ISOBARIC COUNTER DIFFUSION
GIT may spout - but has he ever done a relevant dive?

Isobaric Counter Diffusion (ICD) seems very fashionable on the net at the moment. With OC and CCR Divers getting deeper for longer than ever before, accidents are happening. *Old school* experts need to shrink back into the caves they spawned from…their archaic advice is worthless.

A sadly 'well known' internet clown has even suggested that ICD doesn't exist because he has never had it! Luckily for him - his dive-plans were never quite deep enough and his buoyancy control managed by the cave ceiling. Deep seawater is as far removed from his diving as common sense from his famous ramblings :-)

If you dive deep in the sea…read on

With formal decompression ceilings getting in the 100 metre range, traditional gas switching methods and funky dive software could leave you less than chuffed!

ICD…occurs every time you switch from a light to heavy gas e.g. gas switch from Trimix to Nitrox. Gas switches from Trimix to Nitrox or even Heavy Trimix to Lighter Trimix typically cause a jump in END (equivalent narcotic depth) also. People do these switches all the time without getting (noticeably) injured. However, when certain conditions arise e.g. the gas switch occurs at a decompression ceiling AND the jump in END is sufficiently large, then horrendous injuries can and have occurred.

The severity of the injuries will reflect the current tissue controlling the ascent ceiling for example:
Deep gas switches generally impact fast tissues, particularly the vestibular apparatus. IEDCS (Inner Ear Decompression Sickness) examples have been recorded numerous times at deep stop gas switches where the new mix contained insufficient Helium and a resulting in a jump in END. IEDCS is the most well known symptom with its debilitating extreme vertigo and vomiting. However, any jump in END at or near an ascent ceiling may cause DCS somewhere.

An illuminating IEDCS paper is circulating on the NET by Doctors Doolette and Mitchell. The text suggests the physiological processes behind IEDCS and the impact of counter diffusing gases on IEDCS. The paper makes loose recommendations as to gas switching protocol. Divers embarking on aggressive technical dives should obtain a copy or get a large team of support divers to hold them while they vomit disorientated on the up-line.

The DecoChek program from Steve Burton and Mark Ellyatt makes specific recommendations based on actual dive plans.

Jumps in END can occur during Air Breaks…Back Switching …Gas switches. If the END changes dramatically at or near a decompression ceiling…BEWARE. Shallow gas switches (shallower than 21 metres) can cause similar consequences to slower controlling tissues. Slow tissues are less sensitive to jump in END - they bubble - but you don't often notice it.

Several divers have made panicked gas switches after a rapid ascent. Rapid Ascents will bring decompression ceilings much deeper and even send them below the current stop depth.

Bubble Model decompressions used during Extreme Decompressions (80metres for 30minutes etc) will cause ceilings to stay very close to diver. Contrary to their original postulates - ascent ceilings will not disappear however many deep stops you do!

Experience has shown that doing too many Deep stops will not speed up shallow decompressions. Older Bubble Model use will put divers in very vulnerable situations as depth and time increases.

On larger dives…END's should remain constant or be relaxed very slowly. Steve Burton suggests, as a rule of thumb, a maximum 5% drop in Helium for every 1% increase in nitrogen (at or near a ceiling), especially if ascents speeds may be questionable. To know for sure what the biggest drop in Helium is permissible, simply run the dive-plan through DecoChek, still the only real-time and complete deco plan analysis program.

Below are two screen grabs from DecoChek highlighting ICD warnings. The dive profile is effectively 122 metres for 7 minutes. Image on left shows ICD warnings triggered by OC bail-out switches from CCR containing insufficient Helium and a subsequent jump in END at the ceiling. The image on the right has had Helium optimised in the breathing mixtures to minimise Narcotic Jumps. DecoChek comes in OC and/or CCR formats and will optimise the dive plan before you dive it. In the examples below you will see that the closer the stops come to the 'ceiling' the less END latitude is available.

Examples of BAD 'bailout' gas switches as predicted by the DecoCHEK program

Run-time	Depth(m)	Ceiling(m)	Ascent Lim(m)	DCS-RISK	CCR	CCR P02	Gas O2	Gas He
0	0	0.00	0.00		n		21	-
2	15	-4.86	19.86		y	0.70	8	60
3	30	1.15	28.85		y	1.20	8	60
4	60	18.14	41.86		y	1.25	8	60
5	90	41.21	48.79		y	1.25	8	60
7	122	82.97	39.03		y	1.25	8	60
9	122	94.81	27.19		y	1.25	8	60
11	122	98.17	23.83		y	1.25	8	60
13	122	99.12	22.88		y	1.25	8	60
15	122	99.39	22.61		y	1.25	8	60
16	112	93.77	18.23	ICD-RISK	n	1.25	12	40
17	102	87.10	14.90		y	1.25	8	60
18	92	78.87	13.13		y	1.25	8	60
20	82	62.75	19.25	ICD-RISK	n	1.25	17	30
21	72	58.41	13.59		y	1.25	8	60
23	62	54.04	7.96		y	1.25	8	60
25	52	48.13	3.87	ICD-RISK	n	1.25	25	20
29	42	38.15	3.85		y	1.25	8	60
34	32	28.95	3.05		y	1.25	8	60
45	21	17.22	3.78	ICD-RISK	n	1.30	50	-
50	18	14.33	3.67		y	1.30	8	60
59	15	10.92	4.08		y	1.30	8	60
65	12	9.09	2.91		y	1.30	8	60
75	9	6.52	2.48		y	1.30	8	60
85	6	4.50	1.50		y	1.30	8	60
105	4.5	2.07	2.43		y	1.30	8	60
130	3	-0.39	3.39		y	1.30	8	60
132	0	-0.61	0.61		y	1.30	8	60

And GOOD gas switches - ICD warnings removed from adjacent plan by optimising Helium

Run-time	Depth(m)	Ceiling(m)	Ascent Lim(m)	DCS-RISK	CCR	CCR PO2	Gas O2	Gas He
0	0	0.00	0.00		n		21	-
2	15	-4.86	19.86		y	0.70	8	60
3	30	1.15	28.85		y	1.20	8	60
4	60	18.14	41.86		y	1.25	8	60
5	90	41.21	48.79		y	1.25	8	60
7	122	82.97	39.03		y	1.25	8	60
9	122	94.81	27.19		y	1.25	8	60
11	122	98.17	23.83		y	1.25	8	60
13	122	99.12	22.88		y	1.25	8	60
15	122	99.39	22.61		y	1.25	8	60
16	112	93.77	18.23		n	1.25	12	43
17	102	87.10	14.90		y	1.25	8	60
18	92	78.87	13.13		y	1.25	8	60
20	82	62.75	19.25		n	1.25	17	33
21	72	58.41	13.59		y	1.25	8	60
23	62	54.04	7.96		y	1.25	8	60
25	52	48.13	3.87		n	1.25	25	37
29	42	38.15	3.85		y	1.25	8	60
34	32	28.95	3.05		y	1.25	8	60
45	21	17.22	3.78		n	1.30	50	10
50	18	14.33	3.67		y	1.30	8	60
59	15	10.92	4.08		y	1.30	8	60
65	12	9.09	2.91		y	1.30	8	60
75	9	6.52	2.48		y	1.30	8	60
85	6	4.50	1.50		y	1.30	8	60
105	4.5	2.07	2.43		y	1.30	8	60
130	3	-0.39	3.39		y	1.30	8	60
132	0	-0.61	0.61		y	1.30	8	60

Further examples on ideal OC Gas Switch technique will follow when I get back from a trip

Mark Ellyatt

copyright Mark Ellyatt