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EXAMINATION OF BLOOD AND URINE FROM ESKIMO KILLED BOWHEAD WHALES (BALAENA MYSTICETUS).

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Summary

Blood and urine specimens, as available, were examined from 8 Eskimo harvested bowhead whales. Due to the delay between time of killing and butchering the blood results were of little value. Of more value was the examination of urine which might be useful in assessing the health of the animals before their death.

Introduction

The Bowhead whale *(Balaena mysticetus)* is a rare and endangered species and it is one of the largest extant baleen whales. Their numbers are few, and there is a moratorium on hunting them; however, an exception was made to allow the Alaskan Eskimos to kill a predetermined number to maintain and practice their cultural-ancestral heritage. Adult whales are killed during the spring and fall migrations to and from the Arctic ocean and the Bering Sea. Concern of this yearly reduction in their numbers has resulted in considerable effort expended to determine their population size, biology etc. so that a sensible management program could be instituted to protect them and perhaps encourage their multiplication. The trust of this study was to determine if specimens collected at the time whales were butchered were of any value in assessing the presence of disease or to establish a base for future studies, as for example, the effect of an oil spill or noise harrassment during oil exploration and drilling. The results of the examination of blood and urine from Eskimo-killed bowhead whales constitute this report.

Materials and Methods

Bowhead whales were harpooned by Eskimos as the opportunity arose during the annual whale migration. Harpooned whales were tagged and monitored until they were dead, then towed to fast ice or land to be butchered. Time between initial harpooning and butchering with subsequent collection of specimens varied between 2-3 hours to as much as 14 hours or longer. Temperature within the body during butchering was either at body temperature or above as the heat dissipating mechanisms were no longer functioning. The animals also bled internally more or less depending on where the harpoon struck. The effect of this trauma and heat affected our results noticeably in some respects.

Whole blood was collected by catchment from these killed bowhead whales. Heparin was used as the anticoagulant for cytological examination;however, technical help was not available to do complete hemograms. Some blood was allowed to clot and the serum was separated as soon as possible and frozen until analyzed.

Sera were analyzed for the common chemical constituents with GEMINI[1] and GEMSAEC[2] autoanalyzers. Serum proteins were separated by the cellulose acetate procedure using the Gelman[3] apparatus. Sodium, K, C1, total CO_2 and anion gap were determined by the Nova Analyzer[4]. Osmolality was obtained by freezing point depression (Osmette A)[5]. Blood smears were stained with Wright-Giemsa stain and 100 white blood cells were enumerated.
Urine was obtained by cystocentesis and examined quantitatively by routine procedures and qualitatively (MEDWAY, 1980a) with commercially available dip sticks[6].
Urinary sediment from one whale specimen containing spermatozoa was examined by scanning electron microscopy.
Not all specimens were obtained from every whale; however, varied specimens were obtained from eight whales.

Results

Some biological data and permanent identification of the whales sampled are presented in Table 1.
Some results of the differentiation and enumeration of white blood cells are presented in Table 2. It should be noted that eosinophils were found in blood from only one whale (Nr. 1) and that there is great variation in other cells when comparing the counts from the four whales.
Table 3 shows the results of the electrolyte analyses. The degree of haemolysis should be noted when comparing results between whales.
In Table 4 the results of other blood constituents are presented. Again, the variation of some of the results should be noted.
Results of the serum electrophoresis are shown in Table 5 and results of urinalysis are presented in Tables 6, 7, and 8. The quantitative results represent analyses of discrete samples as opposed to aliquots of a 24-hour specimen.

Table 1. BIOLOGICAL DATA ON THE WALES SAMPLED.

Whale Nr.	NMFS Ident Nr.	Sex	Lenght (m)
1	80B1	F	10.9
2	80B2	M	10.8
3	80B7	F	10.0
4*	80B8	M	8.7
5*	79B1	M	8.7
6	79B2	M	10.2
7	79KK1	M	12.7
8	78B2	M	8.4

*Ingutuk. The Ingutuk is either a subspecies or a variant of the main species. It is smaller, bones are denser and the eskimos believe it is a different whale.

1. Gemini Autoanalyzer. Electro-Nucleonics, Inc., Fairfield, NJ
2. Gemsaec Autoanalyzer. Electro-Nucleonics, Inc., Fairfield, NJ
3. Gelman Sciences. Ann Arbor, MI
4. Nova 4 - 4. Nova Biomedical, Newton, MA
5. Osmette A. Precision Systems, Inc., Sudbury, MA
6. Multistix. Ames Company, Elkhart, IN

TABLE 2. DIFFERENTIAL LEUCOCYTE COUNTS OF THE BOWHEAD WHALE

Whale	Segs %	Lymphs %	Mono %	Eo %	Baso %	Remarks
1	76	22	1	1	< 1	
2	36	64	<1	< 1	< 1	Leucopenic
3	20	79	1	< 1	< 1	3 nucleated erythrocytes
4*	47	53	<1	< 1	< 1	

*Ingutuk

TABLE 3. SOME ELECTROLYTES OF BOWHEAD WHALE SERA

Whale	Degree of Hemo.	Na meq/l	K meq/l	Cl meq/l	PO_4 mg/dl	Ca mg/dl	Mg mg/dl	Total CO_2 meq/l	Osmol MO/ kgH_2O	Anion Gap meq/l
1	1+	170	6.4	122	8	10.3	2.6	27	346	21
2	4+	170	8.3	117	8.3	12.4	4.2	11	348	42
3	1+	162	8.6	119	10.8	11.6	3.2	29	333	14
4*	2+	159	6.1	112	6.7	11.7	2.7	26	324	21
5*	4+	148	---	104	---	---	---	--	---	--
6	4+	172	13.7	149	12.6	---	---	--	---	--

*Ingutuk

TABLE 4. SOME BLOOD CONSTITUENTS OF BOWHEAD WHALE SERA

Whale	Gluc. mg/dl	Creat. mg/dl	BUN mg/dl	SGOT IU	SAP IU	GPT IU	Bil mg/dl	TP g/dl	Alb. g/dl	Glob. g/dl	A/G
1	83	4.8	54	53	313	12	0.4	5.8	3.8	2.0	1.9
2	87	5.0	63	121	269	30	2.0	6.1	3.6	2.5	1.4
3	188	4.5	66	56	444	32	0.7	6.2	4.0	2.2	1.8
4*	148	4.8	66	48	215	23	0.7	6.8	3.9	2.9	1.4
5*	232	8.6	60	--	113	--	--	7.2	4.2	3.0	1.4
6	93	3.3	49	139	75	43	0.4	2.9	1.2	1.7	0.7

*Ingutuk

TABLE 5. SERUM PROTEIN ELECTROPHORESIS OF THE BOWHEAD WHALE

Whale	TP g/dl	Alb g/dl	α g/dl	β g/dl	γ g/dl	A/G
1	5.9	3.8	0.5	O.8	1.0	1.67
2	5.6	3.0	0.6	1.4	0.7	1.16
3	6.5	4.0	0.8	1.1	0.6	1.64
4*	6.9	3.9	0.6	0.9	1.5	1.28

*Ingutuk

TABLE 6. QUALITATIVE EXAMINATION OF URINE SPECIMENS FROM FOUR BOWHEAD WHALES

Whale	Color	Trans.	pH	Specific Gravity	Protein	Ketones	Glucose	Red.** Subs.	Bile	Hemo-globin
3	amber	clear	6.0	1.035	1+	neg.	neg.	neg.	neg.	1+
5*	dark straw	clear	5	1.032	trace	neg.	trace	trace	neg.	4+
7	pale yellow	very cloudy	5.5	1.028	2+	neg.	neg.	neg.	neg.	4+
8	dark amber	clear	5.5	1.032	trace	neg.	neg.	neg.	neg.	neg.

*Ingutuk
**Red. Subs. - Reducing Substances

TABLE 7. QUANTITATIVE EXAMINATION OF URINE SPECIMENS FROM FOUR BOWHEAD WHALES

Whale	Na meq/l	K meq/l	C1 meq/l	Urea N mg/dl	Creatinine mg/dl	Osmolality mO/kgH_2O
3	250	87.3	260	1600	540	1148
5**	310	11.9	383	900	400	1215
7	220	48	195	560	124	1186
8	183	14.4	n.d.*	3000	400	1440

* n.d. not determined
** Ingutuk

TABLE 8. MICROSCOPIC EXAMINATION OF URINARY SEDIMENT FROM FOUR BOWHEAD WHALES

Whale	Red Blood Cells	White Blood Cells	Epithelial Cells	Casts	Miscellaneous
3	TNTC***	0-2/HPF	3-5/HPF	neg.	Moderate unidentified crystals. Very light bacteria
5a	neg.	neg.	few	few (C.G.)*	Much amorphous material, few sheets of sloughed epithelial cells
7	0-2/HPF**	1-3/HPF	1-3/HPF	0-1/HPF (C.G.)	Heavy sperm, much amorphous debris
8	rare	rare	myriads	neg.	Many epithelial cells from entire urinary tract, many unidentified spheroid crystals

a. Ingutuk
* C. G. = coarse granular
**HPF - High power Field
*** TNTC - too numerous to count

Discussion

Analysis of the relative distribution of white blood cells is practically impossible without total leucocyte counts which as stated above, could not be performed. However, certain observations can be made. The haematological stress response in most species is characterized by a neutrophilia, lymphopenia and eosinopenia (SCHALM *et al,* 1975). Only one eosinophil was encountered during the course of the enumeration; occasional cells were presented in the other smears, but they were very rare. This may be an indication of a response to stress. The duration of time between harpooning and actual collection of blood varied between a couple of hours to 14 hours or more. It is not known how quickly the large whales would respond haematologically to stress. Small odontocete whales do elicit a stress response albeit not as marked as in some terrestrial species (SCHALM, 1975; MEDWAY *et al,* 1970; MEDWAY and GERACI, 1964). Very few monocytes were identified in any of the smears from the four bowhead whales. The scarcity of white blood cells is probably due to degenerative loss caused by the high body temperature between death and collection of specimens. However, at room temperature, at least in blood from *Tursiops truncatus,* the white cells will last and be recognizable for 5 days even though ratios between cell types change (GERACI and MEDWAY, 1974).
It is interesting that an apparent reversal of the neutrophil-lymphocyte ratios was seen in 3 of the whales and whale Nr. 1 is abnormal. Perhaps the reverse is true for bowhead whales. This may be an indication of an infectious process or even different life spans of the white cell species at body temperature (GERACI and MEDWAY, 1974). Resolution of this observation will have to wait the examination of fresh specimens. Photomicographs of the various species of white cells and red cells have been reported (MEDWAY, 1980b). The red blood cells are quite

large which agrees with the reports on blood from other cetaceans (RIDGWAY, 1972; HAWKEY, 1975). One of the whales seemed to be leucopenic (Nr. 2), based on the number of white cells seen in the smear.

The nucleated red blood cells found in the smear from one whale (Nr. 3) may be an indication of anaemia or the result of stress (catecholamine release).
Likewise, the electrolytes are difficult to interpret in light of the harvesting technique. The degree of haemolysis on a scale from 1-4 indicates that the serum from 3 whales (Nr. 2, 5, 6) was approaching port wine in color. The degree of haemolysis of red cells and the stress of slaughter had a profound effect on the sodium and potassium results. These results are somewhat higher than those reported for the smaller odontocete whales (MEDWAY and GERACI, 1965; RIDGWAY *et al,* 1970; MALVIN and RAYNER, 1968; MEDWAY and MULDOVAN 1966).

The anion gaps with the eception of the results for one whale (Nr. 3) are reasonable. An increase in anion gap in most instances is a result of organic acidosis usually due to increased lactic acid (GABOW *et al,* 1980). This is probably the case in one whale (Nr. 2), which perhaps struggled more fiercely than the others as it died. Total carbon dioxide, again with the exception of one whale (Nr. 2), was similar to that of smaller odontocete whales.

The glucose values in Table 3 are erratic, however, not markedly and the creatinines all appear to be elevated. These values for creatinine in domestic animals would indicate a moderate degree of kidney disease. In this instance the combination of dehydration (decreased blood volume) due to slaughter, resulting in decreased blood flow to the kidneys, undoubtedly affected the blood concentration. Most of the other results in this table are close to those one would expect. The total protein in one whale (Nr. 6) is obviously very low and is, no doubt, due to the bleeding and restoration of blood volume due to the redistribution of body water as a result of the harpooning (MEDWAY, 1980a). Only two animals (Nr. 2, 6) had elevations of SGOT which would indicate muscle damage. Creatine phosphokinase, another muscle enzyme, could not be determined due to the haemolysis of the specimens.

The serum protein electrophoretic separations are comparable in many respects to those of the smaller odontocete whales (MEDWAY and GERACI, 1965; RIDGWAY *et al,* 1970; MEDWAY and MULDOVAN, 1966). They are also comparable to those from a California Gray whale.[7]) The A/G ratios on the same whale are somewhat different between Tables 4 and 5 because those in Table 4 were determined chemically and those in Table 5 electrophoretically.

Results of the urinalyses for bowhead whales are perhaps closer to the norm than any of the other chemical determinations, since the urine was probably in the bladder at the time of harpooning and probably changed very little in composition. Specific gravity, pH, color, etc. were normal. Haemoglobin content on a scale from 1-4 based on commercially available dip sticks that do not differentiate between haemoglobin, intact red cells or myoglobin was quite variable; however, haemoglobin was not present in significant amounts to grossly discolor the urine. No attempt was made to determine the presence of myoglobin which may have been present due to exertional myopathy. The urine was free of any of the commonly measured components that indicate kidney pathology. The presence of a 2+ protein in urine from whale

7. D.W. Kenney. Personal communication and unpublished data, 1980

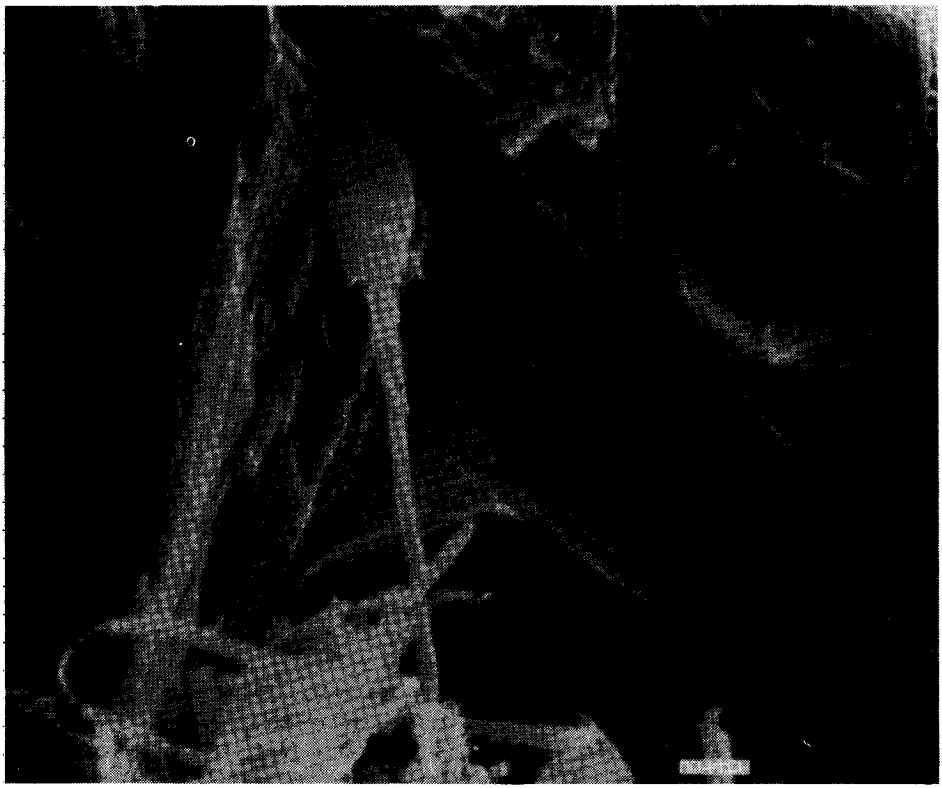

Figure 1. Scanning electron photomicrograph of a spermatozoan in the sediment of bowhead whale urine. x12000.

nr. 7 could be indicative of sexual secretions since many spermatozoa were also present.
The results of the quantitative analysis of the urine indicate reasonably normal kidney concentrating ability. With the exception of the large differences of potassium in the urines of the whales, the results are comparable to those previously reported (MEDWAY, 1980) and are not abnormal.

There were interesting observations on the urinary sediment from four bowhead whales. Bowhead whale Nr. 8 had myriads of epithelial cells probably due to sloughing of the urinary tract mucosa due to post mortem change. Sediment from whale Nr. 5 was unremarkable.

Another interesting finding was the presence of many spermatozoa in the sediment from whale Nr. 7. Though the presence of sperm in the urinary sediment of mature males of the domestic species is a common finding, this is the first observation in the bowhead whale. This ascertained the sexual maturity of the individual (Fig. 1). Many crystals were present, they were believed to be primarily triple phosphate and perhaps some urates and oxalates. Their presence is insignificant.

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