Dental treatment for a patient with motor neurone disease completed under total intravenous anaesthesia: a case report

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Abstract

A 78-year-old male patient presented to the Birmingham Dental Hospital for dental treatment. His management was complicated by amyotrophic lateral sclerosis (ALS) a form of motor neurone disease, with associated inability to protect his airway due to bulbar involvement in the disease process. His dental treatment was managed successfully as a day case with total intravenous anaesthesia (TIV A) by target control infusion of propofol and remifentanil, aided by monitoring with bispectral index monitoring (BIS). No non-depolarising muscular blocking drug was used. Intubation was performed solely under propofol and remifentanil. The procedure lasted 150 minutes due to the extent of dental treatment required and the patient was discharged home 120 minutes after the completion of the procedure. A discharge this early has not previously been reported. No complications resulted

Key words: Total intravenous anaesthesia, motor neurone disease, case report

Introduction

Amyotrophic lateral sclerosis (ALS) includes a spectrum of neurodegenerative syndromes characterised by progressive degeneration of motor neurones. This causes progressive muscular paralysis due to degeneration of motor neurones in the primary motor cortex, brainstem and spinal cord. The disease is confined to the motor system with sparing of the extra-ocular muscles and sphincters. Over time this leads to weakness and wasting of muscles causing increasing loss of mobility in the limbs, and difficulties with speech, swallowing and breathing. However, there is no sensory impairment (Walton, 1989). Patients present at various levels of the disease process for hospital based treatment. Motor neurone disease therefore impacts upon dentistry in a variety of different ways. Patients have increasing problems with mobility and co-ordination thus affecting access for dental care, and hence oral hygiene may be impaired. At some stage of the disease most people will develop weakness of the muscles of the face, tongue, throat and larynx; resulting in dysphagia, dysphonia, dysarthria and drooling (Greenwood and Meechan, 2003). Nerve degeneration is responsible for a hyperactive jaw reflex. General anaesthesia in this group of patients is often challenging as many anaesthetic agents routinely used, either potentiate or exacerbate motor neurone disease. Muscle relaxants are better avoided as they may prolong recovery and precipitate ventilatory depression due to abnormal response to this group of drugs.

We report a patient with ALS in whom total intravenous anaesthesia (TIVA) without muscle relaxant was successfully used in a day stay case setting for his dental treatment.

Case report

A 78-year-old male patient was referred to the special care dentistry department. He presented with dysarthria and reduced mobility, resulting in him being reliant on a wheelchair for his mobility. He had been diagnosed with amyotrophic lateral sclerosis with upper and lower motor neurone disturbances with bulbar signs; presenting with a hyperactive active gag reflex, dysphagia, and an impaired swallowing and cough reflex. The patient presented complaining of pain in the lower left quadrant. A limited examination was possible using a mirror only, revealing a moderately heavily restored dentition with multiple carious cavities. Oral hygiene was poor
with high levels of plaque present. An OPT confirmed the presence of multiple carious teeth and bone loss consistent with generalised chronic periodontitis.

The patient’s symptoms prevented most dental work being carried out using conventional techniques, in addition to increasing the risk of aspiration and airway complications. Previously the patient had minor dental procedures completed under sedation with high doses of diazepam and no anaesthetic cover. Initial consultation with the patient’s neurologist led to the suggestion that dental treatment could be completed under oral sedation, with adequate respiratory support and anaesthetic cover available. However, this method was deemed to be inappropriate due to the complexity of the work which would have required multiple treatment episodes. Furthermore, the patient’s neurological condition had worsened leading to reduced ability in protecting his airway.

This patient was then referred to the consultant anaesthetist who decided that the risks of decreased airway reflexes due to the disease process would only be worsened further by high dose long acting benzodiazepines. Preoperative evaluation revealed that the patient had muscle weakness and atrophy. His condition had progressively deteriorated over the course of 20 years. Pulmonary function tests were not available but the patient was clinically asymptomatic. All other blood results were within normal limits. His American Society of Anaesthesiologists (ASA) physical status was III.

The decision was made to administer total intravenous anaesthesia as a day case procedure, utilising propofol and remifentanil infusions governed by target controlled infusion of the effector site (brain) using base orchestra primea TIVA pumps (Fresenius Kabi). The titration of infusion and doses was based on bispectral index monitoring (BIS) (Aspect medica). The use of TIVA would obviate the need for a non-depolarising muscle relaxant drug, hence, allowing the patient to be anaesthetised for a sufficient time period for all treatment to be completed in a single episode; in addition to providing adequate airway protection.

Premedication was avoided to minimise prolonged sedation and unpredictable drug interactions in this patient. In the anaesthetic room, after full monitoring was instituted, induction was achieved by means of propofol and remifentanil target control infusions (TCI). The patient was monitored throughout the anaesthetic using bispectral index (BIS, Aspect Medical Systems and Newton Massachusetts USA) analysis. After achieving adequate depth of anaesthesia, the patient’s trachea was intubated endotracheally at a BIS score of 45. The endotracheal tube provided positive pressure ventilation and protected the airway from surgical debris and patient secretions to ensure safe oxygenation.

Intraoperatively the effect site concentration of propofol and remifentanil was titrated between 2-4mcg.ml (with a mode of 2.5mcg.ml) and 3-5.5ng.ml (with a mode of 4mg/ml) respectively, to produce as planned by the anaesthetist a BIS value of between 50 and 60. There is evidence to suggest that the incidence of post operative recall is very minimal when the BIS value is kept less than 60 (Gan et al., 1997). Advanced training in neuro-spinal anaesthesia allowed the anaesthetist to assess both the quality and quantity of the BIS waveform to help correctly titrate the concentrations of drugs being administered and minimise awareness.

Induction and maintenance of anaesthesia was uneventful and the patient was extubated at the end of the procedure. The recovery was uneventful and the patient was discharged after he met the discharge criteria for the day stay unit.

The general anaesthesia allowed initially a thorough examination, digital periapical radiographs and formulation of a treatment plan. Five teeth were then extracted and composite restorations were placed on eight teeth. An upper central incisor, which was associated with a chronic abscess, was treated endodontically using digital radiography to assess the working length. Follow up appointments proved that the patient had no recollection of the event and returned to his pre-procedural state without the pain that he suffered from his previously untreated teeth.

Discussion

Amyotrophic lateral sclerosis (ALS) is an uncommon degenerative condition, with symptoms resulting from the associated muscle weakness and wasting. ‘Amyotrophy’ refers to the atrophy of muscle fibres which are denervated as their corresponding anterior horn cells degenerate, leading to muscle weakness, cramps and visible fasciculations due to fleeting muscle twitches under the skin. ‘Lateral sclerosis’ refers to hardening of the anterior and lateral corticospinal tracts as motor neurones in these areas degenerate and are replaced by gliosis. The aetiology of the disease is unclear.

This condition complicates management and can impair the degree of compliance achievable during dental treatment (Greenwood and Meechan, 2003). Limited mobility may cause difficulty during treatment and protection of the airway may be more difficult due to lack of muscle co-ordination. Ideally it is better to use local anaesthetic alone and treat the patient sitting upright (Greenwood and Meechan, 2003) because of the limited airway reflexes and the increased risk of aspiration in the reclined position. Varying degrees of lower motor neurone and upper motor neurone facial weaknesses coexist in ALS. The gag reflex is preserved in these groups of patients and is often brisk, while the soft palate may be weak. However, upper motor neurone involvement can result in muscle spasticity and exaggerated reflexes, including an overactive gag reflex (Hughes and Wiles, 1996). In this patient’s case a severe gag reflex and impaired swallowing and cough reflex...
complicated treatment, precluding the effective use of local anaesthesia alone.

Sedation has long been suggested as an effective treatment modality for patients with a gagging problem (Robb and Crothers, 1996). However it is well documented that this can result in a degree of respiratory depression (Malamed, 2003). Motor neurone disease can result in dysphagia due to weakness of the ventilatory muscles in the chest wall, back and neck. Therefore the combination of dysphagia and dyspnoea precludes the safe use of sedation for the treatment of such patients, in addition to the fact it would result in multiple treatment visits being required.

General anaesthetic allows complex treatments to be completed in a single session, which may be preferable to both the patient and carer. However the use of muscle relaxant in patients with ALS can cause prolongation of neuromuscular paralysis and postoperative ventilation (Lee et al., 2008). Conventional volatile anaesthetic agents have the disadvantage of an unpredictable half-life and wake up time. In addition, generally intravenous anaesthetic agents such as propofol and opioids are thought not to seriously affect neuromuscular function compared to volatile anaesthetic agents. Therefore it was concluded that due to the patient’s underlying neurological condition, treatment would be completed under total intravenous anaesthesia (TIVA) without the use of a muscle relaxant.

TIVA is a method of inducing and maintaining general anaesthesia exclusively by intravenous drugs, without simultaneous administration of any volatile inhalation agent. It has evolved from conventional general anaesthesia which typically is induced with an intravenous agent but maintained by an inhalation agent. TIVA has been used for some time by anaesthetists across all the surgical specialties and has gained popularity and become more practical in relatively recent times. The first reason for this is the development of modern drugs such as propofol and the newer synthetic short-acting opioids which have pharmacokinetic and pharmacodynamic properties which make them suitable for administration through continuous infusion. Secondly, advances in computer technology and pharmacokinetic modelling has allowed the development of advanced delivery systems which allow the delivery of intravenous anaesthesia to be a straightforward alternative to conventional inhalational techniques (Campbell et al., 2001).

TIVA can be delivered by simple intravenous boluses or variable rate continuous infusion, which can be manually controlled through syringe pumps or automated delivery systems. In this case intravenous anaesthesia was delivered by target controlled infusion (TCI). This involves an infusion system which allows the anaesthetist to set and adjust the target blood concentration of the anaesthetic agent, and therefore alter the level of anaesthesia, as required on clinical grounds. These systems usually rely on algorithms incorporated into the pumps that take in to account the height, weight and age of the patients. The titration is based on clinical requirements and in this case we used BIS to monitor the depth of anaesthesia to minimise the incidence of awareness, whilst minimising the volume and dosage of drugs used (Gan et al., 1997).

The advantage of TIVA over commonly used inhalational agents are easy titratability of drugs, quick induction and reversal, superior recovery profile (Gupta et al., 2004), a portable delivery system and less operating room pollution. This therefore makes TIVA an ideal form of anaesthesia for day stay surgery.

Constraints of the technique however are increased cost, availability of delivery systems and currently there is no non-invasive reproducible reliable technique for monitoring plasma concentration equivalent to inhalation agent monitoring. Prediction of plasma levels of intravenous anaesthetic agents is more complex than conventional inhalational agents due to the complicated pharmacokinetics. Therefore there is an increased risk of awareness, especially with concurrent use of muscle relaxants. In order to reduce the awareness risk, we used bispectral monitoring which provides a simple and reliable non-invasive monitoring of the depth of anaesthesia (Matsuzaki and Tanaka, 2002).

The bispectral index (BIS) is an indicator of consciousness through the use of a non-invasive sensor placed across the patient’s forehead incorporating frequency-domain, time-domain and bispectral analysis of the electroencephalogram to produce a dimensionless number ranging from 0 and 100. A BIS score of 0 indicates deep anaesthesia, conversely a score of 100 indicates the patient is fully awake and alert, a level of 40 to 60 is suitable for surgical anaesthesia. BIS-guided anaesthesia reduces the risk of awareness by 82% compared to routine care (Myles et al., 2004). Therefore target controlled infusion and bispectral monitoring techniques allow intravenous anaesthesia to be provided in a simple, convenient and controlled manner.

No single intravenous agent provides all components of anaesthesia; which are amnesia, hypnosis, analgesia with or without the use of a muscle relaxant; therefore a combination of intravenous agents is required. The most frequent combination used is the hypnotic propofol with the analgesic remifentanil, as was used in this case.

Propofol has been used since the late 1970s as an intravenous induction and maintenance agent of anaesthesia (Kay and Rolly, 1977). Propofol provides a good quality of anaesthesia and is a highly lipophilic drug with fast distribution and elimination. Recovery from propofol anaesthesia is therefore typically rapid and characterised by an improved recovery profile (Gupta et al., 2004) and a low incidence of unwanted side-effects, such as post-operative nausea and vomiting (Sneyd et al., 1998).

Remifentanil has a pharmacokinetic profile allowing a rapid titratable potent opioid effect and a predictable offset action without the risk of respiratory depression.
Therefore, the combination of propofol and remifentanil will effectively control the patient’s responses to tracheal intubation allowing the placement of an endotracheal tube, without the need of a muscle relaxant (Hogue et al., 1996).

**Conclusion**

A patient with motor neurone disease, resulting in a severe gag reflex and impaired airway protection was successfully treated using total intravenous anaesthesia as a day case. Thus the use of neuromuscular blockers and inhalation agents was avoided ensuring safe anaesthesia and analgesia for a complicated neurodegenerative case.

**References**