Propofol for pulsed dye laser treatments in paediatric outpatients

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Pulsed dye laser is a new treatment for port-wine stains, congenital lesions in the cutaneous vascular plexus. We report our anaesthetic experience with paediatric outpatients treated in the dermatology clinic. From April to November 1993, 48 ASA 1 children were anaesthetised for a total of 105 consecutive laser treatments. The youngest was eight months old, the oldest was 12 yrs old and most of the sessions (43%) were done for children aged from two to four years. Each received acetaminophen (10 mg · kg^{-1} po) before treatment. A propofol infusion was chosen for anaesthesia to achieve early discharge and to reduce the incidence of postoperative emesis. The infusion was adjusted to maintain blood pressure within 20% of baseline and to keep the child immobile. The dose was progressively reduced during the procedure from 400 μg · kg^{-1} · min^{-1} to 100 μg · kg^{-1} · min^{-1}. Fentanyl (2 μg · kg^{-1} iv) was added for analgesia. Respiration was spontaneous through a naso-pharyngeal airway (air in oxygen 40%). Anaesthesia proceeded uneventfully in all cases and lasted for 15–30 min (63% of treatments), 30–45 min (28%) or 45–60 min (9%) according to the size of the lesion. The mean stay in the recovery room was 25.1 min and none of the patients experienced emesis. Our experience shows that general anaesthesia with propofol supplemented with fentanyl offers a rapid onset and awakening, a painless treatment and an immobile child. It is a safe solution to alleviate pain from repeated painful procedures even in small children under two years of age.

Le laser à colorant pulsé est un nouveau traitement des taches-de-vin, lésions du réseau vasculaire cutané superficiel. Nous rapportons notre expérience anesthésique avec des enfants traités à la clinique externe de dermatologie. Notre collectif comprend 48 patients ASA 1 représentant un total de 105 traitements consécutifs entre avril et novembre 1993. Le plus jeune était âgé de huit mois, le plus vieux de 12 ans et la plupart (43%) avaient entre deux et quatre ans. Chacun a reçu une dose orale d'acétaminophen (10 mg · kg^{-1}) avant le traitement. Nous avons choisi une anesthésie par perfusion continue de propofol afin de pouvoir laisser rentrer à domicile les patients rapidement et pour diminuer la fréquence des nausées et vomissements post-opératoires. La dose de propofol était modifiée pour que la pression artérielle ne s'écarte pas de plus de 20% de sa valeur de départ et pour que l'enfant reste immobile. Elle était progressivement réduite durant la séance de 400 μg · kg^{-1} · min^{-1} à 100 μg · kg^{-1} · min^{-1}. L'analgésie était assurée par du fentanyl (2 μg · kg^{-1} iv). La respiration était spontanée par une canule naso-pharyngée (air et oxygène 40%). La durée de l'anesthésie était de 15–30 min (63% des traitements), 30–45 min (28%) ou 45–60 min (9%) selon la taille de la lésion dermatologique. Le séjour en salle de réveil a duré 25.1 min en moyenne et aucun patient n'a présenté de nausées ou vomissements. Notre expérience montre que l'anesthésie générale intraveineuse au propofol et fentanyl permet d'obtenir une induction et un réveil courts un traitement indolore et un enfant immobile. C'est une solution sécuritaire pour soulager la douleur des enfants, même de moins de deux ans, soumis à des procédures itératives et douloureuses.

Key words
ANAESTHESIA: paediatric, outpatient;
ANAESTHETICS, INTRAVENOUS: propofol;
SURGERY: pulsed dye laser;
DERMATOLOGY: port-wine stains.

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New diagnostic and therapeutic procedures performed outside the operating room have given rise to innovative anaesthetic techniques. The equipment necessary to perform these procedures cannot easily be moved to the operating theatre (interventional radiology, magnetic resonance imaging, cardiac catheterization, pulsed dye laser), implying that anaesthetists will often find themselves in a remote and unfamiliar environment. Furthermore, the staff may be unaccustomed to caring for anaesthetised patients, there may not be a recovery room and colleagues may not be rapidly available should help be needed.

Recent studies have demonstrated favourable responses of port-wine stains (PWS) to treatment with pulsed dye

laser.[1-3] The lesions are congenital vascular malformations characterised by ectatic vessels within the cutaneous superficial vascular plexus. They occur in approximately 0.3% of live births with an equal sex distribution. The majority of PWS are found on the head and neck and persist throughout life.[1] At birth, lesions are flat and relatively uniform in colour but evolve with age to become raised, irregularly surfaced and deeply coloured.[2] Early treatment is beneficial because as the percentage of the surface covered by the stain remains constant, younger (i.e., smaller) children will require fewer laser pulses to treat it.[1,4] Moreover, PWS may disfigure patients and cause psychological disability.[2,3] Easy bleeding after trauma and eventual hypertrophy of underlying bone and soft tissue may also justify early treatment.[3]

We report our anaesthetic experience with paediatric patients undergoing pulsed dye laser therapy on an outpatient basis in the dermatology clinic.

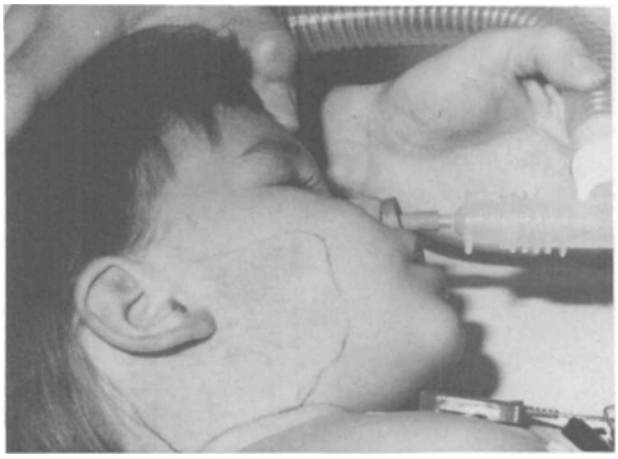

FIGURE 1 Port-wine stain on a two-year-old anaesthetised child. Note the naso-pharyngeal airway connected to the Bain circuit.

Methods

From April to November 1993, 48 ASA 1 patients were anaesthetised for pulsed dye laser treatment of PWS for a total of 105 consecutive sessions.

The children, along with their parents, were evaluated by the attending anaesthetist in the outpatient dermatology clinic before the laser session. The patients were kept fasting for six hours except for clear fluids which were allowed until two to three hours preoperatively according to the age of the child. Each patient received acetaminophen 10 $mg \cdot kg^{-1}$ *po* one hour before the laser session to prevent postoperative pain. The child was then brought to the laser room where the dermatologist or the nurse would delineate with a pen the area to be treated.

Monitoring consisted of pulse oximetry, ECG, automated blood pressure (Dinamap), precordial stethoscope and a temperature probe. The parents were present during induction of anaesthesia. Younger children underwent mask induction using a mixture of nitrous oxide in oxygen 40% with increments of halothane up to 2%. As soon as the child was unconscious, the parents were asked to leave the room and an intravenous catheter was inserted. Atropine 0.01 $mg \cdot kg^{-1}$ *iv* and fentanyl 2 $\mu g \cdot kg^{-1}$ were then injected. Halothane was discontinued and replaced with an infusion of propofol 400 $\mu g \cdot kg^{-1} \cdot min^{-1}$, progressively reduced every five minutes to 100 $\mu g \cdot kg^{-1} \cdot min^{-1}$. The propofol infusion was adjusted to maintain blood pressure within 20% of baseline and to keep the patient immobile. It was stopped some three minutes before the end of the procedure.

To give the dermatologist access to the facial lesion, the face mask was removed, and a lubricated naso-pharyngeal airway was inserted and connected to a Bain circuit (Figure 1). Nitrous oxide was switched off and a mixture of air and oxygen (FiO_2: 0.4) was used to reduce the risk of ignition.[5]

For those older children who preferred intravenous induction of anaesthesia, a bolus of propofol 3.5–4 $mg \cdot kg^{-1}$ was injected after atropine 0.01 $mg \cdot kg^{-1}$ *iv* and fentanyl 2 $\mu g \cdot kg^{-1}$ *iv*. An antecubital vein was selected to avoid pain caused by the injection of propofol. Anaesthesia was then continued with the propofol infusion.

At the end of the procedure the child was transported, lying on his side, to a local recovery room with an experienced nurse in attendance until complete awakening. Discharge from the recovery room was based on the Steward scoring system;[6] the child was then returned to his parents, allowed to drink clear fluids and discharged from the hospital ten minutes later. If necessary, the patient received supplemental analgesia (acetaminophen 10 $mg \cdot kg^{-1}$ *po*, codeine 0.5 $mg \cdot kg^{-1}$ *po* or a fentanyl 1 $\mu g \cdot kg^{-1}$ *iv*) or a sedative (midazolam 0.3 $mg \cdot kg^{-1}$ nasal).

Results

The youngest patient was eight months old and the oldest was 12 yrs old. Most of the sessions (46/105) were done for patients aged from two to four years (Figure 2).

Patients required propofol infusion rates of up to 400 $\mu g \cdot kg^{-1} \cdot min^{-1}$ to prevent any movement during procedure.

The duration of anaesthesia varied according to the size of the lesion. Anaesthesia lasted for 15–30 min in 65 treatments (63%), 30–45 min in 29 sessions (28%) and 45–60 min in nine particularly extensive stains (9%). Anaesthesia proceeded uneventfully for the 105 treatments. Respiration was spontaneous during the procedure

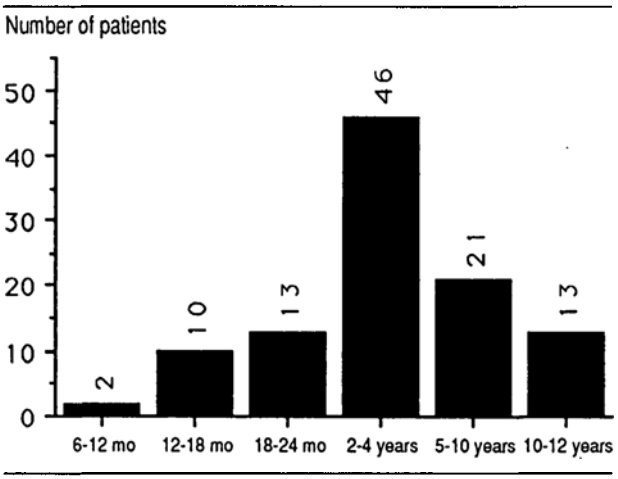

FIGURE 2 Age distribution of patients.

but it was usually necessary to assist ventilation briefly after the *iv* fentanyl injection. Oxygen saturation was maintained >98%.

Among the 25 children less than two years of age, 13 (52%) were restless upon awakening. Six were treated with nasal midazolam (0.3 mg · kg^{-1}) and seven calmed down in their mothers' arms. None seemed to experience pain.

Among the 80 children over two years of age, four were restless upon awakening and treated successfully with nasal midazolam (0.3 mg · kg^{-1}). Residual pain was present in 23 patients. When moderate (19 patients) it was treated with a supplemental dose of acetaminophen (10 mg · kg^{-1} *po*) and if severe (four patients) with codeine 0.5 mg · kg^{-1} *po* or fentanyl 1 μg · kg^{-1} *iv*.

No patient experienced emesis (nausea, retching, vomiting).

The duration of the stay in the recovery room was 25.1 ± 9.38 min.

Discussion

The pulsed dye laser (Candela laser Corporation, Wayland MA 01778) emits a visible (yellow) light energy at 585 nm, a wavelength absorbed by the targeted oxyhaemoglobin molecule, causing selective thermal damage to the dermal blood vessels while sparing other tissue components. The duration of each pulse is calculated to confine selectively the energy to the oxyhaemoglobin molecule before heat is lost by thermal diffusion from the exposure field. These characteristics avoid the hypertrophic scarring seen with the argon or CO_2 lasers due to thermal injury to surrounding tissues.[4]

Treatment with pulsed dye laser is painful. This pain has been described either like the snap of a rubber band against the skin or like the discomfort due to the vertical penetration of the skin by a fine 25G needle.[1,4] This kind of "mild to moderate" pain is not well tolerated by children. In addition, pain is repetitive throughout the procedure as each session, lasting 15–20 min, may necessitate 300–600 pulses according to the size of the lesion. After the session, patients experience a burning sensation, equivalent to sunburn, for approximately 20 min. Although no dermatologist believes that the treatment is painless, some advocate against anaesthesia for infants who could instead be immobilised by the nursing staff and by the parents, and for older children who could receive topical anaesthesia.[1] This approach is based on the presumed risk and cost of general anaesthesia and the short duration of discomfort.

However, it is our experience that patients and their parents who have had treatment with and without general anaesthesia, preferred the former. Patients who have previously undergone treatment of PWS without anaesthesia, were extremely anxious and apprehensive upon arrival at the clinic for a repeat procedure.

We believe that trained paediatric anaesthetists are essential to reduce the risk particularly from the location of treatment. The use of general anaesthesia allows the treatment of PWS in fewer sessions because a larger surface can be treated in a given session, thus reducing the amount of time lost from school and from the parent's work.[1] It is postulated that the use of general anaesthesia may reduce the potential financial loss from the parents. Furthermore, general anaesthesia facilitates the treatment of periorbital lesions as it is necessary to insert an ocular metal eye shield to protect the cornea during the laser session.

The problems we encountered were that the room for laser treatment had no ventilation and was some distance from the main operating theatre as it is used mostly for the treatment of older patients without general anaesthesia. Furthermore, the room available for recovery could accommodate only one patient. We did not want to compromise on patient's safety and used the same professional staff and equipment as in the main operating theatre. In addition, as the dermatologic lesions were located in the face, the anaesthesia technique should leave this area free to allow access to the dermatologist. Finally, the necessity to wear red stained protective glasses during the procedure makes the colour of the child difficult to evaluate.

To achieve early discharge and to reduce the incidence of postoperative emesis, propofol was chosen for anaesthesia. The major drawback was the necessity to make an injection. To avoid the fear and pain from the needle and propofol we chose a brief mask induction for our younger patients.

Although the dose of the propofol infusion was greater

than that used in the adult population, it is consistent with our paediatric anaesthesia experience and with previous reported studied.[7,8] Some sites of PWS are more painful to treat, particularly the periorbital region, nostrils, lips, ears and neck. For these areas the propofol infusion was maintained at 400 $\mu g \cdot kg^{-1} \cdot min^{-1}$. We asked our dermatologists to treat these areas first to allow us to reduce the dose of propofol to 100 $\mu g \cdot kg^{-1} \cdot min^{-1}$ and thus obtain faster awakening. As atropine was routinely injected, no bradycardia was noticed during propofol infusion. We used fentanyl 2 $\mu g \cdot kg^{-1}$ to diminish per- and postoperative pain. Although the risk of ignition is remote because the laser beam is never directed on the plastic airway material, we did not use N_2O and the hair adjacent to the lesion was dampened with water.[5]

As access to the face must be free for the dermatologist, we could not keep the fast mask on during the whole session. We elected not to intubate the trachea and not to use a laryngeal mask as described by Garbin *et al.*[9] to allow the maintenance of a lighter plane of anaesthesia. Intubation would unnecessarily prolong induction and emergence of anaesthesia. We used a naso-pharyngeal airway, connected to a Bain circuit, which gave us the opportunity to monitor ventilation and, if necessary, to assist it.

Most children (62%) were calm and painfree upon awakening. Nevertheless, 40 patients (38%) were either restless and crying or suffered from residual pain. It is difficult to evaluate the cause of restlessness in younger children. This is particularly true for small children (under two years old) because many of them (13 of 25 patients) were agitated upon awakening from propofol. Although seven stopped crying in their mothers' arms, six needed nasal midazolam (0.3 $mg \cdot kg^{-1}$) to calm down. In children over two years old, pain was the reason for discomfort in 23 of the 80 patients (29%) because of the areas in the face which were treated (periorbital region, nostrils, lips, ear, neck). It was successfully treated with acetaminophen for 19 children whose lesions were partially located in these painful areas. An opioid was successfully given to four children whose lesions were predominantly located in these areas producing severe pain. Midazolam was given as a sedative to four other children who were restless upon awakening.

The mean recovery time was 25.1 ± 9.38 min. No emesis was noted among the children who drank clear fluids. As noticed by Hannallah *et al.*,[8] allowing children to drink did not delay discharge. Children were discharged from hospital as soon as they were able to drink the fluids offered to them (none was forced to drink) or ten minutes after complete awakening.

Alternatives to general anaesthesia exist. They consist of verbal relaxation, application of ice packs, topical anaesthesia with EMLA cream, intralesional injection of lidocaïne, regional anaesthesia, oral sedation and analgesia and intramuscular analgesia. None of these techniques is successful in abolishing pain and some may produce adverse effects. The major drawback to intramuscular injection, in addition to the discomfort due to the injection, is the excessive recovery period after the procedure.[1] Sedation in paediatric patients can lead to prolonged depressed consciousness and requires that patients be continuously monitored throughout the session and for hours after the end of the treatment.[10] General anaesthesia offers a rapid onset and recovery allowing the patients to be discharged earlier. The dermatologist can treat more patients in the same day and each child will need fewer laser sessions.

Conclusion

In contrast to deep sedation or intramuscular analgesia, general anaesthesia offers a rapid onset and awakening, a painless procedure and an immobile patient. Large areas and complete treatments involving massive port-wine stains can be treated at a single session, thus necessitating fewer total sessions and resulting in a more rapid clearing of the stain.[1]

It is our opinion that general anaesthesia with propofol supplemented with fentanyl, administered by a trained anaesthetist, is a safe solution to alleviate pain from repeated pulse dye laser treatments in the paediatric population.

Our experience shows that general anaesthesia with propofol can be used for daycase surgery even for small children less than three years old.

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