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SUDDEN UNEXPECTED DEATH OF A PERFORMING DOLPHIN

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ABSTRACT

A performing dolphin was found dead in his swimming pool. Autopsy examination results are presented and a discussion comparing this death with human drowning deaths is presented.

INTRODUCTION

Martin Henry, an 11-½ year old, 284 pound, 89 inches long, gray-white male dolphin (species *Tursiops truncatus*) was found floating dead in his swimming pool at approximately 1:15 p.m. He had last been seen alive at 12:30 p.m. His attendants had observed that he had been off his feed and had become dehydrated in the preceeding ten days. During this interval he had lost 10-15 pounds. He had last performed seven days prior to his death in conjunction with another dolphin. One of the authors (JSB) had been in the audience at that performance and noted that the dolphin performed well. That was his last performance, due to his worsening condition. He also had developed marked halitosis.

Martin Henry was captured in the Gulf of Mexico in 1972 and had been in captivity and performing from 1972 to 1976. He had had the same diet since capture, provided by a firm in Glauchester, Massachusetts. The pool water was carefully controlled, with salinity, composition, pH and temperature monitored.

METHODS

Autopsy examination included a systematic examination of the external body surface and its orifices, and a dissection and gross visual examination of the viscerae. Histologic sections of viscerae stained with hematoxylin and eosin and gram's strain were examined. Cultures of the external surface, subcutaneous tissue, lungs, central body cavities, and blood were performed by aerobic and anerobic technique to detect microbiologic organisms. Blood and urine were collected for analysis for drugs. Drug screen was performed utilizing a series of chromatographic techniques incorporating solvent to solvent extraction, thin layer chromatography, and gas chromatography. A *Hewlett Packard* model 5930A Mass Spectroscope was used to confirm any material found. Heavy metal testing for arsenic and lead were performed on a *Varian* Model 63 carbon rod atomizer Atomic Absorption Spectrophotometer and analysis for mercury was performed on a *Perkin Elmer* Model No. 303 atomic absorption spectrophotometer at the University of Tennessee Center for the Health Sciences Chemical pathology and Toxicology Laboratory in Memphis.

Blood was typed by utilizing a 2-5% saline suspension of 3x washed by patients red blood cells which was tested against anti A; Anti B; Bovine albumin; anti Rho(D); anti, A,B; and anti A Lechitin. It was immediately centrifuged and read macroscopically.

RESULTS OF POST MORTEM EXAMINATION

At autopsy, multiple superficial scars and abrasions were noted. There was excoriation of the skin surrounding the blowhole. Skin incisions revealed a subcutaneous abscess containing pale green fluid, which yielded *Edwardsiella tarde, Clostridium perfringens,* and *Enterococcus.*

The right lung weighed 2,050 grams and the left lung weighed 2,475 grams. The lungs were reddish gray, edematous and congested. Both lungs contained multiple abscesses which varied in diameter from one to six centimeters. (Fig.1a). These abscesses were yellow and some contained green-brown purulent material within central cavities. Blebs and bullae were present on the anterior surfaces of both lungs. Cultures of these lungs grew *Enterococcus, Edwardsiella tarde, Proteus mirabilis, Clostridium perfringens* and *beta Streptococcus.* Blood cultures grew *Enterococcus, Edwardsiella, beta Streptococcus* and anaerobic gram-positive rods which could not be identified. Death occurred as a result of bilateral pneumonia with abscess formation due to a mixed bacterial flora.

The internal anatomic arrangement of organs was comparable to that of the human. The teeth were conical and the tongue has sensory lateral papillae. There was a "Chiari net" malformation present in the left atrium. Bronchial arteries took origin from the aorta as single, rather than paired, vessels. Multiple fish bones and scales were found

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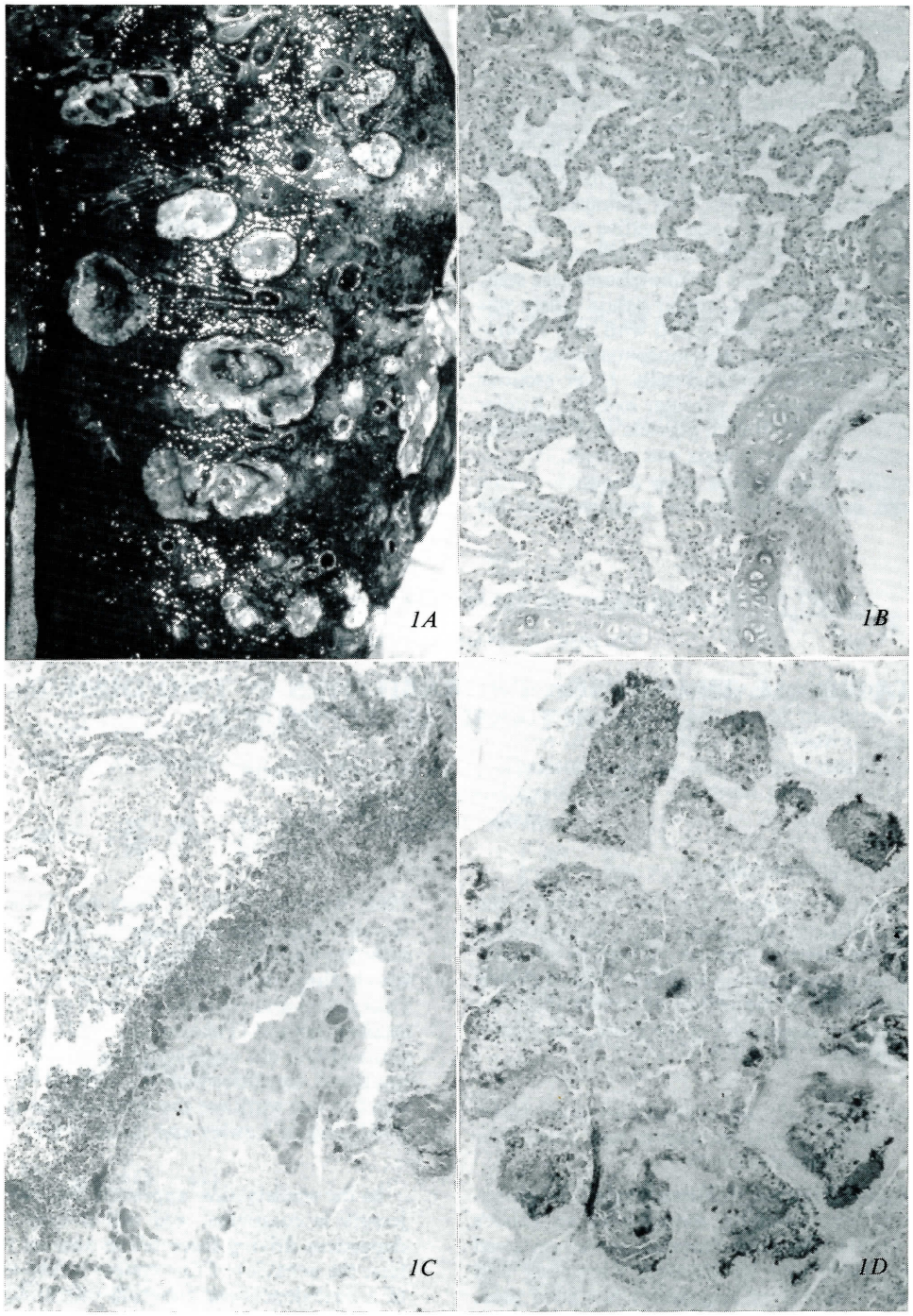

FIG. 1A—*Gross-Cross Section of lung with numerous absesses in a background of pneumonia.*

FIG. 1B—*Near normal lung with Pulmonary edema. Magnification (25 x objective, 12.5 x eyepiece) 312.5 x.*

FIG. 1C—*Lung with Pneumonia, and the margin of an abscess, showing a rim of inflammatory cells, necrosis, and bacterial colonies. Magnification (10 x objective, 12.5 x eyepiece) 12.5 x .*

FIG. 1D—*High magnification (40 x objective, 12.5 x eyepiece) 500 x of bacterial colonies composed of gram positive (dark) and gram negative (light) organisms.*

in the three stomachs, one of which contained a 1974 Lincoln-head penny. The liver was wrapped around the inferior vena cava. Cut sections of the kidneys revealed that they are composed of multiple separate nodules, each with individual cortices and medullae.

Light microscopic tissue examinations of lung showed bronchial cartilage extending to peripheral bronchi (Fig. 1b,c,d). Alveolar spaces were filled with a pale eosinophilic proteinaceous material and polymorphonuclear cells. Multiple abscesses were present, containing necrotic cellular debris, polymorphonuclear cells, and numerous large colonies of gram-positive and gram-negative bacilli and gram-positive cocci. Lymph node sections showed areas of abscess formation with numerous polymorphonuclear cells, basophilic bacterial colonies and cellular debris. There was dilatation of sinusoids which were filled with pale eosinophilic proteinaceous material, polymorphonuclear cells, lymphocytes and reticuloendothelial cells. Liver sections showed a fibrinous eosinophilic capsular exudate, Kupfer cells were filled with golden-brown pigment and intrasinusoidal extramedullary hematopoiesis was present.

Blood and urine drug screens were negative. Urine arsenic, lead and mercury levels were negative, and the blood typed as Group A2B, Rho(D) negative.

DISCUSSION

This case is not typical of most deaths associated with swimming pools which are referred to the Medical Examiner's office. Drowning is the fourth leading cause of accidental death in the United States. Approximately two-thirds of these drowning deaths are accidental, the remaining third are suicide, with rare instances of homicide. It is interesting to speculate whether death occurred with or without drowning, the decedent's compromised pulmonary function leaving him susceptible to (in this case) salt-water drowning. Whether or not drowning played a role in his death, it is the authors' opinion that this death is the result of a mixed bacterial pneumonia.

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ROTATIONAL TRANSITION PROBABILITIES IN TWO DIMENSIONS. II. SEMICLASSICAL APPROACH.

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ABSTRACT

Rotational transition probabilities are calculated for argon-nitrogen collisions by means of a semiclassical method in which the classical trajectory is used to calculate the force acting on a quantum-mechanically treated driven rotor. The dependences of the transition probabilities on initial energies, relative orientation of the rotor, and impact parameter are studied.

INTRODUCTION

The problem of calculating rotational transition probabilities is one of long standing, dating back to Zener's work in 1930. (1931). The older literature is well reviewed by Takayanagi (1963) and by Gordon, Klemperer and Steinfeld (1968). A variety of approaches has been used, including the adiabatic (Ben-Reuven, 1965) and sudden (Kramer and Bernstein, 1964) approximations, and the method of distorted waves. (Brout, 1954; Davison; 1962; Dalgarno and Henry, 1964; Dalgarno, Henry, and Roberts, 1966; Roberts, 1963). Arthurs and Dalgarno (1960) used Racah's formalism to couple the rigid rotor states with the colliding particle's orbital angular momentum states, with which they then considered several approximations, Takayanagi and Nishimura (1960) used the modified wave number method (Takayanagi, 1963) and Allison and Dalgarno (1967) did close-coupling calculations for the $0 \rightarrow 2$ rotational transitions of H_2 and D_2. Of particular relevance to our work are the semiclassical approaches of Raff (1967) and of Lawley and Ross. (1965)

In the semiclassical approach, the classical collision trajectory is computed, and this is used to obtain a time-dependent driving force which acts on the quantized system; the behavior of this system is then analyzed by means of a time-dependent quantum mechanical treatment. The approach has been used effectively for the calculation of vibrational transition probabilities. (Widom and Bauer, 1953; Rapp and Sharp, 1963, Zelechow, et al. 1968, Locker and Wilson, 1970; Locker and Endres, 1969).