

PLATINUM IN MEDICAL APPLICATIONS

Platinum is used in a variety of medical devices to treat heart disease, stroke, neurological disorders, chronic pain, and other life threatening conditions. With an ageing and increasing world population, there is growing demand for healthcare products and services that use components made from platinum group metals and their alloys. This special feature considers platinum in anti-cancer drugs and biomedical devices.



Medical applications for platinum include anti-cancer drugs and implanted biomedical devices such as pacemakers and catheters. Demand for platinum in medical applications, including the dental industry, is forecast to be 255,000 oz in 2010. Demand for platinum in medical applications has grown steadily over the past decade, and currently represents one of the largest demand sectors for platinum.

ANTI-CANCER DRUGS

One of platinum's most remarkable qualities is its ability, in certain chemical forms, to inhibit the division of living cells. The discovery of this property in the 1960s led to the development of platinum-based drugs, which first became available in the 1970s and are now used to treat a wide range of cancers. The advent of the platinum anti-cancer drugs cisplatin and its successor carboplatin has contributed to substantial improvements in the survival rates of cancer patients suffering from a range of common tumours, including ovarian, breast, and lung cancer. Development of platinum anti-cancer treatments has continued – the drug oxaliplatin, which became available in the 1990s, is now used to treat a range of colorectal cancers. Other drugs are being subjected to clinical trials, including the compounds picoplatin and satraplatin.

Use of all three currently available compounds is expected to rise in future, mainly because more cases of cancer will be diagnosed: according to the World Health Organization, new cases of cancer will increase from 11.3 million in 2007 to 15.5 million in 2030. This is largely due to the rising incidence of cancer in the developing world, reflecting longer life expectancies, the adoption of Western diets, and the

widespread use of tobacco. This is leading to much higher rates of lung, breast, and colorectal cancers in particular. Over 25,000 oz of platinum are now used annually in anti-cancer drugs, contributing to the treatment of thousands of patients.

BIOMEDICAL DEVICES AND COMPONENTS

Platinum and platinum alloys are used in a range of devices including pacemakers and catheters which can be inserted inside the body. Key properties that make platinum and its alloys uniquely suitable for biomedical applications are its inertness and biocompatibility; its high mechanical strength, meaning it can be fabricated into extremely small, complex shapes; its electrical conductivity, meaning that it is suitable as an electrode for use in minimally invasive biomedical techniques; and also its radiopacity, which makes it clearly visible in X-ray images, enabling doctors to monitor the position of devices inside the body during treatment.

Platinum's unique properties have been exploited in neuromodulation devices (including 'brain pacemakers', used, for example, to treat Parkinson's disease, and cochlear implants to restore hearing), and in coils and catheters for the treatment of brain aneurysms. The fact that platinum does not corrode and rarely causes allergic reactions makes it ideal for these applications.

CARDIAC RHYTHM DEVICES

Abnormalities of the heart's rhythm are common, often debilitating, and sometimes fatal. Cardiac rhythm disorders can be managed very successfully using implanted devices such as pacemakers, which ensure the heart beats regularly, and implantable cardioverter defibrillators (ICDs), which

deliver a strong electrical impulse to the heart if an irregular heartbeat is detected. Each ICD typically has two or more electrodes made of platinum-iridium alloy, while platinum components are also used to connect the pulse generator to the lead which goes to the heart.

In the developed world, the majority of patients who require a pacemaker now receive one, and consequently, growth in implantation rates is relatively modest (typically less than 5 per cent per annum). However, there remains much potential for growth in the developing world. In the USA and many European countries, the rate of pacemaker implantation is over 1,000 devices per million people. In most developing countries, the rate is no higher than 50 per million and often much lower. As GDP increases and medical coverage improves, this figure is likely to grow substantially over time.

There has been rapid uptake of ICDs in the USA and in some European countries; however, only a fraction of potentially eligible patients worldwide receive a device. There is therefore significant scope for growth going forward, particularly in the developing world.

CATHETERS AND STENTS

Catheters are flexible tubes which are introduced into the body to help diagnose or treat illnesses such as heart disease. The surgeon can perform delicate procedures without requiring the patient to undergo extensive surgery, improving recovery time and minimising the risk of complications. Many catheters incorporate platinum components: marker bands and guidewires, which help the surgeon guide the catheter to the treatment site; or electrodes, which are used to diagnose and treat some cardiac rhythm disorders (arrhythmias).

One of the most common coronary complaints in the developed world is atherosclerosis, the furring of the artery walls with fatty deposits, which can lead to angina and heart attack. Blockages in the coronary arteries are often treated using a procedure commonly known as balloon angioplasty. This treatment uses a catheter with a tiny balloon attached to its end, which is guided to the treatment site then inflated, crushing the fatty deposits and clearing the artery. Afterwards, a small tubular device called a stent is usually inserted in order to keep the newly-cleared artery open. Platinum guidewires help ensure that the balloon is correctly located. This guidewire, made of base metal for most of its length, has a coiled platinum-tungsten wire at its tip, which makes it easier to steer and ensures that it is visible under X-ray. Platinum is also used in marker bands, tiny metal rings which are placed either side of the balloon in order to keep track of its position.

Around 2 million angioplasty procedures are undertaken in the USA and Europe each year. With the ageing of the population and rising rates of obesity, these numbers are likely to grow globally, particularly in developing nations.

NEUROMODULATION DEVICES

One new and rapidly expanding application for platinum is in the neuromodulation or neurostimulation sector. Neuromodulation devices deliver electrical impulses to nerves and even directly to the brain, treating disorders as varied as deafness, incontinence, chronic pain and Parkinson's disease. Many of these devices are based on an extension of heart pacemaker technology, and they are sometimes referred to as 'brain pacemakers'. Like heart pacemakers, they have platinum-iridium electrodes and may also incorporate platinum components in pulse generators.

At present, neuromodulation is expensive and is available only in a small number of specialist centres; even in developed countries only a small proportion of potentially eligible patients receive this treatment. However, neuromodulation can be used to help patients with common and sometimes difficult to treat conditions (such as chronic pain, epilepsy and migraine). This market therefore has substantial potential for expansion in both developed and developing countries.

OTHER IMPLANTS

A more recent development is the use of coils made of platinum wire to treat aneurysms, ballooning in blood vessels caused by weaknesses in the vessel walls. If the blood pressure rises, the vessel may rupture, causing a haemorrhage. Although this can occur anywhere in the body, platinum is mainly used to treat aneurysms in the brain, where surgery is difficult and fraught with risk. In the procedure, a platinum coil is used to fill the aneurysm to stop it rupturing. It is estimated that approximately 200,000 patients have received platinum coils in this way, and further growth is likely as this treatment becomes standard.

SUMMARY

Platinum is being increasingly used in a broad range of medical applications such as catheters, heart pacemakers and defibrillators. In 2010, some 175,000 oz of platinum are forecast to be used in biomedical devices, of which around 80 per cent is for established technologies, such as guidewires, and cardiac rhythm devices. The remaining 20 per cent will be used in newer technologies, such as neuromodulation devices and stents. These applications represent the largest potential for future growth.