portable device used to assist the clearance of bronchial secretions. It is pipe-shaped with a single opening at the mouthpiece and a series of small outlet holes at the top of the bowl. The bowl contains a high-density stainless steel ball bearing enclosed in a small cone. During expiration the movement of the

ball along the surface of the cone creates a positive expiratory pressure and an oscillatory vibration of the air within the airways. The device is held horizontally and tilted slightly downwards until a maximal oscillatory effect can be felt. The Flutter combines the techniques of oral high-frequency oscillation and PEP. It can be used in the sitting position or in the position of supine lying.

The Flutter is placed in the mouth and inspiration is either through

The nose or through the mouth by breathing around the Flutter. A slow deep breath in with a breath hold of 3-5 seconds is followed by a breath out, through the Flutter, at a faster rate than normal. After four to eight of these breathes many patients' use huffing either through the Flutter or without the Flutter. This may precipitate expectoration and should be followed by a pause for breathing control.

Originally the recommended technique for the Flutter was a gentle exhalation through the device. Treatment was continued for a period of 10 minutes. Secretions were expectorated by spontaneous coughing. It was this regimen that was shown by Pryor et al to be less effective than the ACBT. The inclusion of huffing, as described in the regimen above, is likely to increase the effectiveness of airway clearance.

Konstan et al compared three regimens: the Flutter, voluntary coughing and a regimen of postural drainage, which included up to 10 positions. Each session lasted 15 minutes. The Flutter regimen was the most effective as measured by the weight of sputum expectorated, but PEP had been shown to be more effective than a similar postural drainage regimen. In a subsequent study the ACBT was shown to be more effective than PEP.

When Autogenic drainage was compared with the Flutter it was concluded that both regimens were equally effective, but the Flutter was easier to teach. A clinical trial was undertaken using the Flutter in-patients following thoracotomy, but no advantage could be found in its inclusion.

The use of the Flutter in airway clearance may improve compliance in some patients, especially children. Care must be taken to wash and dry the parts of the device after use to minimize the risk of infection.

3.14 Postural Drainage and Percussion:

It was the most common technique until the 80's. Consists of placing the patient in various positions, which allows gravity to assist in the expectoration of the mucus by the patient. Percussion is used to assists postural drainage. Nowadays is used mainly in the U.S.A. and U.K. this technique in another countries is believed that causes various side effects to patients with pulmonary diseases because of the weakness of the lung tissues that this people have in the development of the disease.

3.15 Inhalation Therapy

Is now considered an important component of the treatment in CF with the physiotherapist administrating drugs via airways before starting the physiotherapy.

Bronchodilator drugs may be prescribed and these should be inhaled before treatment to clear secretions. In some patients the airflow obstructions is partially reversible with bronchodilators. Another possible effect of b-adrenergic drugs in an increase in cilia action and this may improve mucociliary clearance.

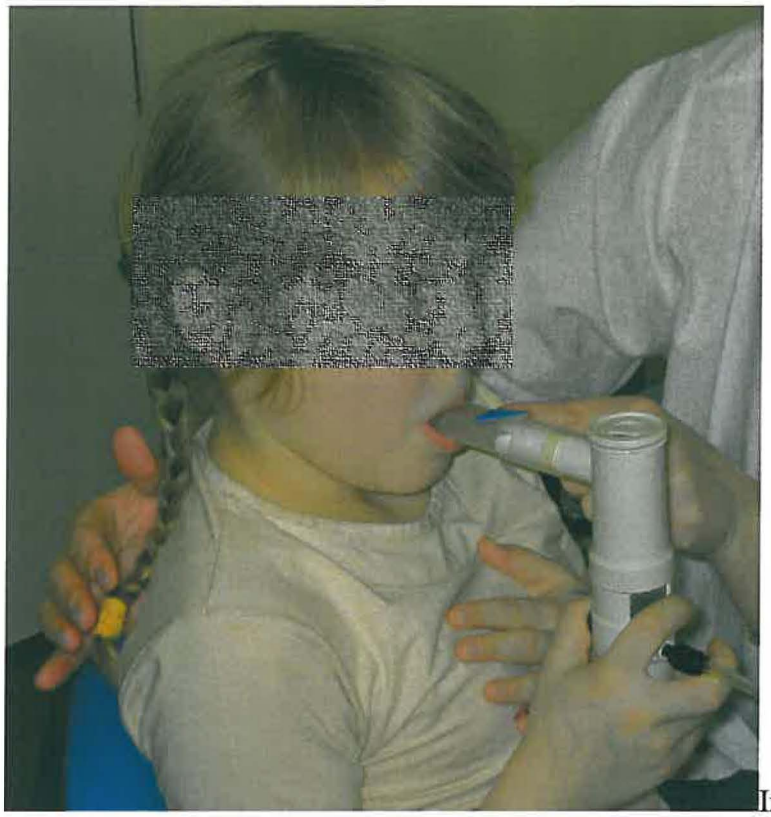
Normal saline or hypertonic saline may be inhaled before physiotherapy to assist in clearance of secretions. If hypertonic saline is used a test dose should be given with recording of PEF or FEV1 before and 5 minutes after inhalation to identify any increase in airflow obstructions.

The optimal time for administration of Pulmozyme in relation to physiotherapy has nor yet been adequately studied and needs to be assessed for each individual. Some patients benefit most by inhaling it about 30 minutes before the physiotherapy for airway clearance. Others find it takes several hours to reach a maximal effect a take it after one physiotherapy session with the result that the next session is more productive.

Pulmozyme should be aerosolized on its own, as it requires isotonic conditions and neutral pH for maximal activity. On theoretic grounds, sufficient time should be allowed to elapse between the inhalation of Pulmozyme and other drugs, e.g. antibiotics, which may be either acidic or alkaline, to ensure maximum benefit from the drugs.

Mucolytic agents, for example acetylcystein, reduce mucus viscosity. They should be used with caution as bronchospasm may be induced.

Aerosol antibiotics should be inhaled after secretions have been cleared. Spirometry is necessary before and after the initial dose to detect any increase in airflow obstruction. If this should occur the effect is usually minimized by the inhalation of bronchodilator before treatment.



Inhaling 'nebulised' bronchodilator drug through mouthpiece

3.16 Mobilization of Thorax:

Its usefulness is very essential because due to the frequent use of breathing muscles shortening and tensions rises. Also inactivity of other muscles occurs. Lastly the mobilization of ribs is important fork assistance of ventilation. Also a proper posture is developed.

PART 4: LONG AND SHORT TERM PHYSIOTHERAPY

4.1 SHORT TERM PHYSIOTHERAPY

Children with CF, may need to spend a lot of time in hospital in order to have some diagnostics tests. Of course everything depend on the condition of the child. The diagnostics tests include measurement of breath, it means the lung's function, and nutritional assessment. When is everything fine and when the doctor realize that there

is no reason to stay in the hospital because the lungs are clear, then the child may leave. Before this, the doctor has to be sure also that the child has started a diet with digestive enzymes and vitamins that will help him to gain weight normally.
Afterwards, he will probably see his doctor for follow-up visits at least once every three months. The basic daily care program of a child with CF varies from child to child, but usually includes pulmonary therapy (treatments to improve lung function) and nutritional therapy (modified diet with vitamin and mineral supplements).
Children with CF can also take doses of pancreatic enzymes by mouth to help them digest foods better. They may occasionally need oral or inhaled antibiotics to treat lung infections, and mucolytic medication (a mucus-thinning drug) to keep mucus fluid and flowing.
Generally the short term physiotherapy is linked to the long term physiotherapy by the ability of the physiotherapist to teach the exercises to a person or persons who are close to the patient so they can help him, the ability of those persons to learn the procedures and finally the ability of the patient to apply all the physical therapy on himself.

4.2 LONG TERM PHYSIOTHERAPY

The long-term physiotherapy is mainly done by certain persons or person related to the patient or by the patient itself on the contrary with the short term physiotherapy the doctor and the physiotherapist are needed more scarcely.
Pulmonary rehabilitation combines exercise training and behavioral and educational programs designed to help patients with CF to improve day-to-day activities. It is a team approach: patients work closely with their doctors, nurses, respiratory, physical, and occupational therapists, psychologists, exercise specialists, and dietitians.
Exercise has been shown to increase fitness, decrease shortness of breath, improve heat tolerance, help mucus clearance, and perhaps improve lung function (some studies say yes, some studies say no, but no study shows any harmful effects on lung function) in people with CF. In those who do not have CF, regular exercise decreases depression improves self-image and worth, it makes sense that these benefits would also apply to people with CF.
Studies have shown that people with CF who are more fit: can do more exercise, have a better quality of life, tolerate heat stress better, and may even live longer.

The best kind of exercise is any form that someone will stick to over a lifetime. Experts suspect that aerobic exercise is best. ("Aerobic" means "with oxygen," and aerobic exercise does not require more oxygen than the lungs and heart can provide to the body's muscles.) Some examples of aerobic exercise include jogging, swimming, biking, stair stepping, walking, aerobics, and aerobic dancing.

The ideal exercise program calls for three to five 30-minute sessions each week (fewer sessions will not increase fitness; more increase the risk of overuse injury.) Do not plan to start with 30-minute sessions; instead, start at 10 minutes and gradually increase to 30 minutes. Exercise hard enough to feel pleasantly tired. (If you feel only tired, that is too hard; if you feel only pleasant, it is not hard enough.)

One very important study showed that the most fit people with CF were the most likely to survive the next eight years, while the least fit were the least likely to survive. Until we know this for sure, though, it is worth remembering an old saying: "whether or not exercise puts more years in my life, it definitely put more life in my years!"

PART 5: PROGNOSIS

Generally it's impossible to make a proper prognosis at a patient with CF. In this disease the organism is very sensitive to various conditions (e.g. dust, air pollution) and diseases (e.g. common cold, rhinitis, flu) comparing to other people which all the above factors cause continued destruction of the lungs tissues. The average lifetime of these people is about 40 years old worldwide. The life of the patient with C.F depends on many factors such as: (a. surrounding environment, b. medical management, c. Physiotherapeutic management, d. family assistance and e. individual's psychology.

PART 6: CONCLUSION

The problem lies on the fact that this disease is chronic and so other people from the close environment of the patient should be involved and also to make the patient available to help himself.

The therapist must realize how important and responsible work physiotherapy is, and the patient is necessary to consider the therapist as a friend and to understand that the improvement of the quality of life is something very important. At the end of the day what is more important is the quality and not the quantity of life.

LIST OF LITERATURE

1. **Button, BM, Heine, RG, Catto- Smith, AG et al.(1994) Postural drainage exacerbates gastroesophageal reflux in patients with lung disease: is positive expiratory pressure an alternative? Pediatric Research 36(1), part 2 pp 47 A, 267**

2. **Chatham, k, Marshall, C(1993) The flutter VRPI device for post-thoracotomy patients.Physiotherapy 79: 95-98**

3. **Dab, IF, Alexander, F(1979)The mechanism of autogenic drainage studied with flow- volume curves. Mongro. Pqaedo. 10: 50-53**

4. **Falk, M, Kelstrup(1984) Improving the ketchup bottle method with positive expiratory pressure, PEP and physical exercise. European Journal of Respiratory Disease 65: 423-432**

5. **G. Tortora- S R Grabowski (1996)Principles of anatomy and physiology 8th edition. Hurber Collins. U.S.A.**

6. **Konstan, MW et al. (1994) Efficacy of the flutter device for airways mucus clearance in patients with cystic fibrosis. Jourbal of Pediatrics 124(5): 689-693**

7. **Non-invasive mechanical ventilation for cystic fibrosis patients. Hodson M, Maden-1991. Saunders U.K.: 98-102**

8. **Oberwaldner, B, Evans, JC (1986) Forced expirations against a variable resistance: a new chest physiotherapy method in cystic fibrosis. Pediatric pulmonology2: 358-367**

9. **Physiotherapy for respiratory and cardiac problems. Livingstone-1998, 2nd edition, Blackwell. U.K.155-168**

10. **Riedler, J, Reade, T, Button,Bm et al. (1995) Inhaled Hypertonic saline increases sputum expectoration in cystic fibrosis. Journal of Pediatric and Child Health (in press)**

11. **Webber, BA, Hofmeyr, JL (1986) Effects of postural drainagr, incorporating the forced expiration technique, on pulmonary function in cystic fibrosis. British Journal of diseases of the Chest 80: 353-359**

12. **Yvonne R Burns and Julie MacDonald (1996) Physiotherapy and the growing child 14: 219-261**

13. **http://www.mayoclinic.com/invoke.cfm?id=DS00287**

14. **http://www.hosppract.com/issues/2001/01/moss.htm**

15. **http://www.cftrust.org.uk/scope/page/view.go?layout=cftrust&pageid=60**

16. **http://www.cff.org/**

17. **http://www.wrongdiagnosis.com/c/cf/prevent.htm**

18. **http://www.cfww.org**

19. **http://interscience.wiley.com**

20. **http://www.ecfcos.org**

21. **http://www.ersnet.org**

22. **http://www.sciencedirect.com**

23. http://www.idealibrary.com