



Pigs, burns and curly tails

Geoffrey C Mullins

In the early 1970s, the Burns Unit at the Royal Children's Hospital in Melbourne was suddenly faced with the management of a number of children presenting with extensive full-thickness burn injuries. This prompted a renewal of interest in the use of fresh pigskin as a temporary cover for burn wounds.

While early debridement and split skin autografts offer the best form of wound coverage, this approach is limited in massive burns by the lack of donor sites available to obtain split skin for grafting.

The aim of temporary cover of burns sites with pigskin is to reduce excessive fluid loss, act as a barrier against burns wound sepsis, protect the wound from mechanical trauma, and help control pain.

Plans to obtain pigskin were made with some degree of urgency. The State Research Farm at Werribee agreed to supply a pig to the hospital, on a weekly basis, for harvesting of a large split skin graft taken from one side of its body. This would be performed under anaesthesia by a member of the surgical staff. We were also informed that these were valuable "pathogen free" pigs and were to be returned alive and intact (minus, of course, the split skin from their side) to the research farm after the procedure.

All that was needed to complete the plan was an anaesthetist. I was selected for the task not on the basis of any experience, skill or knowledge, but primarily because of my junior status within the Department of Anaesthesia. In addition, it seemed that all the other members of the Department had suddenly developed an intense interest in vegetarianism, animal rights, Judaism or any other cause they could find that would preclude them being selected.

Having no knowledge of pig anaesthesia, I consulted what literature I could find on the subject and gleaned the following:

- Pigs can never be considered fully fasted for anaesthesia. They always have a potentially "full stomach", with its attendant risk of vomiting and aspiration under anaesthesia. If fasted in an enclosure, they will eat their faeces if hungry. After all, they *are* pigs.
- Pigs have excellent veins in their ears, suitable for cannulation and intravenous induction of anaesthesia.
- A clear airway may be difficult to maintain in a pig. Manoeuvres such as chin-lift and jaw-thrust are problematic, and endotracheal intubation is made difficult by the airway taking an acute, almost 90° turn just beyond the vocal cords.

There was limited information on how pigs react to anaesthetic agents commonly used in humans. Two points were of concern:

- Pigs are susceptible to malignant hyperthermia, not only in association with anaesthetic agents but even with significant exercise and stress. Landrace pigs are particularly susceptible to stress, and risk becoming "roast pork" if sufficiently stressed.
- Pigs are much more sensitive than humans to non-depolarising muscle-relaxant drugs. These drugs need to be titrated carefully to avoid the need for prolonged positive-pressure ventilation.

Armed with this knowledge, I prepared an anaesthetic machine, some intravenous equipment, drugs, masks and intubating equipment in the animal laboratory operating room. This room was on the first floor at the rear of the hospital and it was here, on the first morning, that I nervously awaited the arrival of the attendants with my first "patient".

When they failed to arrive in the operating room and I was called to go to the goods delivery laneway at the back of the hospital, it suddenly became apparent to me that my role was to be larger than I had anticipated.

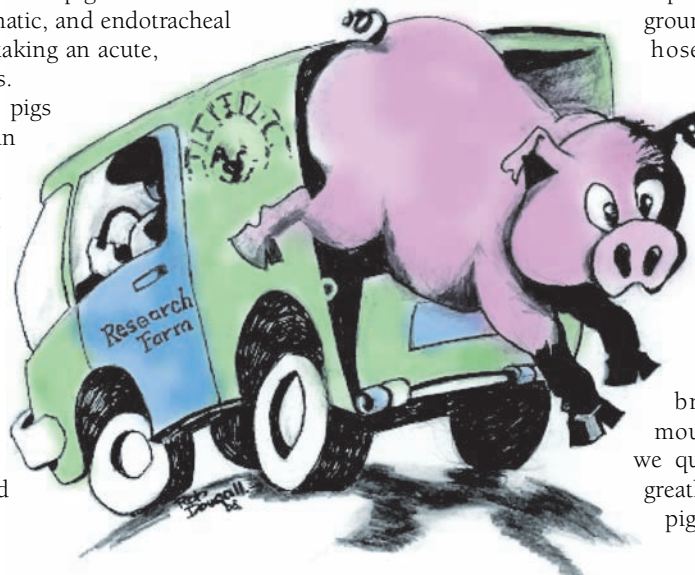
In the laneway was a panel van and beside it were the driver and his assistant, both anxious to get my signature for the delivery of a pig. I peered into the back of the panel van and was confronted by my first view of my patient — a snorting, smelly, very grubby pig with an excess of oral and nasal secretions and weighing about 100 kg. His aggressive stance and demeanour indicated clearly that there would be no cooperation with any medical procedure.

My approach to pig anaesthesia required a hurried revision. There was no way this pig was going to proffer me one of his ears, with its excellent veins, and allow me to establish intravenous access and then administer drugs to render him more compliant.

The only possibility was to somehow get the pig to turn round and present his buttocks to me at the open window at the back of the panel van. Sweet talking and cajoling failed, but shoving and prodding finally got the buttocks within range and I prepared for action. Using a stabbing motion, reserved for intramuscular injections into violent and uncooperative adults, I plunged a hypodermic needle deep into the nearest buttock and emptied my preloaded syringe of 1 g ketamine — hopefully into a gluteal muscle — before quickly moving to a safe distance away.

The pig was angered by this assault, but the ketamine soon took effect and he fell on his side, adopting an air of sweet repose, although snoring loudly, indicating some degree of airway obstruction.

Much haste was now required. Four able bodies, myself included, quickly lifted the unconscious pig out of the panel van and placed him on a sheet on the ground. He was then rapidly hosed down before being transferred to a clean sheet. By lifting the sheet at each corner, we carried our snoring pig hurriedly into the hospital. The noisy, obstructed, breathing pattern intensified as we ascended the stairs to the animal laboratory. Appalled at the thought of having to assist breathing en route with mouth-to-snout ventilation, we quickened our pace. I was greatly relieved to finally get the pig onto the operating table,



where I was able to deliver 100% oxygen via a conical face mask, suction the nose and pharynx, and thus restore a clear airway.

I deepened the anaesthesia by adding halothane to the oxygen delivered from the anaesthetic machine and then placed a large intravenous cannula into one of the pig's superb ear veins. I then attempted to intubate the trachea. This proved very difficult, and after multiple attempts I finally succeeded by using a malleable wire and then passing a cuffed endotracheal tube over the wire.

My greatest fear throughout the procedure was that the pig would develop malignant hyperthermia. The thought of my patient becoming roast pork kept me nervously vigilant.

The skin harvesting went well, and after emergence from anaesthesia the pig was transferred, in a somewhat dazed state, uneventfully back into the panel van and home to Werribee.

Flushed with success and now armed with a proven approach, we prepared for the next pig to arrive the following week. On its arrival in the back of the panel van, I was confronted with a new pig and a new problem relayed to me by the lone driver.

En route to the hospital from Werribee and passing through Footscray, the driver's assistant noted that the pig was trying to climb out of the open window at the back of the panel van. The van was stopped and the driver and his assistant attempted to push the now almost fully extruded pig back into the panel van. Unfortunately, the pig fell out onto the ground, injuring the leg of the assistant driver, and then escaped into suburban Footscray. The assistant was taken to a local hospital while the driver, with help from some local council workers, eventually got the pig back into the van and finally to my care.

In response to this incident, the State Research Farm sternly warned us they would send no more pigs unless we sedated them before departure to ensure the health and safety of the driver, his assistant, the panel van and the pig.

How best to sedate a pig for a journey across Melbourne in a panel van? Clinical pharmacology was in its infancy in the 1970s, and conclusions drawn from human studies and applied to animals were risky. What was needed was a drug that would calm the pig and take away its desire to escape but not sedate excessively. At that time there was much interest in the anaesthetic literature in the drug droperidol.

Droperidol had been used to treat severe agitation in psychotic patients. It was said to produce marked tranquillisation and sedation, allay apprehension and provide a state of mental detachment and indifference while maintaining a state of reflex alertness. Just what we wanted in our pigs! However, there had been some disturbing reports of the drug causing a state likened to a "locked-in syndrome", with marked inner turmoil experienced by the patient despite the external appearance of calm. There was no time for trials, and we reasoned that, if the pig did indeed feel locked in, this would make unruly behaviour even less likely.

Droperidol was in fact given on only one occasion: 10 mg intramuscularly 30 minutes before departure to the hospital. The pig arrived calm and awake, even tranquil. We, however, remained apprehensive, being unsure what this pig was really thinking.

We anaesthetised three pigs in total and the harvested skin was used as temporary skin cover to good effect. It was said that the children's appetites improved, even to the extent that one child reportedly "would now eat almost anything". This is, of course,

purely anecdotal and I find it difficult to attribute this observation to the nature of the temporary skin cover used.

Soon after these three successful anaesthetics, a Surgical Research Fellow arrived at the hospital keen to start a research project on oesophageal atresia, using piglets as an animal model.

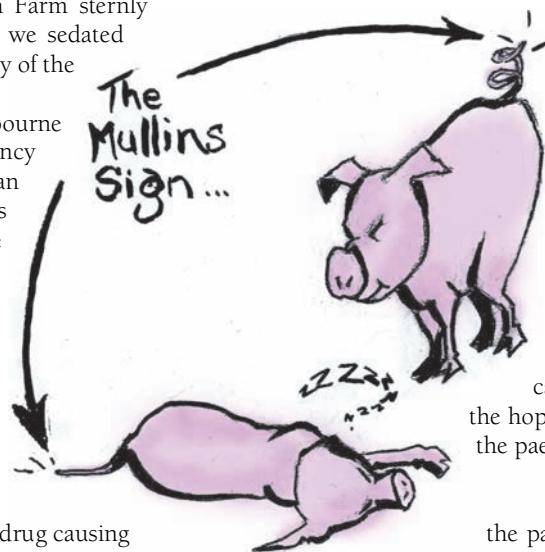
Unfortunately, being now regarded as the pig anaesthesia expert in the hospital, I once again found myself seconded to the animal laboratory to anaesthetise pigs. These, however, were piglets, weighing only about 8 kg each, and were much less of a challenge. In fact, it soon became almost a pleasure to anaesthetise these happy little piglets. They were small enough for me to carry to the operating theatre in my arms. If they squealed or struggled, which usually occurred only when I started to anaesthetise them, they would immediately become quiet if, with one hand, I held them upside down by their hind legs. Then with my other hand I would place the anaesthetic mask over their snout and anaesthesia induction would take place calmly. The induction was so calm and smooth I have at times been tempted to try this technique on uncooperative small children. As with adult pigs, intravenous cannula placement in the ears was easy and endotracheal intubation difficult.

I anaesthetised 10 piglets in total, with only one untoward event: one piglet had a short episode of profound hypoxaemia and appeared to have a somewhat "cerebral" grunt for the first 24 hours after surgery, but then reverted to behaving in a normal piggy way.

The research study on the piglets did not produce any breakthroughs in surgical practice, but did demonstrate that pericardium is probably not a suitable material to bridge the gap in the oesophagus when repairing oesophageal atresia.

There was very little science in my pig anaesthesia experience either, except for one important observation that sadly remains little known even today. I discovered that when piglets were adequately anaesthetised (ie, did not respond to surgical stimulation), their curled tails became straight. I took it on myself to call this the "Mullins sign", with the hope of making a name for myself in the paediatric porcine anaesthesia literature. But despite quite brazen self-promotion of this sign over the past 30 years, the Mullins sign has failed to receive due recognition.

With the acceptance of this article for publication by the *MJA*, I can now say with a mixture of pride and humility that the Mullins sign is finally "in the literature".



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