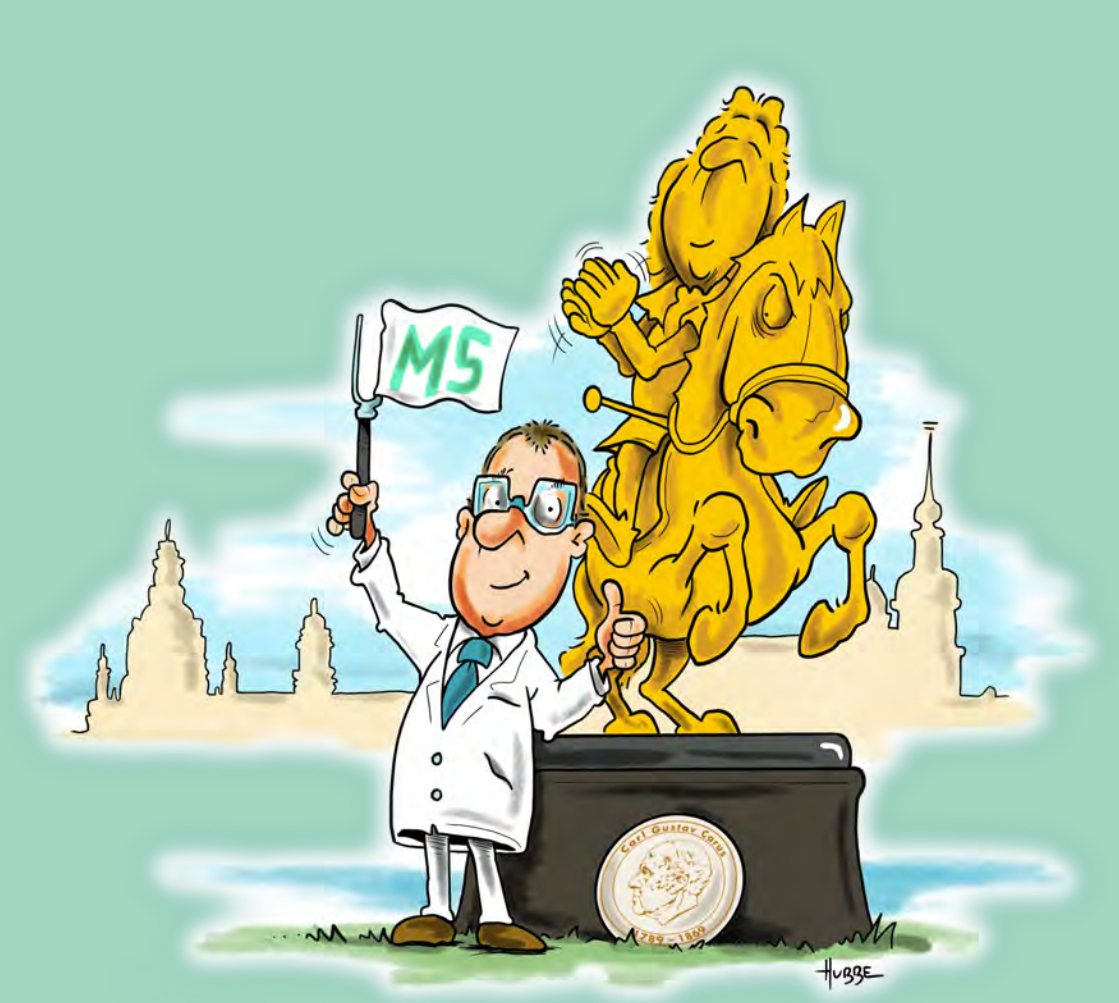


THE WORLD MS DAY 2021

Stay connected

For excellent management of MS patients
at the University Hospital Carl Gustav Carus Dresden

University Hospital
Carl Gustav Carus
THE DRESDENERS.

The world MS day 2021.

Stay connected

For excellent management of MS patients
at the University Hospital Carl Gustav Carus Dresden

Phil Hubbe

Tjalf Ziemssen

University Hospital
Carl Gustav Carus
THE DRESDENERS.

Content

Introduction

WeltMSTag 2021

STAY CONNECTED
WIR BLEIBEN IN VERBINDUNG

For this year's World MS day, which coincides with the Covid19 pandemic for the second time, we have chosen something special for the day´s theme „Stay Connected". Unfortunately, due to the pandemic situation, it is not possible to hold our "Open Day" on World MS Day as in previous years. We came up with the idea in the team to combine the concept of our "Open Day" with this year's motto „Stay connected". After brief consultation with our house cartoonist Phil Hubbe, the idea was born to launch the digital project „Stay connected for MS care at Dresden University Hospital", which attempts to demonstrate how interlinked and complex the care of MS patients is implemented at Dresden University Hospital. Thanks to Phil Hubbe for the great cartoons.

We would like to show patients, relatives and interested parties how interdisciplinary and multilayered the care of MS patients should be. The disease of 1000 faces is of course primarily treated by neurologists, but for optimal management, a wide variety of disciplines must be involved.

We are very grateful that we can provide this service in its complex form at Dresden University Hospital with the constant support of our CEO Prof. Albrecht and our dean and director of the neurological university clinic, Prof. Reichmann. Most important to us, however, is the individual contact, the care of each individual patient. There must be no off-the-peg MS management, especially with this chronic insidious disease, we must find an individual solution together with and for each patient. We hope that we can continue to do this together with our patients in the coming years and further improve it through the innovations presented. A dedicated neuropsychology service has recently become available, and nutritional counselling will be added in 2021. Digital services will be available. Let us stand up to the disease together.

Please support us that the MS center can continue to develop.

For the team of the MS Center Dresden:

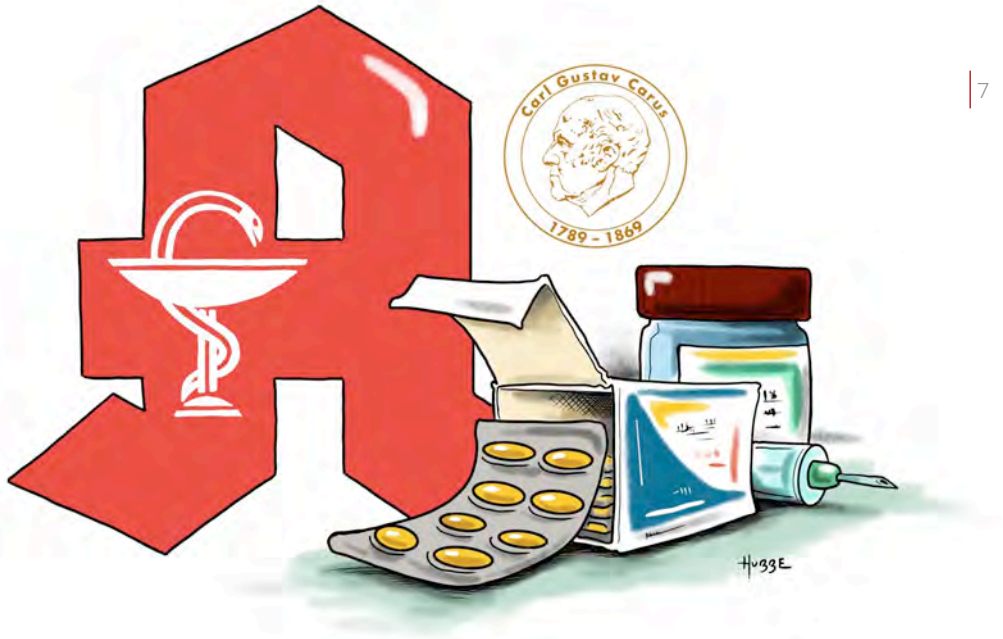
01
Hospital Pharmacy

Hospital pharmacies are responsible for all those medicines that inpatients and outpatients receive at the hospital. For all other medicines that patients take at home, the traditional pharmacy on site is responsible.

Here at Dresden University Hospital, the hospital pharmacy is a high-tech institution whose services go far beyond the simple provision of medicines. By means of a special blistering system, for example, each patient receives an individual sachet of the medication he or she has to take every day, following digital prescription via computer on the ward. This minimises the risk of patients receiving the wrong medication or dosage. In addition, the pharmacists also check whether the prescribed medications fit together.

All medications administered at the MS center are provided to us by the pharmacy or are even specially prepared for each individual patient. This applies in particular to the so-called study drugs that are administered as part of clinical trials. Here it is particularly important that the production meets the highest quality standards, e. g., by the use of clean rooms, as we know them in Dresden for the production of computer chips. Drug storage is controlled and secured. The entire ordering and manufacturing processes are now digitalised to avoid errors and make processes controllable.

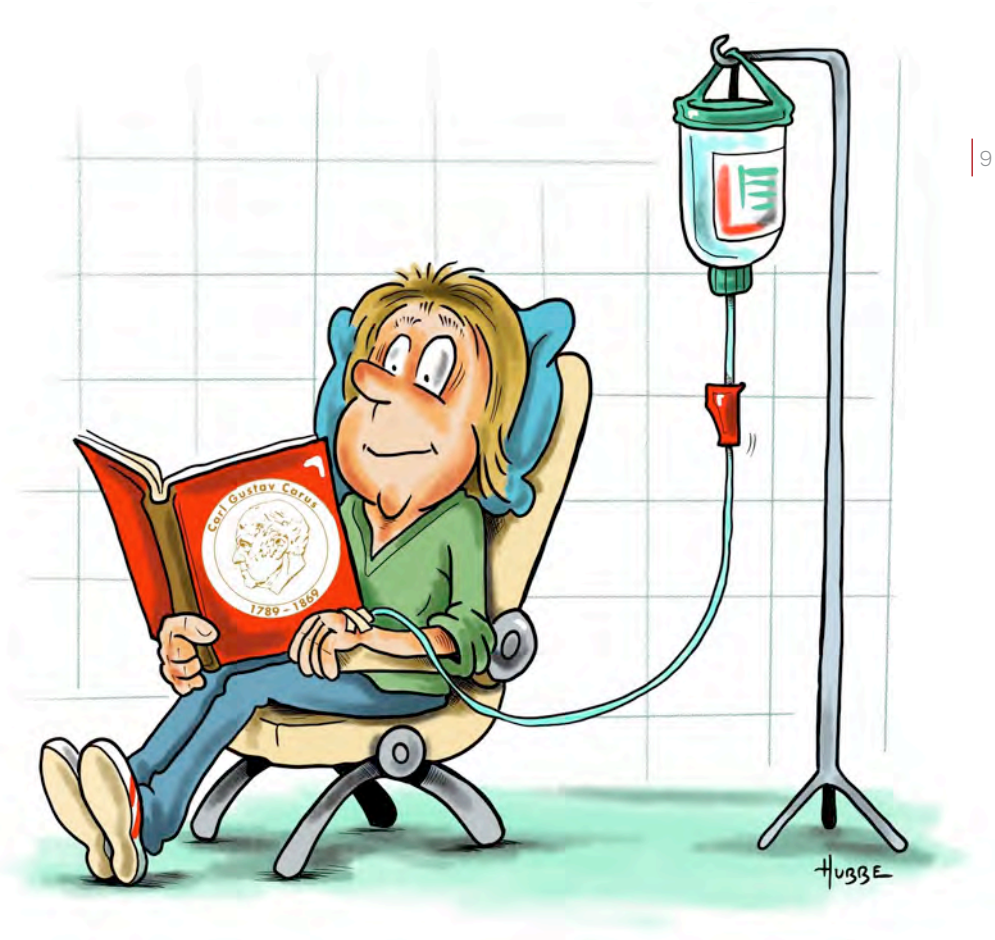
Thanks to the close cooperation with our very efficient hospital pharmacy lead by Dr Knoth, it is possible for the MS Center to offer the complete range of therapies that can be administered in hospital for our outpatients and inpatients, from approved drugs to very special study drugs. In addition, the pharmacy team is always available for consultations on all aspects of medication.



02
Infusion center

Many of the drugs that we apply to treat multiple sclerosis do not survive passage throughout the gastrointestinal tract when taken up orally. Thus, for many immunological drugs as e. g. monoclonal antibodies, it is still necessary to administer them parenterally by eliminating the gastrointestinal tract, either as an injection into the subcutaneous fat tissue or as an infusion directly into the blood vessels. In the past decades, such infusion therapies always required an inpatient hospital stay. However, based on our own experience in MS therapy as well as experience, for example, in the field of oncology, it has become clear that such drugs can also be well administered on an outpatient basis. This means a significant reduction in administrative work and necessary time both for the patient and the MS center.

However, to provide high-quality infusion therapy, a special infrastructure with trained staff, monitoring options and the involvement of an experienced pharmacy is necessary. For example, allergic side effects can occur during infusion therapy, which can be detected early through close monitoring and treated early in a highly qualified infusion center. Because we are convinced that a nice atmosphere is also important when you receive your infusion therapy for several hours, the infusion center must also be designed and built accordingly. For several years now, the MS center at the Center of Clinical Neurosciences includes a high-quality infusion center that can carry out outpatient infusions for various neurological diseases, e. g., from MS to muscle diseases, provided by a friendly and very experienced infusion team. This is the basis for a modern highly effective therapy of neurological diseases.



03
Lumbar puncture

Brain and spinal cord are separated from the rest of the body by the so-called blood-brain barrier. This is to prevent molecules and cells from entering the central nervous system uncontrolled from the bloodstream or surrounding tissue. Beyond the blood-brain barrier, brain and spinal cord are washed by 150 ml of a fluid called cerebrospinal fluid. Its analysis can provide important diagnostic clues to the neurologist. The cerebrospinal fluid itself is a watery liquid which presents with much lower cell number and protein concentration than blood.

For diagnostic purposes, the neurologist can obtain cerebrospinal fluid (CSF) as part of a standard procedure with the help of a special needle by puncturing it from behind between two spinous processes of the vertebral bodies of the lower lumbar spine. In this area, there is no longer any spinal cord in the vertebral canal, but only the root filaments that form the nerves of the lower extremities. These give way when the cerebrospinal fluid space is opened with the CSF puncture needle. Even though it is a frequently performed procedure for the neurologist, it is of course necessary to discuss exactly with the patient how a lumbar puncture is performed and what side effects can occur. The entire puncture is performed under sterile conditions so that infections are rare. So-called atraumatic, specially sharpened needles are used, so that the most common side effect, a position-dependent headache, which occurs especially in slim people occurs less frequently. This low pressure headache increases when standing and improves when changing to a horizontal position. It responds therapeutically to caffeine. So this is the rare case that the attending physician recommends the consumption of a lot of coffee.

The examination of the cerebrospinal fluid is an important part of the MS diagnosis and differentiates MS from other pathogen-related diseases, such as Lyme disease or syphilis. Complications under MS therapy such as viral infections (e. g., progressive multifocal encephalopathy) can be detected promptly by cerebrospinal fluid examination. It also plays an important role in research into new biomarkers, as it washes around the target organs affected in MS, the brain and spinal cord, and can thus be used to track disease processes.

04
Neurological examination

Inflammatory changes in multiple sclerosis, the so-called demyelinating lesions, can occur in a wide variety of anatomical locations in brain and spinal cord. As a result, multiple sclerosis can present a very colourful and variable clinical picture with a wide range of symptoms. This is why the disease is also known as the disease of 1000 faces. When a patient comes to a neurologist for the first time, or when the neurologist wants to assess the course of MS, he or she carries out a detailed medical history and a neurological examination. The history and examination are intended to determine which concrete neuroanatomical structures of spinal cord and brain are affected by the MS lesions. Thus, the experienced neurologist often does not need imaging to identify MS inflammatory lesions in specific locations.

The neurological examination (neuroexam), using a variety of techniques and examining the different neurological functional systems from motor examination to reflex triggering to sensory exam, allows a comprehensive overview of the present deficits. This is important in the initial diagnosis, but the neurological examination also plays an important role in the routine follow-up. The neurological examination is also very close to the patient‘s symptoms. Thus, after identifying abnormalities in the neuroexam such as spasticity (increased muscle spasm), symptomatic therapy can be started directly. The neurological examination can be documented objectively quasi-quantitatively by the so-called EDSS (expanded disability status scale), whereby each individual functional system receives a subscore, from which the total score between 0 and 10 is then calculated. 0 means no neurological abnormality at all, 10 means death from MS. This disability scale is of major importance in clinical studies and in official assessments.

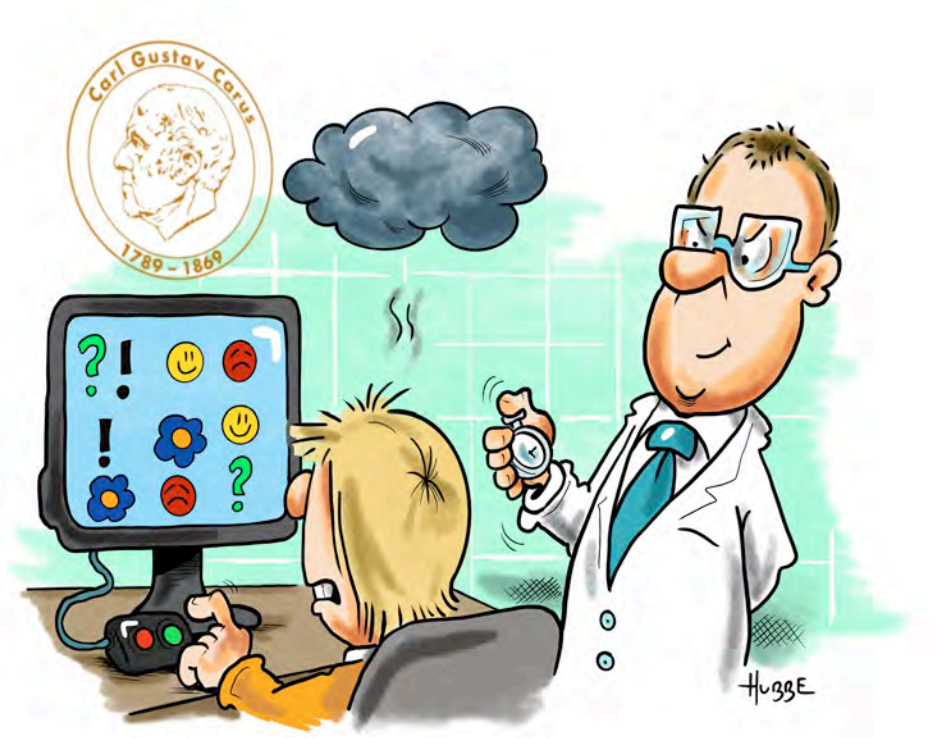
05
Neuropsychological Examination

Dysfunction in cognition and concentration plays an important role for the patient in everyday life, as do the typical MS fatigue symptoms, although these symptoms are not primarily in the foreground as we know them with dementias such as Alzheimer's disease. In many cases, doctors can already detect such limitations when they take the patient's detailed medical history and are told, for example, that the patient is no longer able to perform several tasks at the same time (multitasking).

Optimal modern MS management, however, provides that symptoms and their evolution over time should be recorded as objectively and measurably as possible. This is a prerequisite for being able to treat these symptoms directly and then measure the treatment effect. On the other hand, such significant changes in cognitive functions also play an important role in the choice or, in the case of deterioration, the necessary switch of the MS medication that influences the course of the disease.

Our cognitive functions are so diverse and extensive that a single test is not sufficient for their assessment. It is true that the so-called number symbol test (SDMT) is often carried out as a regular screening test, which allows a certain assessment of the individual processing speed and concentration. However, for a comprehensive assessment of the individual cognitive function, a number of different tests must be carried out. Because personal factors also play an important role for the test result, such as school education, but also mental illnesses, it is important to us that such a comprehensive holistic neuropsychological exam is carried out by an experienced team of psychologists with prior detailed collection of the neuropsychologically relevant medical history.

The MS Center offers such an extensive neuropsychological exam, lasting about two hours, with detailed reporting under the supervision of Prof. Beste, which should be repeated at regular intervals in order to follow the long-term course. Detailed cognitive testing is also a prerequisite for using certain, e. g., digital, therapeutic approaches.



06
Functional therapy

In addition to drug treatment, symptomatic therapy in particular plays an important role in multiple sclerosis. Many deficits that occur due to clinical relapses or progression in the course of the disease cannot mostly recover by any course-modifying therapy. Therefore, functional exercise therapy by means of occupational and physiotherapy as well as speech therapy plays a decisive role.

The brain is an extremely plastic organ that still has excellent compensation possibilities especially in young adulthood. This means that if certain areas of the brain are destroyed, other areas of the brain can take over their function. However, this process does not take place automatically, but rather the functions that have been lost have to be trained again at great expense. In order to retrieve compensation in this sense and use it clinically, the three functional therapies of physiotherapy, occupational therapy and speech therapy are to be applied individually according to the existing deficit. All three functional therapies are available at the University Hospital Dresden, especially for MS patients who have to be treated as inpatients due to the severity of the disease. Several decades ago, absolute bed rest was still prescribed in hospital for those patients. Today, functional training is carried out right from the beginning even if and especially if there is a severe neurological deficit such as paralysis of both legs. Outpatients usually receive their therapies from the therapist close to home, or – if necessary – are trained by them in home visits.

While speech therapy trains speech and swallowing functions, physiotherapy trains motor skills and coordination. In particular, this involves training of motor and coordination functions that have been lost due to inflammatory lesions in the central nervous system. Here, for example, balance is trained, and muscle training of differently affected extremities can also be carried out. Occupational therapy serves to restore the ability to act in everyday life that has been lost or not existent due to MS. For this purpose, movement sequences are trained, but also perception and attention. Among other things, it also offers cognitive training, which can improve impaired concentration and MS fatigue.

At Dresden University Hospital, the three functional therapies are organized in centralized teams. This ensures optimal continuous care for inpatients, even at weekends. Many staff members have additional qualifications, such as physiotherapy according to Bobath and Vojta, which directly benefits MS patients. If these functional therapies have to be carried out more intensively due to pronounced existing deficits, rehabilitation in a dedicated clinic experienced in MS should be considered.

07
Rheumatology

Rheumatology is one of the medical specialties that also deals with autoimmune diseases. While multiple sclerosis affects spinal cord and brain as target organ, the immune system attacks other target structures, e. g., in the area of the joints, in the context of rheumatological diseases and can thus lead to a variety of clinical pictures. Rheumatology plays a particularly important role in the differential diagnosis of MS, because there are some rheumatological diseases that resemble multiple sclerosis.

That is why there is an intensive exchange and cooperation between the rheumatology department at the UKD headed by Prof. Martin Aringer and the MS center here. There are also patients who suffer from a rheumatological disease and MS at the same time. Therapeutically, we have been able to adopt some therapies from rheumatology for MS treatment, such as the B-cell-depletive therapies or teriflunomide, which is used as leflunomide in the basic therapy of rheumatic arthritis. Interestingly, however, there are also drugs that are used in rheumatology, but can trigger multiple sclerosis as a side effect. This shows that autoimmune diseases in rheumatology and neurology are not caused by similar pathophysiological mechanisms. A therapy that helps with a certain autoimmune disease can trigger and intensify another autoimmune disease. The rheumatologist has the advantage that many of the diseases can be well assessed for therapeutic response by clinical tests and signs, such as joint pain and laboratory tests.

Since in MS the inflammatory process takes place behind the blood-brain barrier, the neurologist needs regular imaging to assess disease activity. To understand the immunological processes beyond the blood-brain barrier, a lumbar puncture, for example, must be performed; a blood analysis alone is not informative enough. As in MS therapy, biological therapeutics have found their way into rheumatology already a long time ago. This is also an important point of intersection between these two immunological disciplines.

08
Digital patient portal

Especially for a chronic disease like multiple sclerosis, continuous communication with the patient plays an important role. In addition, the consistent cooperation and participation of the patient over a long time period is in general of great importance with chronic diseases. Since in many acute diseases, such as a heart attack or a broken leg, there are no real treatment alternatives and action must be taken quickly, shared decision making is crucial for the long-term management of especially in chronic diseases.

Here, digitalisation offers new opportunities: In cooperation with other university and industrial partners (Faculty of Business Informatics, esp. Systems Engineering headed by Dr. Hannes Schlieter, MedicalSyn with Raimar Kern), the MS Center has developed a digital patient portal that is intended to serve as a platform for individual information and communication beyond the regular consultation in person. Currently still in pilot operation, the patient portal is soon to go into regular operation.

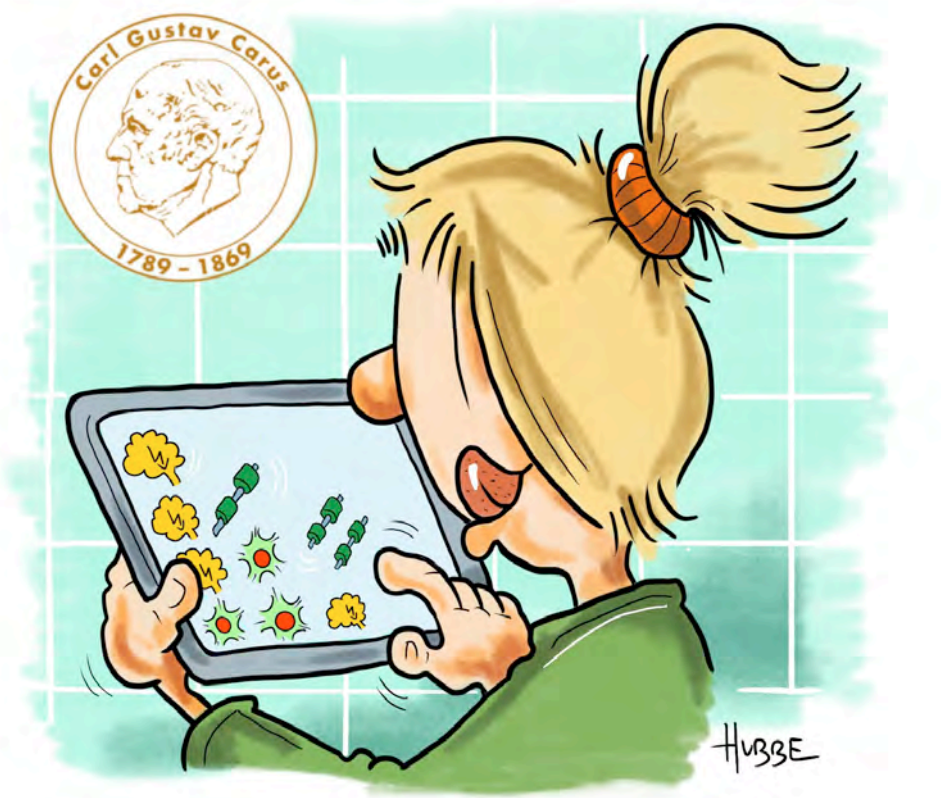
It is intended to provide the basis for regular interaction between patient and MS center. In addition, the patient will find relevant data on his or her disease as well as findings that were collected at the MS Center, such as MRI or laboratory results, in the portal. In the other direction, the patient can make documents available to the treating physician via the web portal. Face to face consultations can be well prepared with the help of the portal, so that the time spent with the MSologist can be used solely for the patient‘s personal concerns and not so much for administrative tasks. The portal is linked to the clinical documentation system MSDS3D. It takes into account the patient‘s individual therapies, which are mapped in special digital patient pathways (QPATH4MS project, ERDF funded). The portal also offers the possibility of video consultations, digital patient training and further education are integrated into this portal as well.

09
Functional digital testing using a tablet

In order to determine certain neurological deficits, the neurological examination is still the gold standard. Despite attempts to objectify the neurological examination and to use standard documentation for it, the examination results may vary from neurologist to neurologist and are sometimes difficult to record quantitatively. In order to objectively measure neurological functions, especially in the long-term course, the possibilities of digitalisation are very helpful.

The MSPT, the MS performance test, is used at the MS Center Dresden for digital function testing, which the patient performs independently on an iPad before the doctor‘s consultation. After an interview by means of a questionnaire (NeuroQoL = quality of life in neurologic diseases), which queries the different neurological functional systems, individual digital function tests are carried out on the tablet, which record e. g. fine motor skills of the hand, concentration ability or contrast vision. The regular performance of these tests allows a quantitative assessment of important neurological functions, optimally complementing the neurological examination. Each examination result is demonstrated to the patient if he or she wishes. Relevant changes are communicated directly to the attending physician so that they can be included in the management and, if necessary, in the adjustment of therapy. Such functional assessments also play an important role in dealing with official institutions, such as health and pension insurance, as they can be used to assess the ability to work or the degree of disability.

There are initial approaches in our center to have these digital functional tests carried out by the patient in his home environment by using special apps on his smartphone, such as Floodlight or KONECTOM. Here, again the MS Center shows its leading position on the digitalisation front.



10
Neurourology

In the still young urological subspeciality, neurourology, all disorders of the urinary and genital tract are included that are related to an injury or disease of the nervous system. Patients with paraplegia are particularly affected, but also patients with MS, Parkinson's disease or patients after a stroke. Our everyday experiences already clearly show us how the brain influences bladder function. Frequently going to the toilet during an exciting thriller is one such example.

For the control of the sphincter and the detrusor muscle in the bladder, there is a complex control system in the central nervous system, which is localised in the spinal cord, but also in the brain. Since inflammatory foci can occur in a wide variety of neuroanatomic locations in the MS course, the probability that the widely ramified network of neurourological control centers is affected is relatively high. Initially, the so-called imperative urge to urinate is the most frequent symptom that occurs in multiple sclerosis. Even when the bladder is only slightly full, it signals that it needs to be emptied quickly. However, during the subsequent visit to the toilet, which must take place promptly to avoid an accident, only a relatively small amount of urine can be passed. Other disorders that can develop in the course of MS are the occurrence of residual urine, which in turn can promote infections through the residual urine remaining in the bladder, as well as complex disorders in the interaction between the sphincter and the detrusor muscle.

The urologist uses different examination procedures for this: One of the decisive special examinations is the so-called urodynamics, with which the most important parameters during urine storage in the bladder up to urination can be examined quantitatively. In addition, ultrasound examinations are often used to measure the filling status of the bladder. Therapeutically, a wide variety of oral therapeutic options are available. In some patients with urinary urgency, the detrusor muscle of the urinary bladder can also be calmed by the instillation of botulinum.

For us, the close cooperation with the urological team around Prof. Thomas in the university urological clinic is extremely important in order to improve the quality of life of our patients with regard to their neurourological symptoms. Not to be forgotten should be the disorders of sexual function, which fortunately can be positively influenced by drug therapies, such as Viagra.

11

Laboratories with cerebrospinal fluid and blood tests

Laboratory tests play an important role both in the initial diagnosis of MS and in the regular monitoring of existing MS patients. At the University Hospital in Dresden, there is intensive cooperation with three partners: In the central laboratory under Prof. Chavakis, a wide range of blood and cerebrospinal fluid tests are carried out. In the immunological laboratory under PD Conrad, certain autoantibodies can be identified, i. e. e. g., proteins that bind to the body's own structures. In the microbiology/virology department under Prof. Dalpke, for example, infections are ruled out, before treatment with immunologically intervening therapies.

Clinically similar infections, such as Lyme disease or syphilis, must also be ruled out in the context of MS diagnostics. The entire laboratory procedure is now digitalised, i. e., the laboratory requests are made digitally on the computer with the help of the clinic information system, and a barcode is printed on the digital request and stuck on the blood collection tubes. An exact assignment of the samples can then be made in the laboratories. Finally, the findings are immediately made available online, so that we have the test results very promptly and transmission errors can be ruled out. In the case of particularly conspicuous laboratory values, the MS center is contacted directly by the lab team; complex constellations of lab findings can be discussed with the laboratory experts.

A special focus of the MS Center is the analysis of the cerebrospinal fluid, which shows certain abnormalities, especially in the case of an inflammatory disease of the brain such as MS. The detection of inflammatory proteins, such as the so-called MRZ reaction or oligoclonal bands, is often diagnostically groundbreaking. Recently, we have also started measuring neurodestruction markers in the cerebrospinal fluid, as e. g., Neurofilament light, i. e., biomarkers that increase in concentration in the cerebrospinal fluid when neurons are destroyed.

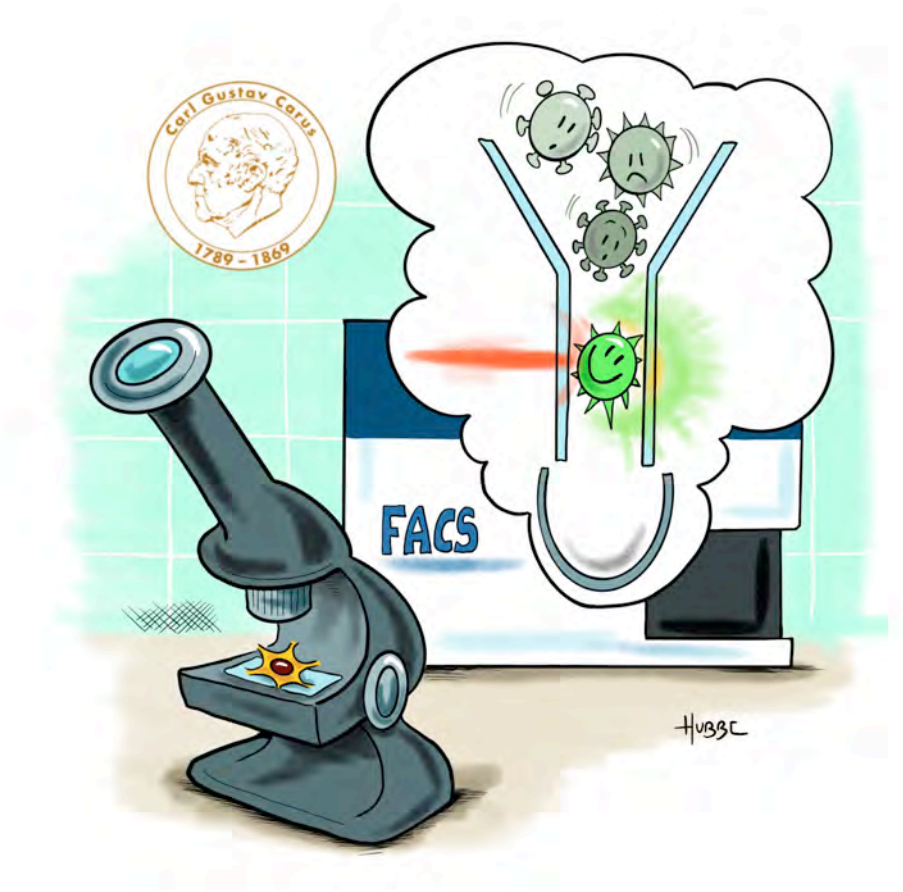
In addition to the primary diagnosis of MS, laboratory diagnostics play an important role in the monitoring of certain therapies. Many therapeutic agents are metabolised via the liver, so the functional parameters of the liver must be examined regularly. The blood count can also be changed by the therapies, especially the lymphocyte count, so that regular blood count examinations are also necessary with most MS therapies.

12
Neuroimmunological Lab (NIL)

The Neuroimmunology Laboratory is even older than the clinical Multiple Sclerosis Center. With the establishment of neuroimmunological research in the department of neurology, the scientific institution of this laboratory was first created, before the clinical care of MS patients in the MS Center was professionalised at the UKD due to the high clinical demand. In the development of multiple sclerosis, two complex systems meet, the nervous system and the immune system. While the nervous system is difficult to study experimentally beyond animal models, immunological techniques can be used to study immunological mechanisms in blood and cerebrospinal fluid.

In this context, clinical translational research on patients has become the most important pillar in the Dresden neuroimmunology laboratory, where, however, basic research is also still being carried out. Immunological translational research in particular can provide important support for the development of personalised MS therapy. Each therapeutic agent leads to typical immunological changes, which can be quantified for the individual patient and related to clinical and imaging data.

In recent years, another technology has come into use that allows us to measure the consequences on the survival of nerve cells caused by inflammatory activity in the central nervous system. With the help of the complex and expensive SIMOA technology, it is possible to detect so-called neurodestruction markers even in the blood, such as the light chain neurofilament, i. e., factors that are released into the blood when nerve cells are destroyed. These important biomarkers are still in the research phase and are only used in clinical care by a few centers like us. However, previous data already show, especially in relapsing-remitting MS, that determination of neurofilament will be of great importance in the individualised management of patients in the future. An important component of the neuroimmunological laboratory is the biobank, which is of decisive importance, especially in the vision of personalised MS therapy.



Research is only possible in cooperation, which is why we are very grateful for the diverse laboratory cooperation's that we are able to maintain with external partners and colleagues in Dresden. Currently important cooperation projects are the Triomed project for the translation of innovative cellular biophysics into personalised medicine and the Proteosens project at the EKFZ.

↗ www.qualitype.de/de/forschung/

↗ https://digitalhealth.tu-dresden.de/research/innovation-projects/proteosens

13
Neuropediatrics

While MS most often occurs in younger adulthood, there are exceptions to this rule: MS can also occur after the age of 50, but it can also occur in childhood. While the onset of MS in children is most common after puberty, there are also patients in whom the disease manifests itself in early childhood. In the field of childhood neurological diseases, the neuropediatrician is the primary contact person. There are far fewer neuropediatricians than neurologists in private practice, so that the university departments play a very important role. The University Hospital Dresden also has an excellent neuropediatric department, headed by Prof. von der Hagen.

In principle, the same procedures are used in the diagnosis and monitoring of childhood MS as are used for adult MS patients. The neuropediatrician treats the child, but always also the parents, for whom dealing with a chronic disease in the offspring is naturally extremely difficult. The picture of childhood MS is slightly different from adult MS in that the inflammatory changes in the central nervous system are often very pronounced, as shown by imaging and the number of relapses. The deficits after clinical relapses usually regress better.

A major problem in the treatment of childhood MS is that there are not yet many studies on drug therapy that have been carried out specifically in children. This is a general problem in pediatrics, but is particularly problematic in MS. Fortunately, in recent years there have been the first studies of highly effective drugs that can keep childhood MS in check. The effects of childhood MS are, of course, extremely negative if disease activity cannot be controlled. Schooling and education are important developmental steps that cannot proceed normally if MS is inadequately treated.

However, the nature of life dictates that every neuropediatrician will hand over his patients to the neurologist at some point. This is where the good cooperation between neuropediatrics and the MS center proves itself again, in order to ensure continuous care for the then adult patients.

14
Plasmapheresis

The relapsing form of multiple sclerosis, which is the most frequently diagnosed (90%), is characterised by the occurrence of clinical relapses. Depending on the anatomical localisation, the formation of inflammatory foci in the central nervous system leads to a neurological loss of function, which is caused by the inflammation-related loss of myelin sheaths and the negative effect on nerve cells at the inflammatory focus. The clinical deficits can vary widely, from optic neuritis to sensory and motor dysfunction to bladder dysfunction. In many cases, the neurological disorders can be so severe that, for example, everyday activities are restricted.

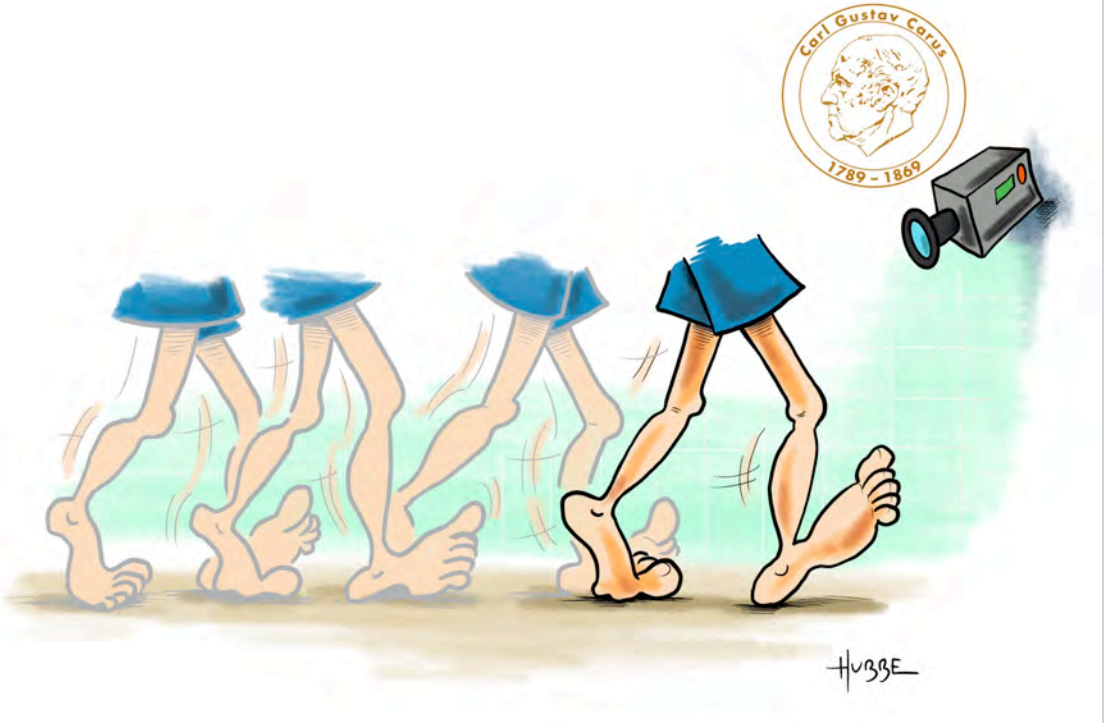
In the case of such clinically relevant relapses, a high-dose cortisone infusion should be given promptly within a maximum time window of 4 to 6 weeks after the onset of symptoms in order to extinguish the „inflammatory fire“ in the brain with the „cortisone extinguishing foam“. In some cases, there is no relevant improvement even after two high-dose cortisone infusions in the interval. If the severe deficits persist, such as loss of vision in one eye due to optic neuritis, the acute relapse therapy must be escalated. While the cortisone infusions predominantly influence the cellular components of the blood or immune system, the soluble, immunologically relevant components of the blood are targeted during the escalation of the relapse therapy. This is done in close cooperation with the nephrological colleagues at the university hospital under Prof. Hugo, who offers our patients the procedure of blood washing, or in technical terms plasmapheresis, whereby the blood plasma is exchanged in the patient.

Similar to dialysis, after a vascular access is created, the patient is connected to a special device in which the patient‘s blood circulates, the blood plasma is separated and after passing through the device, the blood cells are transferred back to the patient. The patient receives a saline solution with blood proteins back as a substitute.

In addition to classical plasmapheresis, immunoadsorption can also be performed nowadays, which is also offered by internal medicine colleagues. Here, too, an external machine is used as in dialysis. In this technique, the blood passes an immunological column that can bind certain components, such as antibodies in MS immunoadsorption, while the purified blood is transferred back to the patient. The two procedures are probably equivalent. Due to the need to have large central vascular access available, they are usually only to be performed in the hospitalised patient.

15
Gait analysis

The laboratory for gait analysis at the Center for Clinical Neurosciences is an important facility that only a few multiple sclerosis centers have to offer. Because research at the MS Center Dresden does not take place in an ivory tower, but close to the patient, there is also the special feature that a regular examination of gait function is available to all MS patients and can be used both for individual clinical assessment and scientifically. Walking function is an important parameter for the assessment of multiple sclerosis. Impairment of different functional systems, such as motor or sensory function as well as coordination, can contribute to the limitation of walking. If this is not recognised, it can lead to falls with far-reaching consequences, among other things.



The gait analysis at the MS Center Dresden is multidimensional, i. e. different functions of walking are recorded as quantitatively as possible. This includes, for example, the quality, speed and endurance of walking. The effects of gait disorders on everyday life are also assessed with the help of special questionnaires. Special sensors are used to measure the relevant parameters. At our center, patients walk on the ugliest but most expensive carpet, the GAITrite system, a carpet which uses sensors to record the movement pattern of the feet. We are also very proud of our Carus Walk, where the patient has to walk between two Carus heads placed on the floor in our center hallway.

A brand new diagnostic tool is a force plate borrowed from sports medicine, which we can use to examine balance and jumps. Especially in gait research, the cooperation with colleagues at the Institute for Biomedical Technology at Fetscherplatz headed by Prof. Malberg is an important piece of the puzzle. There, a high-tech DIERS gait measuring station with integrated treadmill is available for comprehensive gait analysis. The knowledge gained flows directly into the care of the patient and can lead to the optimisation of symptomatic therapy. But important adjustments of the course-modifying therapy can be triggered by these examination results as well.

16

Autonomic and neuroendocrinological function lab (ANF)

Similar to the Neuroimmunological Laboratory, the autonomic and neuroendocrinological function Laboratory (ANF) has a long tradition in the neurological department at Dresden university hospital and celebrates its 20th anniversary in 2021. In this laboratory, the function of the autonomic nervous system is examined, which can be impaired in a wide variety of neurological and non-neurological diseases. Due to the good measurability, the cardiovascular autonomic system in particular is in the foreground here, because with the help of ECG and blood pressure, the respective signals can be recorded very well and then also be analyzed. Like a central heating system in a large building, all these factors are subject to complex control circuits that can be examined by the help of different functional tests.

The classic test of the autonomous laboratory is the tilt table test, in which the effects of a passive change in position from the horizontal to the almost vertical are examined. The change in position causes a large amount of blood to sink into the lower extremities, so appropriate adjustments must be made to heart rate and blood pressure regulation. Changes in the autonomic nervous system also play an important role in MS. All internal organs are controlled by the autonomic nervous system, so the bowel and the bladder. However, certain therapies in the MS field can also lead to impairment of the autonomic nervous system, so that monitoring of autonomic functions is particularly important when these drugs are first administered, as is the case with S1P modulators.

Another focus of the Dresden ANF laboratory is pupil diagnostics. The size of the pupil is also subject to important regulatory circuits. From the spontaneous pupil level, the sleepiness of the respective person examined can be concluded. This procedure is particularly suitable for differentiating between sleepiness and MS-related fatigue. The examination of the fundus of the eye with the help of a retinal camera also allows important statements to be made about the function of small blood vessels in neurological and non-neurological patients.

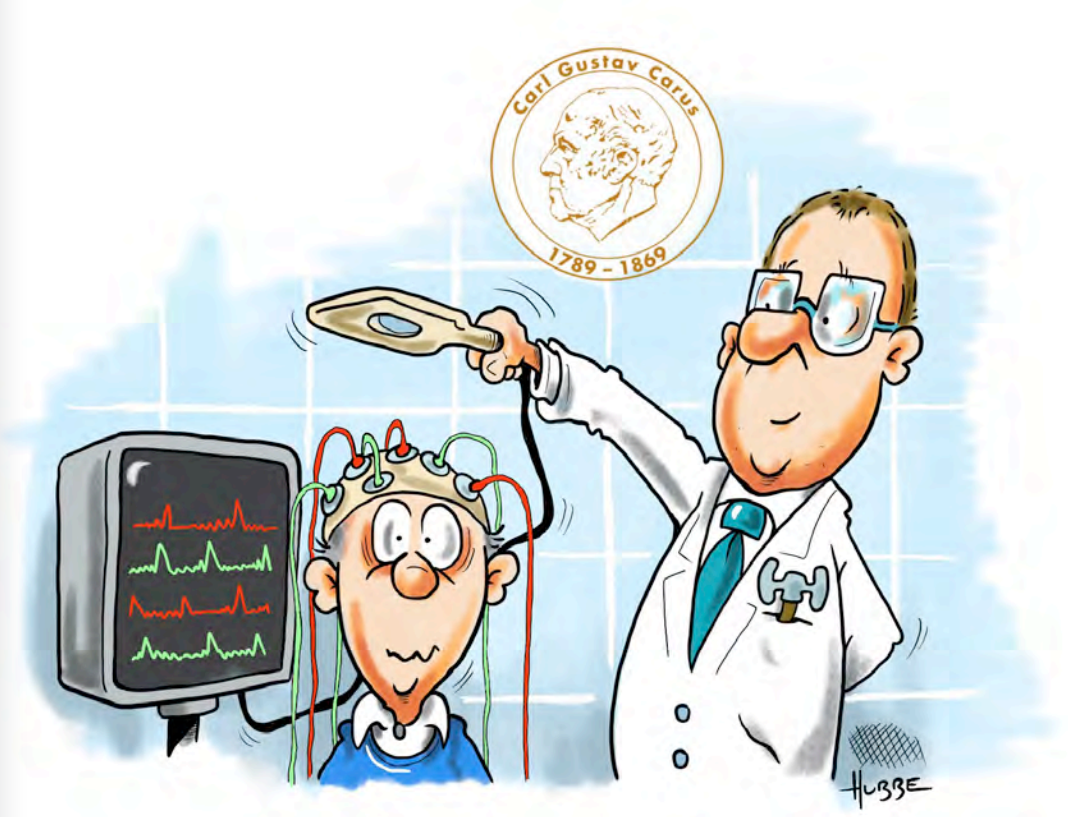
17
Electrophysiological tests

In addition to clinical assessment, imaging plays a very important role in the diagnosis and monitoring of MS today. Imaging allows the depiction of structural abnormalities in the central nervous system, but by its very nature cannot detect functional changes. In the context of the inflammatory foci that occur in MS, there is local destruction of the insulation that surrounds the axons, the so-called myelin sheaths. Demyelination occurs, in which the insulation of the „nerve current cable“ is destroyed. The myelin not only serves to protect the axons, the nerve cell processes, but the insulation function of the myelin is what makes a high electrical conduction speed via the nerve cell process possible in the first place. Thus, an optimally insulated axon conducts the electrical excitation at a speed more than 100 times higher than an axon with an insulation defect.

Since demyelination in the disease of 1000 faces can occur in the most diverse neuroanatomical locations in the central nervous system, it is only possible to prove with the help of so-called electrophysiological examinations whether a delay in the conduction of excitation occurs in the area of the examined lead due to demyelination. With the help of the so-called evoked potentials, a stimulus is set, and at the end of the nerve pathway it is checked when the signal arrives there. If there is an MS lesion with destroyed insulation on the path of the nerve conduction, the signal arrives later, not at all and/or with reduced signal strength.

The easiest way to imagine this is in the area of visual function. You look at a chessboard pattern on a screen, with the pattern changing each time. Each change induces a sensory stimulus in the eye, which is perceived via the retina and transmitted along the visual pathway. With each stimulus, one looks at when the signal arrives in the visual cortex at the back of the head. Many stimuli are carried out in succession and added up before a nice assessable curve is obtained.

In addition to these visual evoked potentials (VEP), there are also the sensory (SEP) and motor (MEP) evoked potentials, which examine the sensory and motor pathways respectively. In primary MS diagnostics, this detection of functionally relevant MS foci is still important in order to be able to detect different locations of MS lesions.



18
Obstetrics

At the timepoint of MS diagnosis, the most commonly affected group is that of young women. As with many other autoimmune diseases, we see a higher incidence in women, especially in relapsing-remitting multiple sclerosis. This probably has to do with the fact that women can become pregnant. The challenge of harbouring a child as a partial foreign body in one's own organism for a period of nine months presents the immune system with complex challenges. We now know that female sex hormones can modulate the various processes in multiple sclerosis. All these considerations are of course highly relevant in a group of female patients who very often want to have children.

Since multiple sclerosis is actually not considered as a genetic disease and the risk for the offspring is only slightly increased, we can fortunately recommend normal family planning to enable our patients to have a normal family life despite and with MS. While child planning is often spontaneous, it is necessary to make certain arrangements and plans in consultation with the treating neurologist, especially in the case of treated MS. Very good cooperation with the obstetrician colleagues looking after the pregnancy is important here. Here, too, the department of gynecology headed by Prof. Wimberger at Dresden University Hospital has a very experienced center of expertise with the obstetrician experts around Prof. Birdir, with whom we jointly care for MS pregnancies. Especially in smaller obstetric centers there is little experience with the pregnancy care of MS patients, so that our colleagues take on an important supra-regional care function.

This refers on the one hand to the control examinations during pregnancy, but also to the conduct of the birth, in which case our neonatological colleagues of the pediatric clinic headed by Prof. Rüdiger also provide support in the initial care of the newborn. Especially if it becomes necessary to continue MS therapy during pregnancy, an experienced tandem of neurologists and obstetricians who know the effects of treatment on mother and child is very important. There is also close cooperation in terms of research in order to be able to uncover important connections that are still unknown, especially in the treatment of pregnant patients.

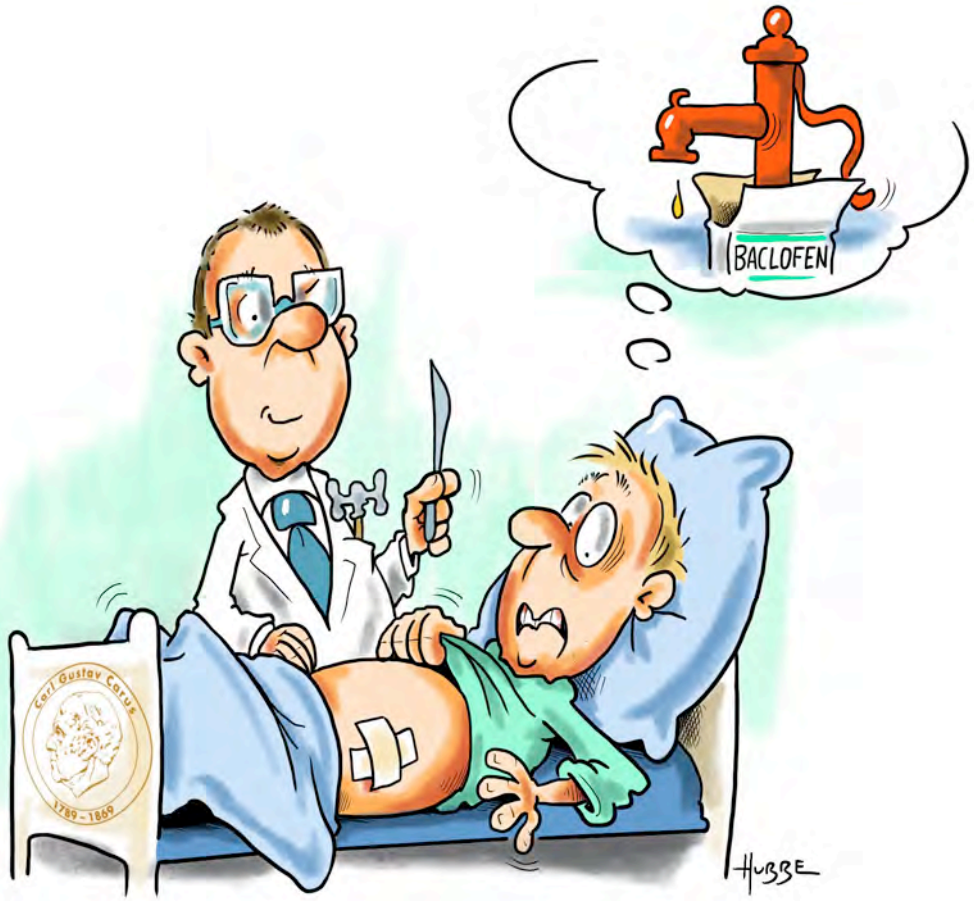
19
Neurosurgery

While the treatment of MS patients is mostly conservative by means of drug and functional therapies, the involvement of our surgical colleagues is necessary from time to time. Here, neurosurgery in particular plays an important role, as they have extensive surgical experience in dealing with the brain and spinal cord by nature. Here, too, the UKD has an excellent neurosurgical department under Prof. Schackert, with whom intensive cooperative clinical and scientific relationships exist.

Thus, it is rare that multiple sclerosis cannot be clearly diagnosed with the help of imaging and laboratory examinations. In these rare cases, one can fall back on the aid of brain biopsy, in which samples are taken from the brain by the neurosurgeon and the histological examination by a neuropathologist provides important diagnostic information.

On the other hand, neurosurgeons are important for innovative symptomatic therapies. In cases of severe spasticity (pathologically increased muscle tension) that does not respond adequately to medication or whose treatment is associated with excessive side effects, the neurosurgical insertion of a baclofen pump into the spinal canal can be a valuable therapy option. There, an externally adjustable pump delivers the drug locally, where it works better and is responsible for fewer side effects. Neurosurgeons also have many years of experience in pain therapy. The extreme pain episodes of trigeminal neuralgia can be positively influenced by certain stimulative procedures implanted by the neurosurgeons or destructive procedures. This is particularly important when drug therapies do not respond adequately.

Peripheral nerves can also be irritated by implanted stimulators if the muscles supplied by them are no longer properly controlled due to a central MS lesion. Then, for example, paralysis of the foot lifter can be compensated via such stimulation.



20
Clinical study center

The daily experience of dealing with multiple sclerosis patients results in our urgent need to develop further and better treatment options for this chronic disease. Especially when one reviews the developments in the last 20 years, it becomes clear what fascinating therapeutic milestones have already been achieved for a previously untreatable disease. In addition, it is also the important task of an university hospital to conduct its own research and to pass on research results quickly and directly to patients in the so-called translational research.

Therefore, the study center at the Center for Clinical Neurosciences is a very important part of the concept at the MS Center Dresden. New therapies do not fall from the sky, but must be researched in elaborate clinical studies with regard to efficacy and safety. If such clinical studies were not carried out, no new treatment options for MS would have emerged in recent years. This was the very unsatisfactory situation we still had to experience until the beginning of the 1990s. Of course, the safety of the patients plays a very important role in clinical trials. The nursing and physician study team is therefore in constant and close contact with the study patient. Fortunately, many of the studies conducted nowadays are no longer placebo-controlled, i. e., they are not compared against a sham therapy. As a rule, two different therapies are compared with each other nowadays. While the first efficacy tests of MS drugs are usually carried out in so-called phase II studies with the help of magnetic resonance tomography, the large phase III studies are of decisive importance for the approval of drugs. Over a period of mostly two years, clinical effects are primarily investigated against a comparative therapy or, rarely, placebo.

Studies are also important after the approval of a drug, then in so-called phase IV studies, which are becoming more and more important with regard to personalised MS therapy, especially when many different MS therapies are available.

Clinical trials are the essential investment in future improvement of MS therapy, so it is necessary that this area is given special importance at the MS Center Dresden. We are very grateful that we can work here in a very interdisciplinary way with the eye and skin clinic as well as the experts for internal medicine and neuroradiology. Not to forget our ethics committee, the data protection officer and our center for clinical studies (KKS).

21
Medical devices

In addition to drug and functional therapy, the provision of aids plays an important role, especially for MS patients with more severe neurological deficits. Through intensive cooperation with the rehabilitation clinics and the medical technicians in the region, we are able to identify optimal aids for the patients and then prescribe them accordingly. The individualised approach is important here, because not every aid can be used for every patient.

Ideally, the prescription is made during a rehabilitation stay in the rehabilitation clinics cooperating with us, as they have a lot of experience with regard to the available aids. Whether it is the Quellenhof, the Schmieder Clinic, our regional rehabilitation clinics in Pulsnitz, Kreischa and at the Tharandter Forest, our partners support us greatly in the challenge of keeping the patient in life. Aids can take many forms. It starts with walking aids and extends to wheelchairs or walker, special ortheses and modern electrical stimulation. For example, in the case of foot lifter paresis due to a central problem in multiple sclerosis, a stimulator can electrically stimulate the nerve at the knee and thus decisively improve the gait pattern. Optimal provision of aids has a decisive influence on the patient‘s quality of life and possibilities to participate in social life. Unfortunately, assistive devices are not cheap, so that intensive discussions with the funding agencies are often necessary. In many cases, a trial of the assistive device helps to demonstrate during the trial phase that significant positive effects can be achieved with the help of the assistive device.

22
Video consultation

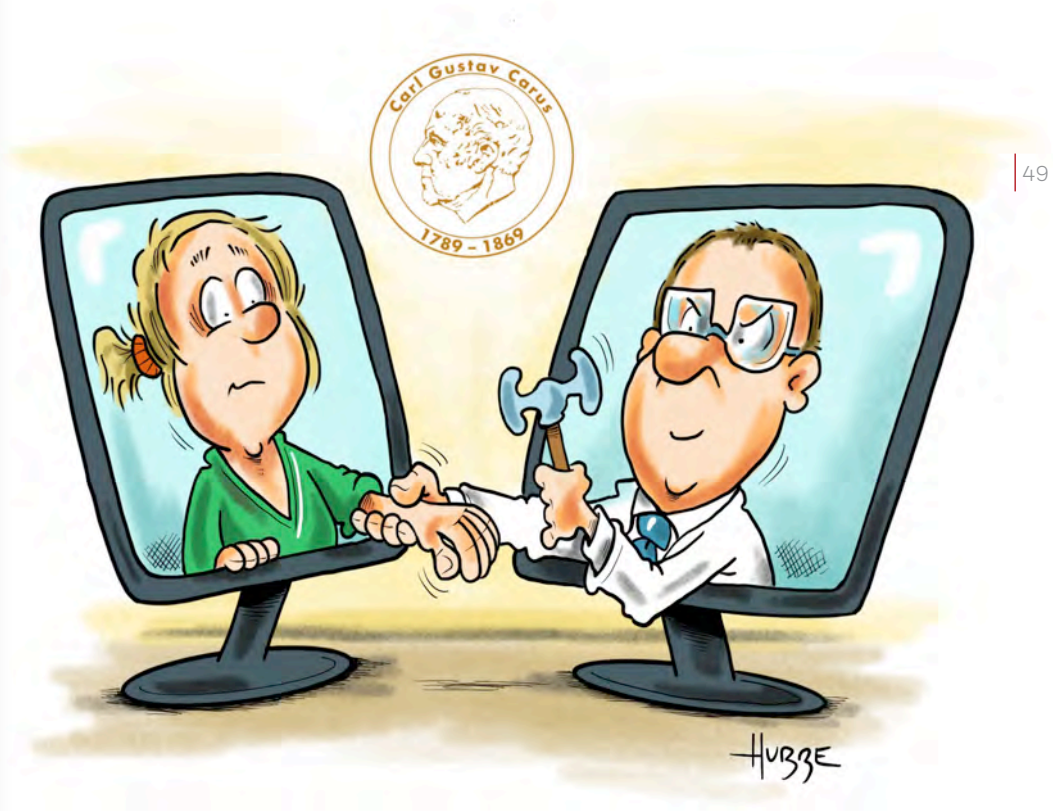
Many things were put to the test by the COVID-19 pandemic. While inpatient care had to be significantly reduced due to the necessary focus on COVID-19-patients, outpatient care with the naturally necessary adjustments to the respective infection situation proved very successful. Thus, the care of MS patients through our MS Center actually increased during the pandemic period.

Important aids can be digital innovations in this process, which are of course more difficult to implement, especially in a large clinic like the University Hospital Dresden, than in smaller private practices. Despite its size, however, the University Hospital has a very innovative IT department under Prof. Sedlmayr and Mr Senf-Mothes, with which important innovations can be implemented quickly. On the other hand, the MS Center has many contacts and experience in the field of digitalisation and has used the time to integrate innovations. One such innovation is the possibility of video consultation, which was developed for the entire hospital by a company spin off from the MS Center, MedicalSyn, under the leadership of the Carus Consilium Sachsen under Dr. Müller.

It makes us very proud, of course, that the developments that originally came from the MS Center now extend beyond the MS area. The video consultation cannot replace personal doctor-patient contact, nor does it allow the application of medication or blood controls. However, this important tool can be used for follow-up consultations or other consultation appointments that do not require the personal presence of the patient at the center. In the long term, the video consultation will also be integrated into the patient portal provided by the MS Center in the future, so that an optimal combination of personal and digital care services can be identified individually for the patient.

↗ www.medicalsyn.com

↗ www.carusconsilium.de



23

Ocular coherence tomography (OCT)

In multiple sclerosis, the typical inflammatory lesions often occur in the area of the visual pathway, which extends from the retina to the visual cortex. Therefore, the visual function with reduction of vision or the visual field is often affected clinically, but also subclinically within the scope of the disease. Because the retina actually already represents brain tissue in terms of its development, the optical apparatus of the eye offers the advantage of being able to look through the eye at the retina, i. e., at an area of the brain that is normally not accessible beyond magnetic resonance imaging. Whereas years ago it was only possible to mirror the back of the eye and detect specific changes there, such as the fading of the optic nerves as they enter the eyeball, in recent years there have been technologies that allow a differentiated view of the different layers in the retina. Optical coherence tomography (OCT) is a non-contact procedure for examining the back of the eye that shows the layered structure of the retina in detail. The procedure uses harmless laser light to optically display the tissue layers of the retina.

The different layers reflect the incoming light differently, so that a cross-section of the examined tissue can be calculated and displayed with the help of the information obtained, similar to what is known from ultrasound examinations. In MS, the inner layer of the retina, the nerve fibre layer, is of particular interest. If an inflammatory focus develops along the visual pathway in the course of multiple sclerosis, this procedure can be used to determine whether nerve fibres have also been destroyed in the process, which is unfortunately always possible in the course of the inflammation-related loss of the myelin sheath.

Interestingly, the optic nerve fibre layer in the retina is also affected by processes located far back in the visual pathway. In addition, OCT allows an objective determination of a drug side effect, the so-called macular oedema, during treatment with S1P modulators such as fingolimod, siponimod or ozanimod.

24

Magnetic resonance Imaging (MRI)

Early diagnosis of MS as well as the current innovative therapies would not be conceivable without the revolution in multiple sclerosis imaging that began with the first nuclear magnetic resonance imaging (MRI) of the brain in 1970 and continued with the availability of MRIs in clinical care since the 1980s. Today, diagnosis as well as monitoring are decisively based on these imaging techniques, which are about ten times more sensitive than purely clinical assessments. About 90 % of the iceberg of inflammatory MS activity lies below the water surface and cannot be assessed clinically; MRI imaging alone allows the detection of this activity below the water surface.

Magnetic resonance imaging is a technique that allows cross-sectional images of the human body to be displayed. It is based on very strong magnetic fields as well as alternating magnetic fields in the radio frequency range, in which the hydrogen atoms in the body are excited in such a way that an electrical signal is induced. Thus, this technique does not generate or use any harmful X-rays, which is positive for regular examination by MRI. In order to depict acute inflammatory foci, which plays an important role especially in the initial diagnosis, paramagnetic contrast medium is used, which passes into the tissue if there is an acute inflammatory focus.

At the MS Center Dresden, there is very intensive cooperation with the Neuroradiology Department of Prof. Linn. Especially Dr. Kitzler and his team are responsible for high-quality MRIs of the spinal cord and brain, which are not only used for clinical care but also for research.

Thanks to a unique cooperation as part of the MS PATHS project, we have recently been able to carry out a quantitative assessment of the MRIs we perform. With the help of special software and the MRIs carried out in our clinic as standard, it is possible to describe the changes in MS lesions as well as the changes in brain volume during the course of the disease. As a rule, there is always a decrease in brain volume due to the ageing process. In the MRI checks carried out at the UKD, it is now possible to assess whether the change in brain volume goes beyond the age-appropriate level. Because of these possibilities, we strive for imaging at our center for all patients, as with this imaging, more far-reaching statements are possible than with the standard MRI. In parallel, we are trying to establish this standard with the other radiologists in private practice.

25
Patient education

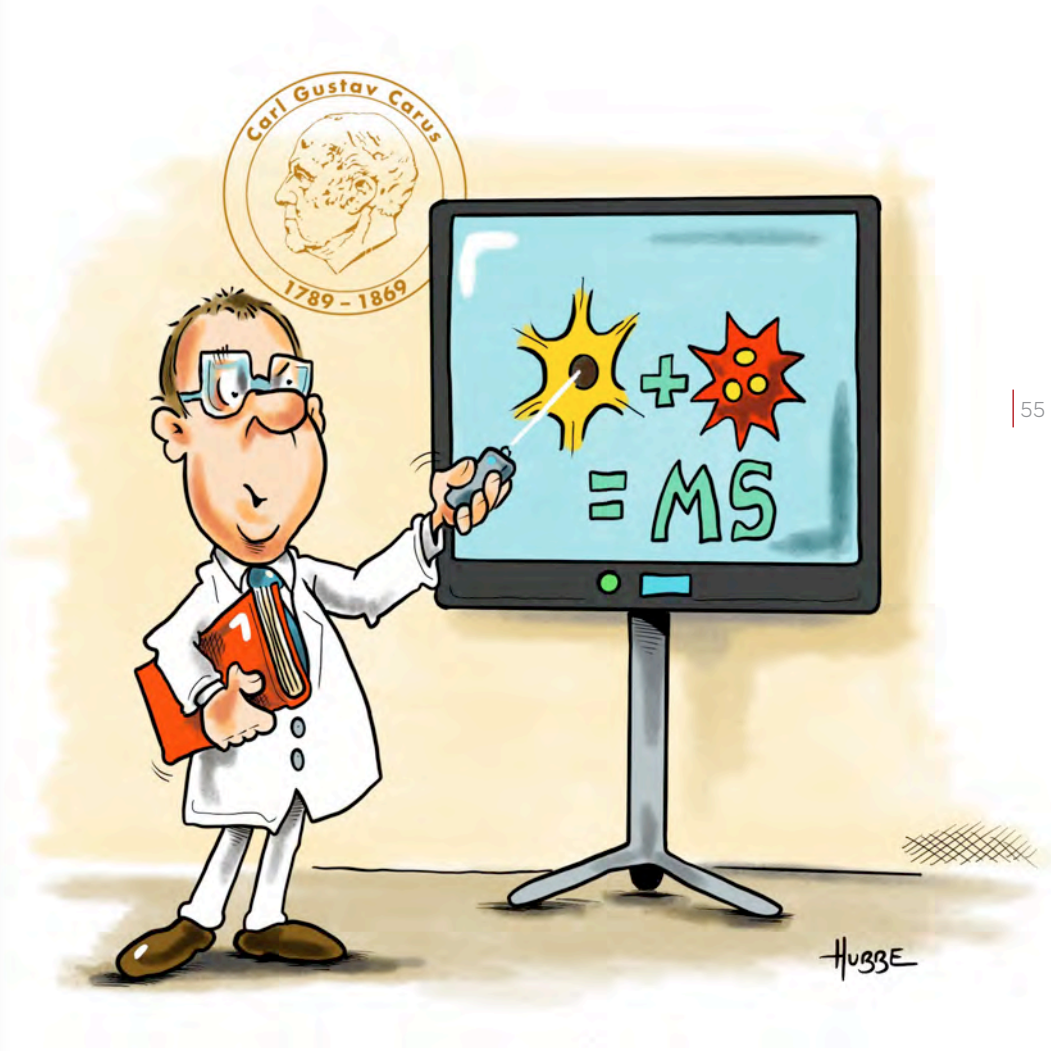
Especially with chronic diseases like multiple sclerosis, the informed patient plays an important role. In contrast to many acute diseases, which metaphorically would rather represent a sprint, chronic diseases are a long marathon that demands a lot of endurance and stamina from the patient. Thus, the individual daily life must be adapted to the disease, therapies must be carried out over a long period of time, which is not easy in our demanding times.

It is all the more important that the patient her-/himself becomes an expert on her/his illness. By nature, there is an asymmetry of knowledge between doctor and patient. Why would a doctor have spent so long studying and completing his specialist training in order to acquire the specialist knowledge necessary for individual treatment? Nevertheless, in the case of chronic diseases such as MS, the asymmetrical knowledge relationship between doctor and patient must be actively addressed and reduced. Only the informed educated patient, who is also convinced of the agreed intervention, will also implement and persevere with therapeutic advice relevant to lifestyle.

The further education of patients at the MS Center Dresden is a very important pillar. Even before the COVID-19 pandemic, regular patient academies were always held on Tuesday afternoons. On world MS Day, we always opened our center for an open day. Once a year, on a Saturday in November, we hold our Patient Day.

↗ www.youtube.com/c/zkndd

↗ www.facebook.com/mszdd



However, the COVID-19 pandemic has shown us that digital events can help us to stay in touch even in difficult times. Since last year, we have therefore been offering our monthly patient podcast on the first Tuesday of the month. Over about 1.5 hours, different topics are presented alongside an update on the COVID-19 pandemic, and there is plenty of time to answer listeners‘ questions as well. A livestream is available via Zoom, but also Facebook, and the video library can be found on Youtube. However, none of this can replace the individual medical consultation at the center.

26
MS master course

The Center for Clinical Neurosciences at Dresden University Hospital tries to follow the triad of patient care, research and teaching. In doing so, we do not only relate teaching to our students. As explained in the patient education part, it is important to us that every patient becomes an expert on his or her disease. Other neurological colleagues and MS nurses also receive further training with us through a lively continuing education program. Innovative training concepts such as the MS Workshop, the MS Safari or the Dresden Preceptorship have been developed for this purpose. It is also important for us to pass on knowledge to other medical disciplines, such as physiotherapy, radiology or general practitioners, who are usually primarily involved in the diagnostic chain of multiple sclerosis and also play a very important role in the long-term management of MS patients.

Beyond our intensive training program, we were able to go one step further two years ago. Together with the Dresden International University we launched the first multiple sclerosis master's program. With this two-year part-time course, students can obtain a Master's degree in MS Management. After individual counselling and decision by the DIU, the program is open to all interested persons who have a university degree and experience in the medical field.

↗ www.di-uni.de

↗ www.di-uni.de/studium-weiterbildung/medizin/ms-management

Currently, the first student group is studying hard in a total of six modules, all of which are concluded by an examination. In addition to the basics on the pathophysiology and diagnosis of MS, treatment knowledge plays an important role. At the end of the program, students complete a Master's thesis. Despite the purely digital training due to the COVID-19 pandemic, which was not planned originally, the first 20 students are enthusiastic and are learning everything about multiple sclerosis in a systematic way for the first time. A continuation with next German-speaking group are planned as well as an international study program in English.

27

Documentation software MSDS

With a chronic disease like multiple sclerosis, a lot of data accumulates over the years of treatment for each individual MS patient. Due to new possibilities in diagnostics and monitoring, its data density and complexity is constantly increasing. On the other hand, since more and more therapy methods are available that have to be selected individually for the patient, the systematic consideration of large amounts of data is of great importance. Data that are in paper files can only be mastered by leafing through them for several hours. In order to have large complex amounts of data available for individual patient care, digital applications must be used. For more than 20 years, Prof. Pette has been dealing with this topic at the Dresden University Neurology Department and launched the Multiple Sclerosis Documentation System – MSDS – which is still used in many ways throughout Germany.

Following this tradition, the team at the MS Center has participated in the continuation of this success story and has developed the current MSDS3D version, which is mainly used in German-wide, but also in international observational studies. Especially by linking with the patient portal and other innovative concepts such as the development of digital clinical pathways to help doctor and patient establish optimal care, the next step is the development of documentation software, which plays an important role especially on the path of personalised MS therapy. Here, it becomes clear that digitalisation and specialised software can be decisive in simplifying our daily work routine. The time gained here directly benefits the patient: it is much more productive to discuss relevant matters directly with the patient than to spend hours leafing through files.

28
Socio-medical counselling

Multiple sclerosis is a chronic disease that mostly affects patients in young adulthood. In addition to the consequences on family planning, there are of course a variety of socio-medical aspects that have to be taken into account in the course of treatment. Our occupation represents an important pillar of our lives. When a chronic disease like MS enters a person‘s life, it naturally has implications for this important area, which must be adapted to the changed situation. Despite all the criticism in Germany, we have the privilege of living in a functioning welfare state that makes the quality of life of the individual and participation in social life the goal of life guaranteed by the Basic Law, even in the case of severe illness and existing deficits.

In this regard, for us at the MS Center, the socio-medical support in the jungle of applications for rehabilitation and for disability assessment up to other special forms is a decisive component in the individual patient care. Particularly for inpatients, we are supported by competent and creative social workers who help shape the way back into life, especially in the case of acute serious problems.

In this continuous care of multiple sclerosis patients, the patient organisation of the German Multiple Sclerosis Society ↗ www.dmsg.de plays a decisive role. Particularly through the exchange with other affected persons and the availability of experts, especially in the socio-medical area, it has great advantages for MS patients to join this organisation and to help shape it. The MS Center Dresden also maintains close cooperation with both the Saxon regional association and the federal association of the DMSG in Hanover. Many events as well as, for example, the MS master course (see above) are carried out in cooperation with the DMSG. Additionally, the MS Center is represented in the medical advisory board. The participation in the MS register is also evidenced by the DMSG certificate, which the MS Center Dresden has just recently obtained again.

29
eHealth-health economics

Since the development of the MS documentation system MSDS by Prof. Pette more than 20 years ago, digitalisation has played an important role for the MS Center Dresden. It is crucial that these innovative concepts are developed by those involved, i. e., by and with ourselves, and that our patients and colleagues are also included in the development. It is therefore understandable that a working group at the Center for Clinical Neurosciences has been dealing with e-health issues for several years.

If innovations are to be integrated into everyday life at a center with patients, it must be clear how well such innovations are accepted by physicians and patients. Also, on the way to personalised medicine, large data sets have to be analyzed, for which expertise must also be available as well. In times of limited resources, research on health economic issues also plays an important role, especially the linking of health insurance data with clinical data. How patients benefit from certain therapies or interventions must be addressed correctly in terms of data protection before important conclusions can be drawn. Therefore, the Center for Clinical Neuroscience is very proud of its e-health scientific group, which supports the entire scientific area of the center with its data science expertise. Within the framework of this working group, important questionnaires and other instruments have already been developed, such as the MS health resource questionnaire (MS-HRS) with the help of which the different costs of care can be presented for individual patients. The first spin-off from the Center for Clinical Neurosciences, MedicalSyn, was also formed in the field of e-health. In the meantime, MedicalSyn has become an independent company that continues to pursue the visions of the Center for Clinical Neurosciences and cooperates closely with us. Other important external partners such as ZEGV, IPAM or the Faculty of Business Informatics, esp. Systems Engineering at Technical University of Dresden with Dr. Hannes Schlieter should also be mentioned here.

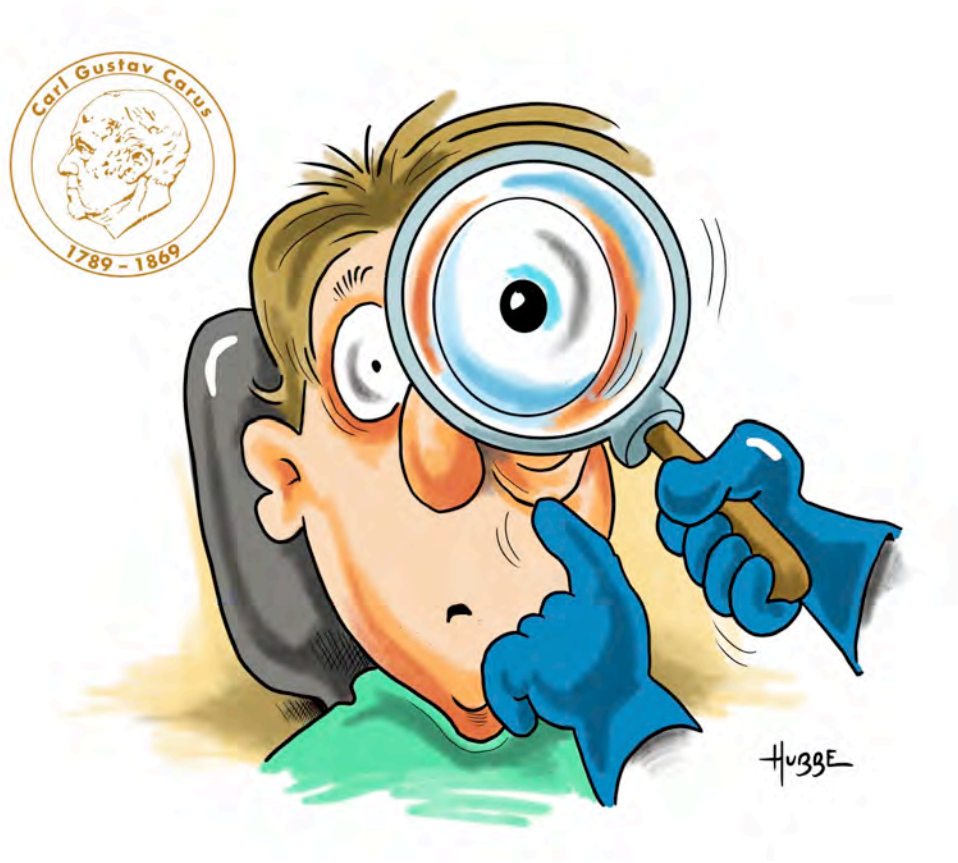
↗ www.medicalsyn.com

30
Ophthalmology

Due to the proximity between the eye and the brain, there is a close connection between the clinical subjects of neurology and ophthalmology. This is particularly true for multiple sclerosis, for which the MS Center Dresden is very grateful for the close cooperation with the University Eye Clinic under Prof. Pillunat. The direction of the cooperation varies depending on the phase of the disease:

Because the most frequent initial manifestation of multiple sclerosis is optic neuritis, which is mostly diagnosed in the eye clinic, many patients from the eye clinic are presented to the MS Center and then clarified by us. An inpatient admission, which is unpleasant for the patient, is no longer necessary nowadays, as all diagnostics are quickly available on an outpatient basis at the MS Center Dresden.

In the course of the disease, the direction then changes. The MS Center often asks the ophthalmological colleagues to help look after MS patients when it comes to the question of whether the visual problem is due to multiple sclerosis or another ophthalmological disease. The assessment of visual pathway is an excellent tool for monitoring multiple sclerosis, and ophthalmologists have a variety of methods for quantification at their disposal, such as ocular coherence tomography (OCT, see above).



In addition to optic nerve function, the oculomotor control of the eye muscles can also be impaired in multiple sclerosis, which can lead to eye tremor, so-called nystagmus, or double vision. Here, the orthoptist can help symptomatically, for example. Interestingly, MS patients also show other inflammatory diseases of the eye, the so-called uveitis. This requires regular ophthalmological check-ups with targeted therapy to maintain eye function. In short, in Dresden the eye is used intensively as a window to the brain and is always included in the holistic treatment concept.

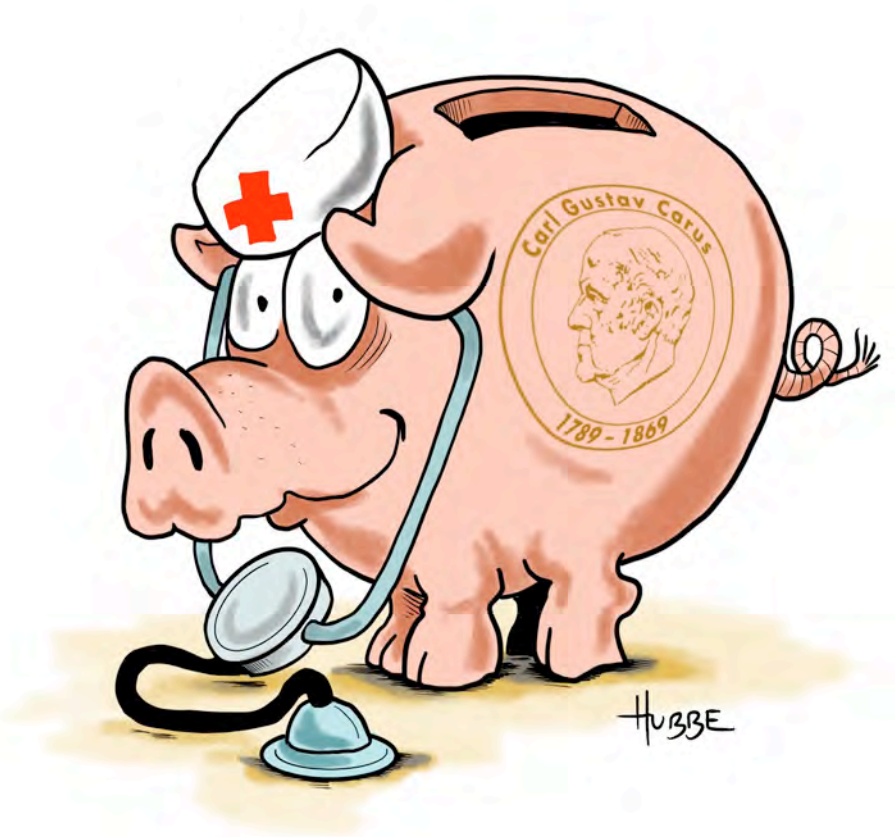
31

Stiftung Hochschulmedizin Dresden

Many activities at the MS Center Dresden, both in clinical care and in education for doctors and patients, go far beyond the usual standard. Unfortunately, these personnel- and time-intensive activities are not financed by the funding agency; ultimately, the work at the MS Center is less well remunerated by the health insurance than the care provided by a neurologist in private practice. Research, too, is unfortunately not a financially attractive business, but does require significant financial resources. In order to still be able to implement the triad at the MS Center Dresden with excellent clinical care, unique education as well as innovative research, we are on the one hand dependent on research applications, cooperation with other institutions and industry, clinical studies and sponsoring. Fortunately, we are also being approached by more and more patients who want to support our work with a donation. In the USA, such support from private individuals is far more common than it is in Germany.

We are very grateful to have the Stiftung Hochschulmedizin, an institution in the University Medical Center Dresden, which directly supports the Center for Clinical Neurosciences along with other partners. Every donation to the Stiftung Hochschulmedizin Dresden earmarked for the MS Center reaches us directly without deduction. This support will enable us to continue to provide clinical care, education and research activities with the same enthusiasm and intensity as you are currently used to from us. Of course, all donations to Hochschulmedizin Dresden are tax-deductible.

↗ www.stiftung-hochschulmedizin.de



Contact:
Stiftung Hochschulmedizin Dresden
Ostsächsische Sparkasse Dresden
IBAN DE27 8505 0300 0221 0457 40
BIC OSDDDE81XXX
+49 351 458-3715
info@stiftung-hochschulmedizin.de

Imprint

Publisher
Universitätsklinikum Carl Gustav Carus Dresden
Klinik und Poliklinik für Neurologie
Multiple Sklerose-Zentrum
https://msz.uniklinikum-dresden.de/

Illustrations
Phil Hubbe

Editorial
Prof. Dr. Tjalf Ziemssen

Image credits
DMSG.de (Seite 4)

Design · Layout · Realization
ketchum.de | Dresden

/ukdresden

ukdd.de