

I recently had an appointment with Dr X a specialist in radial keratotomy. He advised that I should abstain from diving for six months after the procedure. As diving is my principal sport and recreation I suggested that this period of "drying out" could be a problem. Dr X then suggested "you could probably squeeze it down to four months".

At this stage I began to worry about the arbitrary nature of these time frames and the basis from which they had been deduced.

I sought advice from Dr Y a diving medical expert of very high repute. Dr Y suggested that any diving activity should be prohibited for at least 12 months after radial keratotomy. He drew the analogy of a window pane with cuts 75% through its thickness trying to withstand hurricane force winds.

I got back to Dr Y and explained Dr Y's opinion. Dr X, who does not specialise in diving medicine assures me that six months would be more than adequate.

Now I am confused. Is it four or twelve months and who actually knows? Why not 2 years or even 5 years?

I am in a dilemma. The reason I want my eyes "fixed" is for diving but to get them "fixed" I must give up diving albeit for four to twelve months.

My question is simply this. Has any research been done on the effects of radial keratotomy on divers and if so, what are the results?

Yours faithfully

L Griffiths
Associate Member

This letter has been shown to Dr Y whose comments appear below.

As yet I have not read any published work dealing with the effects of radial keratotomy on divers. So my advice was based on the knowledge that radial keratotomy is normally restricted to those with mild myopia and that there have been corneal complications in patients in the USA. Under these circumstances I would not have the operation. Lenses in one's mask are much cheaper than the operation of radial keratotomy and are not associated with any ocular complications. Of course when someone has dropped a weight belt or a tank on your mask you can not see clearly using a borrowed mask. But care will prevent such accidents.

REPORT/DISCUSSION PAPER 1987-1

COMMENTS ON DECOMPRESSION SICKNESS IN WESTERN AUSTRALIA IN 1986

Douglas Walker

SUMMARY

There was a significant increase in the number of divers who attended at HMAS Stirling for recompression treatment during 1986 (20) and this increase has accelerated during 1987 (33 cases in the first 5 months). The information available concerning the divers treated during 1986 is reviewed to discover whether there are any identifiable reasons for this increase or identifiable remediable factors. It is suggested that the increase may be more apparent than real and represent a greater awareness among the at-risk diving community of the availability of the upgraded RCC facilities now available at HMAS STIRLING, this making visible a previously hidden frequency of decompression sickness. The length of delay before seeking medical assistance makes this probable.

CASE 1

This trained and very experienced diver had made a series of six dives to 30 metres for 20 minutes between 27th December and 6th January including a stop at 3m for 5 minutes in each ascent. He presented on 8th January. This knee had been injured in 1975. The knee was noted to have restricted movement. He had also made a dive to 6m for 50 minutes on 19th January but it was not stated whether this had effected his symptoms. He was treated on RN Table 62 plus IV fluids and dexamethasone and complete resolution of his symptoms was achieved. No additional details of these diver is known.

CASE 2

This trained and apparently experienced diver had made repeat dives on three consecutive days, an intermittent "pins and needles" sensation over his back, chest, and arms commencing after his last dive on 11th January. This became more severe and regular as the days passed until it was occurring ever 15-20 minutes. There were no other pains. He had some time in the past suffered an injury of his left shoulder and periodically experienced pain in this shoulder after repetitive and deep dives. There were no significant clinical findings. A diagnosis of neurological DCS was made and he was treated with IV fluids, dexamethasone (16 mgm then 8 mg tids),

DIVERS RECOMPRESSED AT HMAS STIRLING IN 1986

CASE	MONTH	AGE	TRAINED	EXPERIENCE	DIVE PURPOSE	DIVE TABLE	MAX DEPTH	DIVE PROFILE (that day)
1	January	39	Yes	30 years	Recreation	Royal Navy	30 m	30m x 20 min. stop 3m, 5 min.
2	February	26	Yes	20 years	Not stated	DCM	17 m	14m x 40 min. stop 10m, 10 min 1 hr then 17m x 35 min stop 7m, 5 min
3	November December	26	No "on job" learning	1 year	Pearl diving Hookah	Not stated	40 m	x 5 - x 6 daily last dive to 30-40m, 35 min.
4	February	33	Yes	13 years	Recreation	BSAC	20 m	20m x 35 min. Surface 2 hr 18m x 29 min. DC 10m, 5m, 5 min.
5	March	33	Yes 3-4 years	Experienced	Recreation	Not stated	14 m	12-14m x 4 min. Ascent normal.
6	March	33	No	Not stated	Crayfish Hookah	Nil	21 m	approximately 6m x 20 min x 1; 21m x 60 min x 2.
7	April	46	No	Experienced	Recreation	Nil	21 m	21 m x 50 min. 1 hour later 21 m x 55 min no decomp. stops.
8	April	31	Yes	15 years	Recreation	PADI	43 m	40m x 20 min. Stop 3m, 7 min
9	July	43	No	Not stated	Spearfishing: Hookah	Nil	15 m	15 m x 30 min. 15 min surface 15m x 45 min time estimate use of petrol by compressor!

(Based on available information)

PREVIOUS DIVING	SYMPTOMS ONSET DELAY	TREATMENT DAILY	DCS TYPE	TREATMENT/RESULT PREVIOUS HISTORY
5 days similar dives	Right knee pains 11 days	Further 2 weeks	1	Table 62 + IV etc. Symptom free. Right knee injury, 1975.
Day 1 3 x 14m 40 min Day 2 5 x 35-40m 14 min.	Paraesthesia trunk, arms increasing severity 3 weeks	3 weeks	2	Table 62 + IV and dexamethasone symptoms cleared. Right shoulder injured in past: painful after deep dives.
2 month x 6/day diving	Right knee pain paraesthesia weak right leg 2 months	2 months	2	Table 62 + IV and dexamethasone + Table 61 x 3 + Oxygen soaks x 2 PH in-water treatment.
—	Right shoulder, neck pain, paraesthesia lower limb 36 hours later	5 days	2	Table 62 extended. IV, dexamethasone. Previous DCS had left paraesthesia left thigh
—	Sudden weakness, disorientated 2 min after surfaced	1 hour	AE	Oxygen at 18 metres. Table 62 extended. Minor residual impaired balance.
—	Sight blurred end last dive. Right shoulder pain; weak, numb left arm	few hours	2	Oxygen in plane. Table 62 in Recompression Chamber. Symptom free.
—	Right shoulder pain 1 hour post dive. Later impaired cerebation.	2 days	1	Table 62 + IV etc. "Usually fatigue, thirst and poor concentration post dive".
—	Right shoulder pain 10 min post dive, worse. Upper arm neck paraesthesia.	8 hours	1	Table 62 extended. IV, dexamethasone then Table 61. Also strain arm.
—	Chest tight, both arms numb 5 min. after surfaced, then legs weak and numb and urine retention.	7 hours	2	Flown: Oxygen, IV, head down. Table 62 extended then oxygen soaks. Nil response: history laminectomy 6 years previously.

CASE	MONTH	AGE	TRAINED	EXPERIENCE	DIVE PURPOSES	DIVE TABLE	MAX DEPTH	DIVE PROFILE (that day)
10	July	41	Yes	10 years	Recreation	PADI	15 m	15m x 45 min; 55 min surface; 19m x 45 min.
11	August	37	Yes	2 years	Recreation	Not stated	30 m	24m x 20 min; 30m x 15 min; stop 5m x 5 min; 21 m x 30 min; stop 5m x 4 min.
12	September	22	Yes	6 months	Pearl diving Hookah	Not stated	36 m	4 dives today. 30m x 30 min x 2; 36m x 30 min x 2. Oxygen stops.
13	September	31	No	Not stated	Pearl diving Hookah	Not stated	41 m	5 x 38-41m but made x 2 further dive trips.
14	November	-	Not stated	Not stated	Seashell collect. Hookah	Not stated	40 m	40m x 35 min stops 10m, 5 min; 6m 5 min; and 3m for 20 min.
15	November	26	No	Not stated	Pearl diving Hookah	Not stated	14 m	8m x 60 min; 9m x 180 min; 14m x 75 min; 14m x 45 min.
16	November	21	Not stated	Not stated	Pearl diving Hookah	Not stated	14 m	9-14m, 5 dives in 6 hours; dive times not reported.
17	December	17	Yes	Inexperienced 6 months	Recreation	Not stated	15 m	15m x 30 min; 2 hours surface; 12m x 50 m in.

PREVIOUS DIVING	SYMPTOMS ONSET DELAY	TREATMENT DAILY	DCS TYPE	TREATMENT/RESULT PREVIOUS HISTORY
-	That night "full" head, later ache. Flew home: continued malaise, headache.	17 hours	2	Table 62 reduced headache. Oxygen soak next day. "Much improved".
10 day many repeat dives	Left elbow pain in evening; balance disturbed; flew back home 3 days later, developed paraesthesia left hand.	ENT 4 days	2	Table 62. Oxygen soak next day. Residual balance impairment. Cause uncertain.
7 day series 10/day	Right shoulder pain 1 hour post 4th dive: worse when drove over hills and other symptoms.	9 day	1	Table 62. Oxygen soak 3 days later as 2? recurrence. History in-water O ₂ x 4 past 6 months.
x 10/day 15-23m; 40-70 minutes	Left shoulder pain persisted, much less when dived.	> 1 month 10 days after last dive.	1	Table 62. Stated had total cure.
Not stated	Hanging by left arm decompression stops, then mowed lawn. Pain left biceps 11 hours post dive which increased.	1 day	1	Table 62 extended + IV, Decadron Clinical cure.
Not stated	Right knee pain 1 hour after last dive; worsened. 3 days later dizziness, general weakness, collapsed. Relief knee pain with O ₂ .	3 days	1	Table 62 extended + IV, Decadron + Oxygen soak. Claimed injured right knee day prior to symptoms.
Not stated	Not stated. symptoms/onset in-water treatment 3 days later: day 4 after table tennis swollen elbow so x 2 in-water: 20m, 35m.	9 days	1	Table 62. No relief, to hospital.
Not stated	5 mins after end 2nd dive left elbow pain, fatigue, thirst, light headed.	a few hours	1	Table 62 + IV etc. Good relief but chest discomfort 1 day further.

CASE	MONTH	AGE	TRAINED	EXPERIENCE	DIVE PURPOSES	DIVE TABLE	MAX DEPTH	DIVE PROFILE (that day)
18	December	25	Yes	Not stated	Recreation	Not stated	18 m	18m x 30 min; 5 min surface; 18m x 20 min.
19	December	40	No	Not stated	Recreation	Not stated	14 m	14m x 45 min; 90 sec surface; 14m x 80 min stop 3m, 10+ min.
20	December	24	Yes Inexperienced	11 months	Recreation	Not stated	25 m	25m x 30 min stops 6m, 2 min and 3m, 5 min

and the RN Table 62 protocol. There was a complete resolution of symptoms but the "pins and needles" recurred three times that evening so RN Table 61 was given the next day, and this producing a permanent clearing of symptoms. His dive profile was

Day 1 3 dives - 40 min at 14m 1 hr between dives

Day 2 5 dives-14 min at 35-40m 1 hr between dives

Day 3 2 dives - 14 min at 14m with DC stop 10 min at 10m, 1 hour surface interval before 2nd dive, 35 min at 17m with DC stop 5 min at 7m

CASE 3

This man presented with a two month history of a painful right knee, weakness, and "pins and needles". His dive pattern was of making 5-6 dives to 30-40 metres daily in late November and early December. During the November dives he suffered bilateral knee pains and these responded to recompression in the sea. His last deep dive was 8th December and since that time he had developed increasing pain in his right knee, a sensation of "pins and needles" over this knee, and a marked weakness of both extensors and flexors of knee and ankle. These symptoms were reduced after treatment by Table 61 and oxygen soaks but there was residual knee pain about 50 per cent of the presenting severity and both the flexors

and extensors of his knee remained weak. It is probable he had suffered a spinal bend affecting both motor and sensory pathways and he was advised to attend for follow-up. He had been pearl diving for a year, his diving instruction being "on the job" and informal. His symptoms appeared after his last deep dive on 8th December but he did not attend for treatment until 7th February. His activities in the intervening period are not known.

CASE 4

This diver experienced a 36 hour delay before the onset of pain in his right shoulder, neck pain, and prickling in his left foot, calf, and right pectoral region. There was also paraesthesia of his left thigh, the result of a previous DCS incident. He had made two dives, the first to 20m for 35 minutes with a no-stop ascent, followed after a 2 hour break by a second dive, this to 18m for 29 minutes. He made 5 minute stops at 10m and 5m after this dive. An extended RN Table 62, Hartmanns solution IV, and dexamethasone 16 mg followed by 8 mg tid, was successful in clearing all symptoms, some intermittent stabbing back pains resolving spontaneously.

CASE 5

This experienced diver made an apparently normal ascent but suddenly developed a generalised weakness, disorientation, and decreased consciousness with numbness of his arms and legs

PREVIOUS DIVING	SYMPTOMS ONSET DELAY	TREATMENT DAILY	DCS TYPE	TREATMENT/RESULT PREVIOUS HISTORY
Not stated	2 hours post dive left shoulder pain which worsened.	a few hours	2	Table 62 extended and IV, Decadron complete relief.
Not stated	Abdominal pains and bad chest pains when surfaced, then lost power in both legs so in-water oxygen.	1 day	2	IV, Decadron, O ₂ during transfer Table 62 extended, later O ₂ soaks slight residual.
Not stated	Next morning right shoulder pain. Flew home - got right elbow, shoulder pains, headache.	3 days	1	Table 62, IV and Decadron: relief but recurrences so O ₂ soaks x 2.

2 minutes after surfacing. By the time he reached HMAS STIRLING, about one hour later, he was semiconscious, with weakness and paraesthesia of all limbs, responding partially to commands and questions, speech slurred, and complaining of the numbness of his limbs. He was taken directly to the recompression chamber in a head-down position and compressed to 18m on oxygen. There was marked improvement during the "descent". Treatment was by extended RN Table 62, which left him well except for a slight tingling in his arms and legs. This resolved overnight but a mild impairment of balance persisted. He was checked later by a neurologist and advised not to dive again.

CASE 6

This man was a self taught diver crayfishing using a hookah supply system. Neither dive depth nor duration was measured but he estimated that his three dives were to 20 fsw for 20 minutes, 70 fsw for 60 minutes, then 70 fsw for 60 minutes with surface interval of 40 minutes and 20 minutes respectively. He noticed blurred vision during the last dive and felt unwell soon after surfacing. One hour post dive he developed a sharp pain between his shoulder blades, this quickly moving to his right shoulder. It became worse when

travelling over a 600 foot hill. He subsequently noticed that there was weakness and numbness of his right arm and bruise-like blotches developed over his torso that evening, so he presented at the local hospital the next day. He was flown at sea level, on oxygen, to HMAS STIRLING. Full power and function returned to his right upper limb after treatment with an extended RN Table 62. Follow-up was arranged and he was given advice about safer diving methods.

CASE 7

This untrained diver of unknown experience made two dives to 70 fsw (as measured by depth sounder), for each 50-55 minutes approximately, there being a little over one hour between the dive dives. No decompression stops were made. One hour after he surfaced from the second dive he developed a pain in his right shoulder which gradually increased in severity. The next day the pain was a little less but he noticed excessive thirst, decreased concentration, and difficulty in writing or holding objects. This led to him presenting for treatment the following day, two days following the index dive. He showed no apparent distress and was described as being neurologically normal. There was history of diving most summer weekends from the age of 12 (now 46), often to 120

fsw, following a similar dive profile to that stated. He apparently frequently experienced lethargy, thirst and decreased concentration following diving. He was treated by oxygen at 18 metres, IV fluids, and dexamethasone. The shoulder pain cleared after 70 minutes at 18 metres. The next day he was feeling well, more alert, and pain free. He was strongly advised about correct diving practices.

CASE 8

This man, who was trained and experienced, developed a pain in his right shoulder 10 minutes after surfacing from a dive for 20 minutes at 130 fsw, having made a 7 minute stop at 10 feet depth. The dive had not been strenuous but he thought he might have "pulled" his shoulder getting out of the boat. This pain steadily worsened and he also noted a slight discomfort in his upper arm and neck, and "pins and needles" in his right hand, but no weakness was apparent. He attended for treatment 8 hours later. There was some reduction of abductor power of his right upper limb but no other evidence of neurologic deficit was noted. He was treated by IV Hartmanns, Dexamethasone 16 mg stat, and an extended RN Table 62. His shoulder pain became less and the "pins and needles" was eased, but he developed a pain in his right biceps at 18 feet "depth" and this persisted even after a Table 61 treatment the next day which cleared the remaining shoulder pain. This continued despite a further Table 61 treatment the following day, indeed recompression appeared to exacerbate the biceps pain, which continued despite the continued use of Decadron 8 mg tid and Indocid. He failed to return for checkup. The biceps pain may have represented actual strain injury rather than being decompression sickness related.

CASE 9

This man was spearfishing using hookah supply and had made two dives to 15 metres, the first for 30 minutes and the second for 45 minutes, with a surface interval of 15 minutes. These times were estimates based on the amount of petrol the compressor used as neither the diver nor his companion had a watch, and depth was estimated by using notches on the anchor line. After a reportedly slow and normal ascent he climbed back into the boat without any difficulty but 5 minutes later he noticed some chest tightness and numbness and weakness in both arms. These symptoms quickly resolved but were replaced by numbness and weakness of both legs: by the time the boat reached the shore he was unable to stand and when he reached the local hospital he was unable to lift his legs off the bed and pain sensation

was grossly diminished in both his legs. In view of the dive profile and the rapidity of onset of the symptoms it was initially thought that he must have suffered a cerebral arterial gas embolism (CAGE), so oxygen and a lignocaine infusion were commenced and he was transported to the nearest RCC facility in a head-down position in a Royal Flying Doctor plane pressurised to 1 Bar. There was reportedly some clinical improvement during this journey. When he reached the RCC, 7 hours after the onset of his symptoms, there was gross weakness noted in both legs and inability to discriminate pin-prick sensation up to the level of the umbilicus but he was reasonably well and orientated. He was compressed to 18 metres on oxygen but this produced no relief so he was laid flat and catheterised. As there was still no real improvement after 120 minutes and the clinical picture pointed to a spinal cord lesion, a non-diving cause was thought possible and a neurological review arranged to follow the completion of an extended RN Table 62.

It was known that he had a long history of lower back pain and of left leg numbness, a problem treated by a laminectomy and spinal fusion in 1980. This had been only partially successful, leaving him at the time of this dive with an ability to walk only 300 metres before having to rest. However investigations, including both CAT scan and myelogram, were negative apart from showing evidence of the L 3-4-5 surgery. It was decided to treat him as a case of spinal decompression sickness and a series of daily 10 metre oxygen soaks commenced. A progressive improvement in power of his lower limbs was noted, the right more than the left, and the level of sensation moved down, but there remained significant impairment of both bowel and bladder control. During the evening following the sixth oxygen treatment he developed dyspnoea, retrosternal discomfort, and haemoptysis. A cautious further treatment the next day was aborted after 30 minutes and a provisional diagnosis was made of pulmonary embolism. This was confirmed by lung scan and a chest x-ray and he was commenced on heparin. The combination of pulmonary embolism and a developing pulmonary oxygen toxicity now precluded further hyperbaric oxygen therapy and he was returned to purely medical management. The outcome is not known.

CASE 10

While on an interstate diving holiday this trained, fit, and experienced diver spent a week diving at one resort. On the evening of the seventh day he developed a headache and feeling of fullness in his head. He had made two dives that day, 50 fsw for 45 minutes and 30 fsw for 45 minutes with a 55 minutes

surface interval. The next day and twice subsequently he travelled using commercial aircraft, returning home 9 days after this index dive. He attended for advice 8 days later, presenting a 17 day history of persistent dull headache and malaise. After a treatment with RN Table 62 the headache was improved and only occasional so he received a further oxygen treatment, 10 metres for 2-1/2 hours, 5 metres for 1/2 hour. This further reduced but did not totally eliminate his lethargy and vague residual headache. The final clinical result is not known.

CASE 11

This diver, well trained, was on a 10 day diving holiday during which many repetitive dives were made. On the index day there were three dives, 24 metres for 20 minutes, a surface interval of just over 5 hours then a dive to 30 metres for 15 minutes with a decompression stop at 5 metres for 5 minutes. The third dive, 3 3/4 hours later, was 21 metres for 30 minutes with a decompression stop at 5 metres for 5 minutes. That evening the left elbow developed pain, a dull ache extending to the upper arm. Some imbalance had been noticed when leaving the boat and there was an increased thirst the next few days. After flying home three days later "pins and needles" and numbness occurred in the left hand. Because the balance remained impaired medical advice was obtained but the other symptoms were not reported to the doctor. However the persistence of a dull ache in the right elbow and tingling in the left palm and fingers caused the diver to attend HMAS STIRLING two days later, six days after the apparently critical dives. After treatment with RN Table 62 the symptoms resolved, but they returned slightly and an oxygen soak (2 hours at 10 metres, 30 minutes at 5 metres) was given the next day. The persistence of a mild imbalance despite this therapy was taken to indicate that this symptom was not due to Decompression Sickness and the case was defined as being one of musculo-skeletal DCS.

CASE 12

This diver had obtained scuba certification at some time but had been working as a pearl diver using hookah for the past six months. This involved making repeated dives to 21 to 24 metres depth, about 60 dives during a 10 days work schedule, although during the first 7 days of this trip he had usually made 10 dives daily to approximately 13 metres. The dive depths and times were not accurately measured. On the eighth day he made four dives, pain developing in his right shoulder one hour after the fourth dive, followed by pain in his left elbow and right knee.

- | | |
|--------|--|
| Dive 1 | 30 m x 30 min: stops 12m, 3 min and 9m, 2 min. |
| Dive 2 | 30m x 30 min: oxygen stops 12m x 5 min; 9m x 2 min; 6m x 2 min. |
| Dive 3 | 36m x 30 min: oxygen stops 12m x 10 min; 9m x 5 min; 6m x 5 min. |
| Dive 4 | 36m x 30 min: oxygen stops 12m x 15 min; 9m x 5 min; 6m x 5 min. |

This was not the first time he had experienced Bends symptoms - in fact he had been treated four times in the six months of his employment by in-water oxygen. No details are known concerning the treatment schedule used, his symptoms, the effectiveness of the treatment, or even whether any of the other divers required, or received, similar treatments. This was the last dive of this trip and some unstated time later he noticed that when driving back to Perth across 300 metre high hills these pains were exacerbated. He had continued to have variable but fleeting pains in his shoulders, elbows, and knees and also experienced some visual distortion, lethargy, and difficulty in concentrating. This led him to seek medical advice 9 days after his last dive. He was treated on RN Table 62, which resulted in the complete resolution of all his symptoms, though some pain returned in his right shoulder, right knee, and left elbow 3 days later and required an oxygen "soak" (10 metres for 2 hours). He was advised to abandon his pearl diving career.

CASE 13

Untrained and of unstated experience, this pearl diver had developed a pain in his left shoulder after a dive mid-September and this had persisted. Despite this he made two further trips, on the last one making 9-10 dives to 15-23 metres, each of 40-70 minutes duration. During these dives the shoulder pain did not trouble him. He presented for treatment 10 days after his last dive, with pain but full function of his left shoulder. Treatment using RN Table 62 produced full resolution of the symptoms. He failed to attend for follow-up check.

CASE 14

The training, experience, and age of this diver is unknown but it is probable that he was experienced as he was diving for sea shells using a hookah. The dive was to 130 fsw for 35 minutes with decompression stops for 5 minutes at 30 fsw, 5 minutes at 20 fsw, and 20 minutes at 10 fsw depth, hanging on by his left

arm. At home later he mowed and raked his lawn. That evening he developed a pain in his left biceps, this increasing overnight despite taking analgesics, so he drove to HMAS STIRLING the next day. There were no objective signs of damage so he was commenced on IV fluids and given Decadron (16 mg stat, 8 mg tid), and treated with an (extended) RN Table 62. Complete resolution of symptoms resulted.

CASE 15

This was the second time this pearl diver had attended at HMAS STIRLING in 1986 with DCS. He reported that he had injured his right knee the day prior to making five no-stops work dives:

- Dive 1 8 metres x 60 minutes
- Dive 2 9 metres x 180 minutes
- Dive 3 9 metres x 45 minutes
- Dive 4 14 metres x 75 minutes
- Dive 5 14 metres x 45 minutes

He developed a painful right knee one hour after the last of these dives and this gradually became worse, then a general weakness and dizziness developed and he collapsed. He was taken to the local hospital, where he was commenced on oxygen and transportation was arranged to HMAS STIRLING using the Flying Doctor Service. On his arrival there he had been on oxygen for 13 hours and the pain in his right knee was much improved but he had developed pain in his right elbow and ankle and there was a generalised weakness, worse on the right side. He could stand and walk but his alertness was reduced. Treatment with IV fluids, Decadron and RN Table 62, which was extended at 18 metres, was effective. As there was slight stiffness of his right knee the next day he was treated by oxygen 10 metres for 2 hours and this was clinically effective.

CASE 16

This pearl diver made 5 dives to 9-14 metres in 6 hours, receiving in-water treatment (no details of symptoms or treatment are available) 3 days later. The next day he developed swelling, pain and stiffness of his right elbow after playing table tennis, this being treated by two in-water treatments, first at 20 metres on air and then to 35 metres on air with oxygen at 15 metres: no relief was obtained. He was admitted to the local hospital on day 8 and transferred to HMAS

STIRLING the next day. By this time there was no pain though there was some swelling and a 15° reduction in extension of the right elbow. He was treated with RN Table 62 but the elbow became more painful the next day, indicating a non-decompression cause.

CASE 17

The first dive was to 15 metres for 30 minutes, then after a 2 hour break there was a second dive, 12 metres for 50 minutes. Five minutes after surfacing from this dive he noticed an ache in his left elbow which fluctuated in intensity and radiated into his left thumb. He also felt tired, thirsty, and light-headed. He gave a history of having a similar pain after a Treasure Hunt dive two weeks previously, this resolving spontaneously over 3 to 4 days. When he attended for treatment he showed signs of dehydration, the left elbow was tender on movement, the wrist had decreased power, and there was slight abdominal tenderness. He was commenced on IV fluids and Decadron and treated with RN Table 62. This resolved all symptoms save for a slight chest discomfort, this clearing by the next day, so the IV fluids and Decadron were then discontinued.

CASE 18

An overseas visitor, trained but of unknown experience, made a dive 18 metres for 30 minutes and then another 18 metre dive for 20 minutes after a five minutes surface interval. Two hours after the second dive he developed a slight pain in his left shoulder which became gradually worse. There was no loss of power or shoulder movement. He was treated by IV Hartmanns, Decadron (16 mg stat, then 8 mg tid), and an extended RN Table 62. This produced a complete resolution of all symptoms. The Decadron and IV fluids were ceased the next day as he remained symptom free.

CASE 19

Self taught and of unstated experience, this man initially made a dive to 14 metres for 45 minutes, then surfaced for 90 seconds before returning to 14 metres for a further 80 minutes. No details are available concerning the dive group dive purpose, or the equipment used. He made a decompression stop (3 metres, 10 to 15 minutes) as he ascended from the second dive. On surfacing he reported severe chest pains and some abdominal pain, and 10 to 15 minutes later developed "dull, solid pain" in the lower back and pins-and-needles down both legs, then a loss of power in both legs. He took the boat to 7 metre

TABLE 2
BREATHING APPARATUS, TRAINING, EXPERIENCE AND NUMBER OF DIVES

	Trained			Experienced			No of dives	
	Yes	No	Not stated	Yes	<1 year	Not stated	Single	Repeat
SCUBA	9	2	-	7	2	2	2* (*+1 Air Embolism)	8
HOSE SUPPLY	2	5	2	1	2	6	1	8

deep water and hung off the side breathing 100% oxygen at 4 metres for 15 minutes, which was associated with a return of sensation. He surfaced at a rate of 2 minutes per foot. However after a further 15 minutes he noticed more tingling so treated himself for a further 22 minutes at 3 metres, then had to surface and return home as the weather worsened. He noticed slight tingling in his legs but this later disappeared.

Next morning he awoke with numbness and weakness of both legs and attended the local hospital. He was found to have weakness of both lower limbs, altered sensation L2 down, and loss of pin prick and light touch sensation in both feet. He was commenced on IV fluids, Decadron (16 mg stat, 8 mg tid), and oxygen and transferred to HMAS STIRLING. He was described as obese. Diagnosis: Spinal DCS. He was treated by RN Table 62, extended for 25 minutes at 18 metres: this produced great improvement but there remained some back pain and slight numbness over the right toes. It was suggested that this numbness antedated the incident but the records do not enlarge on this statement. As he complained of migratory numbness over his left hip and the soles of both feet, with decreased sensation in these areas, he was treated with a 2 hour 10 metre oxygen soak 2 days later, and again the following day. Residual impaired sensation of the sole and toes on the right foot was regarded as irreversible, however his other symptoms were now resolved and power appeared to have fully returned to his lower limbs. He was "given advice about diet, diving, and flying" and discharged as fit for work.

CASE 20

While on an overseas holiday this man dived to 25 metres for 30 minutes, making decompression stops at 6 metres for 2 minutes and 3 metres for 5 minutes. The next morning he noticed some malaise, lethargy, and an ache in his right shoulder. During the flight

home later that day the shoulder pain was exacerbated and he also developed pains in both elbows and a headache. He apparently recognised the cause of his symptoms so presented for treatment on reaching Perth. This was the third post-dive day. He was commenced on IV fluids, Decadron, and RN Table 62. There was an initial resolution of the symptoms but some pain recurred in his right shoulder the next day and this was treated by an oxygen soak, 10 metres for 2 hours, a treatment repeated the following day as the pain again returned. This was successful and no further treatments were necessary.

DISCUSSION

The information contained in these brief cases notes indicates some of the matters requiring further examination when considering both the factors significantly effecting the recent increase in numbers of decompression sickness cases receiving treatment and the best ways to reduce this incidence of DCS. First it is necessary to note that discussion is being directed at cases attending at HMAS STIRLING for treatment and the true incidence of cases is unknown as many divers are probably allowing their symptoms to resolve and failing to attend for treatment. This is suggested by the delay in attending for treatment noted in many of these cases. It is to be noted that the pearl divers are proportionally over represented in this survey despite the evidence that they are frequently treated by ad hoc in-water decompression. There appears to be need for better diving procedures in this industry. It is very likely that the divers employed in pearl diving would show a high incidence of aseptic bone necrosis changes if surveyed.

It is noticeable that a large proportion of divers were experienced and it is reasonable to suppose that the index dives were similar to their usual diving procedures. Whether it was the availability of improved recompression facilities or the occurrence of symptoms more severe than they usually experienced

TABLE 3
BREATHING APPARATUS AND MAXIMUM DEPTH OF DIVE

MAX DIVE DEPTH	<=10m	<=15m	<=20m	<=30m	<=40m	>40m
SCUBA	-	4	2	3	-	1
HOSE SUPPLY	-	3	1	1	3	1

and tolerated which was the factor which decided several of these divers to seek treatment is unknown but it cannot be assumed without further investigation that the true incidence of decompression sickness has changed. It can be assumed, however, that the incidence is greater than present figures indicate. If the improved facilities for treatment have in any way increased the willingness of divers to attend for treatment of decompression sickness it would be unwise to discourage their attendance by interposing a fee for treatment. While this would effectively reduce the number attending for treatment it would in no way effect the incidence of decompression sickness. Prevention depends on the identification of a problem and then applying the appropriate management of such factors. The failure of Government agencies to regulate Pearl Diving activities in either Queensland or Western Australia is reprehensible. Had the diving community in Western Australia supported the collection of reports of diving incidents, the Stickybeak Project, the severity of the Decompression Sickness problem would have been identified far earlier and there would have been no need for a Task Force to be set up by the WA Government to collect information and threaten legislation.

Another point of interest is the fact that several cases appear to have occurred following "safe dives". Readers may like to check the dive profiles declared in cases 1, 2, 4, 9, 17, 18, and 20 against the Swiss Tables or any other tables. It is a matter for investigation as to whether the problem lies in the inaccuracy of the divers in measuring dive depths and duration, their previous diving history, their physiological oddity compared with the Tables, or the Tables themselves. Diver error appears the most likely factor, and it is noteworthy that the majority of cases followed repeat dives. It is possible to calculate the residual gas BUT it is often forgotten that the diver's physiology has been altered by the first dive so presents a different substrate for the second and subsequent dive changes. In several cases the presence of previous pathology may have been significant.

It is regrettable that divers have not accepted the knowledge that in-water air recompression is a poor option although it may appear to produce cure, and the misuse of oxygen treatment in case 19 must be deplored. There appears to be a belief that recompression CURES decompression sickness. This is not necessarily so. Such treatment seeks to halt and reverse the sequence of damaging changes which have caused the presenting symptoms, but such symptoms indicate that damage has already occurred. In particular it is now believed that resolution of symptoms of Spinal Cord Bends does not indicate the complete resolution of the damage to the spinal tracts. Such damage is permanent.

The single case of CAGE in this series is another warning that the ascent phase of the dive is critically important. There is now an increasing awareness that this tragic misadventure DOES occur with apparently normal ascents.

The answer to this "Bends" problem will only be found by examination of case histories which are as full and accurate as possible. This requires the co-operation of the divers as well as of those whose task it is to treat them. Better understanding by divers of the factors influencing the development of decompression sickness, the limitations of The Tables, the importance of early treatment, and the limitations of treatment are all factors requiring attention.

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THE DIVING CHAMBER AT BROOME AUSTRALIA'S FIRST AND AUSTRALIA'S OLDEST ?

John Hayman

Diving for pearls and pearl oyster shell off Australia's north-west coast has a long history, which stretches back to the time of first European settlement of Western Australia's inland regions. Dampier visited the coast in September 1700 and recorded the