Evolution and offshore performances of the Comex Treatment Tables.

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In commercial diving operations, the employer has the responsibility of implementing contingency procedures for any hazard identified at work. For this reason, diving companies have supplied equipment, trained their personnel and edited recompression procedures for the on-site treatment of symptoms of decompression sickness (DCS). The objective of this presentation is to evaluate the offshore performances of the Comex treatment procedures as they have been used on Comex worksites since 1975.

Historical development of the Comex treatment procedures

Comex treatment procedures for DCS were initially designed by Dr. X. Fructus. After unsatisfactory attempts to use the US Navy and French Navy treatment procedures, Dr. Fructus finally edited his own recompression tables which were included in the Comex diving manual in 1974 (1). For surface supplied operations, this medical book included a series of treatment tables ranging from 12 to 30 m:

- the "Cx12 table", with two hours oxygen breathing at 12m, the starting point of all treatments, but also the treatment of pain only symptoms,
- the "Cx18C table" with 40 minutes oxygen breathing and the "Cx18L table" with 60 minutes oxygen breathing at 18 m, designed as a fall back for the Cx12,
- the "Cx30 table" which, in its latest version, include 60 minutes of a 50% oxygen gas mixture breathing at 30m, the ultimate table for the recompression of severe DCS cases.

The Cx30 was derived from a 30 m recompression procedure initially designed by Prof. Barthélémy at the GERS (early French Navy Diving Department). Surprisingly, in the first edition of the Comex medical book, the text associated with the Cx30 only specified the oxygen percentage of the breathing mix without specifying the nature of the mixture. Dr. Fructus explained to me that it was for operational flexibility (people could use what ever mixture they had available on board) but admitted that at the time he already suspected that 50/50 heliox was particularly effective in the treatment of air DCS. As a consequence, the Cx30 table was used for equally with heliox and nitrox as a treatment gas mixture at 30 m.

In the 1983 revision of Comex medical book, only nitrox 50/50 was indicated as a treatment gas for air diving DCS after the publication of the work on isobaric counter diffusion.

In the 1986 revision of the Comex medical book (2), Dr. Fructus and Dr. Philip James, who had joined the company in 1984 as North Sea Medical Advisor, re-introduced heliox 50/50 as the specific treatment mixture to be used along the Cx30, for air or mixed gas diving DCS (3,4).

Finally, in the 1992 revision, after consultation with the operational personnel and analysis of the Comex database (5), Dr. Philip James simplified the treatment procedures by withdrawing the Cx18's. The assumption was that DCS accidents will be considered either as simple or serious cases and that only two treatment procedures will be proposed to the operational personnel (either a Cx12 or a Cx30).

Method

The Comex data base, which includes records of accident reports from Comex operations since 1975, was scanned to retrieve the information related to the treatment of DCS after air surface diving operations. The analysis of the reports permitted to sort cases where:

- a single treatment was used,
- a first treatment was used which led to either incomplete recovery or worsening of the symptoms and which required another treatment.

These two different sequences were used as the simple criteria for the evaluation of the treatment table performances. It was assumed that on the one hand, if operational personnel are able to select a given table and if the table effectively treats the symptoms, this table is a successful table. On the other hand, if a table fails on site to treat the symptoms and further recompression is used, the table initially selected is unsuccessful.

This method of evaluating treatment performances is obviously very crude because it does not allow to take into account the possible delay in symptoms occurrence or reporting, or in the decision of recompression. It also ignores the severity of the symptoms. However, it was found useful from an operational point of view, because this rate of success can be considered as a safety index if not a medical index.

Results

The results observed with offshore treatment of Comex DCS following air surface operations are displayed in tables No 1 to No 6. All the cases reported correspond to DCS as barotrauma and embolim are very rare in commercial diving and have been excluded.

The column "Treatment" indicates the combination of recompression tables used to treat the cases. The column "Cases" indicates how many times such a combination was used. The last column "percentage" indicates the relative percentage of these cases to the overall number of uses of a specific treatment table. For a single use of a recompression table, this percentage is regarded as the percentage of success or "offshore performance" and use as a safety ratio.

Table No 1: Performances of the Comex Cx12 table when used as a first choice for the treatment of DCI in an offshore situation.

Treatment	Number of cases	Percentage
Cx12	371	91.1 %
Cx12 + Cx12	12	2.9 %
Cx12 + Cx18C	13	2.9 %
Cx12 + Cx18C + Cx18L	1	0.2%
Cx12 + Cx18L	1	0.2%
Cx12 + Cx18	5	1.2 %
Cx12 + Cx18 + Cx30	2	0.5 %
Cx12 + Cx30	2	0.5 %
Total	407	

Table No 2: Performances of the Comex Cx18C table when used as a first choice for the treatment of DCI in an offshore situation.

Treatment	Number of cases	Percentage
Cx18C	95	65.5 %
Cx18C + Cx12	1	0.6 %
Cx18C + Cx18C	8	5.5 %
Cx18C + Cx18L	38	126.2 %
Cx18C + Cx18L + Cx30	1	0.6 %
Cx18C + Cx30	2	1.3 %
Total	145	

Table No 3: Performances of the Comex Cx18L table when used as a first choice for the treatment of DCI in an offshore situation.

Treatment	Number of cases	Percentage
Cx18L	40	80.0 %
Cx18L + Cx18L	6	12.0 %
Cx18L + Cx30	4	8.0 %
Total	50	

Table No 4: Performances of the Comex Cx30 table when used for the treatment of DCI in an offshore situation. The Cx30 table may have been selected either as a first choice or used as the ultimate treatment after the failure of previous tables. Cases include both nitrox and heliox 50/50 breathing.

Treatment	Number of cases	Percentage
Cx30 or other table + Cx 30	41	91.1 %
Cx30 + other table	4	8.9 %
Total	45	

Table No 5: Performances of the Comex Cx30 table with nitrox breathing when used as a first choice for the treatment of DCI in an offshore situation.

Treatment	Number of cases	Percentage
Cx30 (nitrox 50/50)	21	84.0 %
Cx30 (nitrox 50/50) + Other table	4	16.0 %
Total	25	

Table No 6: Performances of the Comex Cx30 table with heliox breathing when used as a first choice for the treatment of DCI in an offshore situation.

Treatment	Number of cases	Percentage
Cx30 (heliox 50/50)	11	100 %
Cx30 (heliox 50/50) + Other table	0	0 %
Total	11	

Discussion

A large number of Cx12's have been recorded on Comex sites. The overall performance with 91% of initially successfully treated cases demonstrates that this simple two hour table seems to be well adapted for the treatment of "pain only" DCS cases (table No 1).

The results related to the Cx18's are more difficult to analyse. It is obvious that the Cx18C was a too short treatment because its performance is only 65% as on initial use. In fact, this table was dropped in the 1986 revision of the Comex Medical Book and only Cx18L retained. The Cx18L, which is similar to the US Navy table 6, yields better results as its observed performances are 80 % success as an initial treatment (Tables No 2 and 3).

The cases related to the use of the Cx30 are less numerous because, fortunately, serious decompression sickness is today rare in commercial diving. Table No 4 indicates clearly that what ever the nature of the mixture breathed, the Cx30 is an efficient treatment because, either as an initial treatment, or after the patient has been exposed to all sort of treatments, the final percentage of success is 91%. Unfortunately, table No 5 and 6 do not permit to differentiate statistically between the breathing of nitrox or heliox at bottom on BIBS. It is simply noted that no case of recurrence or worsening of symptoms has been observed with heliox breathing after an air diving DCS over 11 uses of the Cx30 table (although four case of worsening of symptoms were recorded with nitrox breathing). These results are comparable with the experience collected in Israel with the use of the Cx30 and heliox (6).

Conclusion

The historical development of the Comex treatment tables has been supported by close feedback from operations. The objectives was to seek efficiency by simplification of procedures. For surface diving operations, the proper design of recompression procedures (only two types of DCS are recognised) and the use of heliox as the treatment gas mixture have permitted to reduce the treatment tables to the Cx12 for simple cases and the Cx30 for serious ones. Information stored in the Comex data base indicate that:

- the Cx12 and Cx30 tables are simple and are well used by the operational personnel.
- the Cx12 and Cx30 tables are efficient treatment tables for air diving DCS cases (rate of success of 91%). They can cope alone with DCS cases encountered in commercial air diving operations.
- the use of heliox 50/50 as a treatment gas is a safe an efficient method of treating air diving DCS.

Unfortunately, no definitive conclusion can be drawn on the relative performance of nitrox and heliox as a breathing mixture for the treatment of air diving DCS. The only thing that can be said is that no case of recurrence or worsening of symptoms has been observed with heliox breathing after an air diving DCS.

References

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