Outcome of Injuries in Wild Birds

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Abstract

1167 birds presented to Healesville Sanctuary over a 26 month period. The injury or illness at arrival was recorded along with the outcome, released or not released. Statistical analysis was performed to determine if any relationship existed between injury and outcome. The release rate was found to be statistically reduced when birds had humerus fractures or infections compared to birds without these presentations. The release rate was found to be statistically increased when head traumas were suffered, compared to birds with other presentations. No statistical significance was found between wing injuries (other than humerus fractures) leg injuries, or pectoral girdle injuries and release.

Introduction

Approximately 1,000 sick and injured wild animals are brought to Healesville Sanctuary annually. Of these 56.5% are birds. The research presented here aims to identify whether or not the admitting injury or illness in birds affects outcome. Clinicians in veterinary practices frequently are faced with injured birds, and despite improved training at Universities, numerous papers on treatments, release and rehabilitation protocols being established for raptors and the occasional reference to radio-tracking of rehabilitated raptors, there is no direct data on injury type as a predictor of rehabilitative success. It is therefore hoped that the data contained in this paper may be useful as a guide to helping clinicians decide which cases of injured birds are worth pursuing, and which cases should be euthanised to alleviate suffering. This paper represents part of the research performed to fulfil the requirements of a Masters of Veterinary Science, University of Melbourne. The research was performed at Healesville Sanctuary.

Method

All 1167 avian admissions to Healesville Sanctuary, from March 2002 to April 2004 inclusive, were admitted as usual. In all, 103 species of bird were represented. In this study, along with the normal data collected, the bird's injury type was recorded. These injury types were broadly grouped into 6 categories for the purposes of statistical analysis. These groups were:

Humerus Fractures
Wing Injuries (excluding humerus fractures)
Pectoral Girdle Injuries
Leg Injuries
Head Injuries (excluding eye injuries alone)
Infection

Wing injuries (excluding humerus fractures), pectoral girdle injuries and leg injuries were further subdivided, but no statistical analysis was performed as sufficient numbers of subjects were not available.

Treatments employed were based on individual cases, but most were recognised, published methods.

The outcome of each of the patients was recorded as either released or not released.

A Fisher's Exact Test was then used to analyse whether any correlation between injury type and outcome existed.

The same tests were performed on 94 Crimson Rosellas, *Platycercus elegans,* and 128 Laughing Kookaburras, *Dacelo novaeguineae,* to determine if species variation existed.

Results and Discussion

Overall only 18% of birds were released. However, this figure includes those birds that were deemed not able to be rehabilitated and those that presented dead. 34.5% of birds were euthanised at presentation for a number of reasons: severe, untreatable injuries (multiple fractures, spinal fractures); a moribund state; feral species; difficulty in rehabilitation; infectious disease, and chronic injuries or illness being the main justifications. 13.5% arrived dead or died before treatment could be initiated. If these are removed from the outcomes then the release rate jumps to 34.6%. The non released birds then fell into 5 categories: 6.9% went into captivity, 16% went onto other shelters for further rehabilitation (release assumed, but not guaranteed), 2.7% had unknown outcomes, 18.2% were euthanised after treatment was initiated and 21.6% died after treatment was initiated.

These rates represent overall outcomes to birds, but there does appear to be species variation. Kookaburras have a much higher overall release rate of 44.5% and crimson rosellas have a release rate closer to all birds at 23.4%. Without the immediate euthanasias and dead on arrivals, the release rates jumped to 58% and 47.5% respectively.

Humerus fractures

Of all the disabling injuries to the wings of birds, humerus fractures were represented the most. 35.4% of wing injuries were humeral fractures, which occurred at least three times as often as any other wing injury. Humerus fractures required one of the highest rates of immediate euthanasia (80.5%). The reasons for immediate euthanasia fell into 4 categories in most cases: open fractures older than 24 hours, multiple injuries, comminuted fractures, and fractures involving joints. Of the birds where treatment was initiated (23) only 26% (6) were eventually released. Failure to be released was due to extensive internal trauma (undiagnosed at presentation) leading to eventual death (5), tracheitis after endotracheal tubing (2), further disease (2 corellas with psitticine beak and feather disease and one aspergillosis case), delayed diagnosis (2), and unsuccessful repair (4 of 5 went into captivity). Overall only 5.1% of all birds, 4.8% ofkookaburras and 7.7% of crimson rosellas were released following humeral fractures.

Humerus fractures were found to be statistically significant to outcome in birds overall. 20% of birds were released without humerus fractures compared to only 5.1% with humeral fractures. In birds, humerus fractures should be considered to have a poor prognosis.

In kookaburras, humerus fractures have a statistically significant relationship to release. Only 4.8% ofkookaburras with humerus fractures were released compared to 52.3% ofkookaburras with injuries other than humeral fractures. Humerus fractures in kookaburras cany a poor prognosis.

Interestingly, humerus fractures do not have a statistically significant effect on outcome in crimson rosellas. Only one bird was released (7.7%) after presenting with a humerus fracture. This low *n* value may account for the statistical insignificance. One study (Redig, 2000) assessing the surgical technique of external skeletal fixator and intramedullary pin tie-in (ESF-IM) on outcome found that 35% of humerus fractures (7/20) were released (compared to the 26% (6/23) where treatment was initiated found here). Where treatment was attempted 45% of the surgeries resulted in birds that could not fly adequately for release, compared to 33% performed at Healesville Sanctuary. The main reasons in Redig's study were failure to heal adequately, patagial contraction that limited wing extension and poor rotational alignment of the fracture resulting in angular deformity incompatible with flight. In Redig's study /mly 1 (5%) of birds died after surgery was attempted compared to 30% (7/23) in this study.

Another study by Howard (but reported by Redig, 2000) reports of 81 humeral fractures repaired with normograde IM pin and coaptation with polymethylmethacrylate and shuttle pins. In this study only 15% of the birds flew again.

From these results it could be assumed that humerus fractures always carry a guarded prognosis at best; that the surgical technique's applied at Healesville Sanctuary are giving comparable, if not better results than other published results; but that the assessment of which cases should be treated needs further analysis to avoid treating birds whose injuries are so severe that treatment will fail.

Other reasons humerus fractures present difficulties to the clinician include open fractures often failing to heal due to the "formation of large segmental sequestra resulting from non-viable, external bone at original accident becoming sequestrum when incorporated into the repair" (Redig, 1993). Punch (2001), also found that osteomyelitis, sequestrae formation and non-union contributed to unsuccessful humerus repair. All birds where non viable bone was found on arrival were euthanised at Healesville Sanctuary. Redig (2000), found that only 1/9 (11%) of open fractures flew again after treatment. 2/6 released birds in this study at Healesville Sanctuary had open fractures at presentation. Overall 47% of humerus fractures were open in this study. Martin (1993 a), found that avulsion of the ventral tubercle of the humerus was found commonly with luxation of the shoulder joint. No ventral tubercle avulsions and only one shoulder luxation was released in this study. 3/6 released birds did not undergo surgery as treatment. All three had non-displaced, proximal (high) fractures which Redig (1986), reports are "often sufficiently stabilised by the surrounding muscle mass so as not to require surgical intervention". These birds were rehabilitated with cage rest and gradual exercise increase alone.

The poor recovery rate of humerus fractures in wild birds was shown by Brandwood *et al* (1986) who found only 45 healed fractures, of 12,860 wild bird skeletons examined. Of these only 2 (4%) were to the humerus. One was a mallard duck which could recover away from predators on the water.

Of the six birds released after humerus fractures in this study, 1 kookaburra was radio-tracked. That kookaburra was found dead 2 days after release having drowned in a horse trough made of a disused bath tub. The signal was heard coming from the same spot the night of the release and hence it is assumed the kookaburra died the same day it was released. Whether the kookaburra died in some way due to the humerus fracture was not able to be determined.

Wing Injuries apart from humerus fractures

Wing injuries, apart from humerus fractures, do not have any statistical significance to outcome in birds as a whole, or kookaburras, or crimson rosellas. These injuries were considered together as no other single injury presented with enough frequency in the time allocated to allow statistical analysis.

A few points of interest did become apparent. Metacarpal fractures and shoulder and elbow dislocations warranted immediate euthanasia in greater than 80% of cases (similar to humerus fractures). Of 46 dislocations (shoulder, elbow and carpus) only 2 were released (4.3%) and one was an accident when a black-shouldered kite *(Elanns axillarus)* escaped from his enclosure overnight. Elbow dislocations made up the majority of dislocations seen (54%) and despite literature suggesting a success rate of 50% if treated early enough, Martin *et al,* (1993b), only 1/25 (4%) birds was treated during this study for this injury. This bird, a Tawny Frogmouth, was euthanised 5 days after arrival due to deterioration of his overall condition. 64% of birds with elbow dislocations were immediately euthanised as they had fractures of the humerus or ulna into the elbow joint.

Carpometacarpal fractures, like humeral fractures, had a poor release rate (10%) due to the frequent sequelae of vascular damage to the distal wing with such injuries. There is a single artery (the superficial ulnar artery) supplying the distal wing in birds and if this vessel is damaged, either due to the initial trauma or iatrogenically during surgery, avascular necrosis occurs distal to the point of injury (Bennett, 1997). Treatment was attempted in only 20% (4/20), and only 50% (2/4) of these were released (the last two saw one go into captivity, and the final bird was euthanised due to avascular necrosis of the distal wing).

Fractures of the radius or the ulna had a far better release rate, 26.7% and 26.3% respectively. Ulna fractures were the second most common wing injury seen (11.4%). The majority (52.6%) were still euthanised at arrival due, to the presence of multiple injuries -17/20 were euthanised for this and the other 3/20 were euthanised because the injuries were older than 4 days. Once treatment was elected the success rate was better (55% ulna fractures released and 50% radial fractures released) Brandwood *et al* (1986) found only 45 healed fractures, of 12,860 wild bird skeletons examined. The most frequently encountered fracture was to the radius, 15 or 33.3% of fractures. Only 3 (6.7% of fractures) ulna fractures were found, and these were all in Anatidae species that can recover on water. Only 1 of the healed fractures was found in the metacarpal bones. Brandwood *et al* emphasises that these findings represent the *healed* fractures and not the fracture incidence overall, since the methodology employed could not determine how many birds died from their injuries. The findings, when considered with the results from the research presented here, do suggest that the most common fracture to birds, fractures of the humerus, cany an extremely poor prognosis in the wild. Ulna fractures and metacarpal fractures fair similarly. However, radial fractures alone, which occur infrequently (fractures to the humerus, tibiotarsus, ulna, coracoid, femur, combined ulna/radius and the metacarpals occurred more commonly) appear to have a fair chance of healing without human intervention. Interestingly no combined ulna/radius fractures were found healed by Brandwood *et al.* The lifestyle of birds appears to affect the outcome in the wild. Research undertaken examining the incidence of healed fractures in wild populations of vultures and griffons (Houston reported by Roth *et al,* 2002) found a 20% incidence of healed ulna fractures. These birds are large scavengers that do not engage in high risk activity for food.

The combination of radius and ulna fractures did not have as favourable an outcome with only 7.1% being released. 67.9% were euthanised at arrival, usually due to the severity of the injury, but 21% were euthanised or died after treatment was initiated due to unsuccessful surgery or further complications.

Tears to the patagium frequently resulted from being caught in barbed wire fences. Of the 9 seen during this study, 3 were released. Two were kookaburras that were radio tracked and found to survive at least 44 and 52 days before tracking ceased. In the second kookaburra, after surgery, the leading edge of the patagium and the ligamentum propatagiale (Brown and Klemm, 1990) broke down, but the scar tissue formed a "pseudo" leading edge. Despite the reduced area of the patagium, this kookaburra flew normally and was tracked for 52 days after release. Her radio-transmitter was found off her after this time.

Pectoral Girdle Injuries

The pectoral girdle injury category included fractures to the clavicle (furcula), the scapula, the coracoid and dislocations of the shoulder. These injuries have been singled out in this study due to the increased probability that they will be frequently undiagnosed (Bennett, 1997) by rescuers and veterinarians, especially if a radiograph is not taken.

Overall, pectoral girdle injuries were not found to be statistically significant to outcome in birds. 22.7% of birds with these injuries were released.

No crimson rosellas were released with pectoral girdle injuries, yet these were still not statistically significant to outcome due to the low number of cases (8) and the low percentage (25.6%) of birds with other injuries being released.

30% of kookaburras with pectoral injuries were released and no statistical significance was found.

Pectoral girdle injuries represented 5.7% of all injuries seen in birds, 7.8% in kookaburras and 8.5 % of all injuries seen in crimson rosellas. Notably coracoid fractures were the third most common wing injury (11.1%) seen in birds overall. Bennett (1997), reported "in one study, coracoid fractures accounted for 86% ofavian fractures at a raptor facility". The increased release rate with pectoral girdle injuries compared to other injuries is largely attributable to clavicle and scapula fractures. These had the highest release rates of all the wing injuries, 55.6% and 30.8% respectively. Shoulder dislocations and coracoid fractures kept the average low with some of the lowest release rates, 16.2% and 14.3% respectively.

Though a diagnostic challenge in some cases, clavicle and scapula fractures are easily treated with cage rest. Coracoid fractures present a further challenge often requiring difficult surgery involving intramedullary pin placement. Holz, 2003, found that treated conservatively, only 2/9 coracoid fractures were released compared to 6/8 that were treated with surgery. He also found that the weight of the bird was less important than the wing loading of the bird in determining how important surgery was to release. The larger the wing loading, the more important surgery was to rehabilitation.

Shoulder dislocations often necessitated euthanasia (85.7%) due to the extensive soft tissue involvement and the frequent association of fractures with these injuries. Middletpn (pers comm) has devised a surgery to enable shoulder support to the dorsally subluxating shoulder, but none of the cases seen here were suitable candidates.

Lending support to the ease of rehabilitation of scapula and clavicle fractures Roth *et al* (2002) examined 339 pectoral girdles of wild accipiter skeletons and found that 16% had healed fractures to the clavicle, 4 % had healed fractures to the scapula, but only 1 (0.3%) had a healed coracoid fracture. The fact that 3 times as many coracoid fractures as clavicle or scapula fractures were seen here suggests that though a more frequently encountered injury, the likelihood of successful rehabilitation is reduced comparatively.

The evidence suggests that birds can survive fractures to the scapula and the clavicle, but very few live long enough to heal coracoid fractures. Interestingly Roth *et al* (2002) found that no significant increase on the incidence of fractures occurred with time and urbanisation from 1921 -1998. This was assumed to imply that anthropogenic causes were no more significant than natural causes to injuries to the pectoral girdle ofaccipiters.

Leg Injuries

Leg injuries were not found to be statistically significant to outcome. Bennett, 1997, reported that pelvic limb fractures occurred less frequently than thoracic limb fractures, and this study confirmed that 99 leg injuries (83 fractures) were encountered compared to 333 wing injuries (278 fractures). Bennett also noted that leg fractures are less common in free-ranging birds than in companion birds, but no data was collected from collection birds for this study, so a comparison could not be made.

The release rate of leg injuries was 17.2% compared to 13% in wing injuries, but this includes humerus fractures. Once these are removed the release rate was identical.

Redig (1986), stated that the tibiotarsus was the leg bone most likely to be fractured as a result of any trauma. That was the case in this study with 51.8% of leg fractures being to the tibiotarsus and the femur being the next most likely bone to be fractured at 34.9%. Contrary to the published recommendation that intramedullary pins were never successful for tibiotarsus fractures (Redig, 1986), they were successfully applied to 5 cases in this study. 5 released birds recovered with external coaptation and/or cage rest alone. Excluding euthanasias, 29% of the birds with tibiotarsus fractures died within 24 hours of arrival. This high death rate after treatment is deemed appropriate, was mostly due to internal haemorrhage from the initial injury. Fractures to the tibiotarsus represented the best release rate of the leg injuries, after coxofemoral subluxations, with 25.6% being released.

33% (2/6) birds with subluxated coxofemoral joints were released following the surgical repair as reported by Martin (1994). One was a Brown Goshawk, *Accipiter fasciatus,* and the other an Australian Magpie, *Gymnorhina tibicen.* This shows that the repair of certain joint injuries should not be considered futile.

Despite no statistical significance of leg injuries to release (numbers were not high -7/94) no crimson rosellas were released with leg injuries. 5 (71.4%) were euthanased immediately due to the presence of other injuries (3) or permanent chronic deformation to the limb (2). The remaining two died under anaesthetic, 1 on arrival while applying external coaptation, the other at the time ofintra medullary pin removal.

The incidence of leg injuries in kookaburras (21.1% of all injuries) was found to be considerably more than crimson rosellas (7.4%) or birds overall (8.5%). The difference is likely to be due to the fact that kookaburras actually *do* injure their legs more often than other birds. This may be due to the lifestyle of kookaburras which often sees them hunting close to roads and subsequently being hit by cars. 29.6% of kookaburras with leg injuries were released compared to 48.5% of those released without leg injuries. This result showed no statistical significance between leg injuries and release in kookaburras.

Overall 31% of birds with leg fractures presented with fractures to other bones in the body also.

Head Injuries

Head injuries were defined in this study as being those injuries that altered the mentation of the patient. These included stunned birds, those that showed neurological abnormalities (excluding spinal injuries and radial nerve injuries), depressed birds where no internal haemorrhage or trauma was found and those found with evidence of head trauma such as bruising. Patients whose eyes were injured without other head trauma symptoms, were considered separately.

Head injuries were found to be statistically significant to release in all birds. Birds with head traumas have an increased chance of being released than other injuries. Overall birds have a 35.2%, chance of being released after sustaining a head injury, but crimson rosellas and kookaburras fair much better with 65.4% and 74.2% release rates respectively. In crimson rosellas and kookaburras head injuries are the second most common injury encountered, 27.7% and 24.2% respectively (of the 6 groups in this study), behind wing injuries (excluding humerus fractures). 9.3% of all injuries experienced by birds overall are head injuries, but the degree can range from mild to severe. Given the likelihood of successful rehabilitation with head injuries it would be prudent for clinicians to initiate treatment in the majority of these cases. In this study no score was assigned to grade the degree of head trauma and therefore to assess if release rates could be linked to the degree of head trauma. Future studies could look at allocating a grading system to establish whether the severity of symptoms can be related to release or not.

Infection

Of 136 kookaburras seen, only one presented with an infection (bacteraemia) and it was dead on arrival. No statistical analysis on kookaburra outcome and infections was performed. 21.3% of crimson rosellas presented with chlamydophila. None of these birds were treated due to the advanced stage of the disease by the time they presented to us, the contagious nature of the disease to other parrots, the prolonged treatment course necessary for resolution and the zoonotic potential of the disease. The euthanasia of all crimson rosellas with confirmed chlamydophila (using clinical picture, Clearview tests, and later post mortem findings and histology) skewed the results markedly and hence a statistically significant relationship was found between infection (chlamydophila) and release.
In other birds the main infectious diseases seen were spironucleosis in king parrots, *Alisterus scapularis,* (only 24/75 king parrots presented were *not* spironucleosis cases), psittacine beak and feather disease (PBFD), and aspergillosis. The remainder were a miscellaneous assortment ofbacteraemias and specific organ infections, almost exclusively diagnosed at necropsy.

The 100% euthanasia rate of PBFD, 100% fatal outcome of aspergillosis, almost 100% death rate of miscellaneous infections and 70% death rate of spironucleosis cases led to statistical significance between infection and outcome in birds. Infections were found to have a negative relationship to outcome.

Conclusion

The type of injury a wild bird presents with was found to have some statistical significance to outcome. Humerus fractures and infections were found to have a negative relationship to outcome with fewer birds in these categories being released than those with other injuries. On the other hand, head injuries had a positive relationship to release. Birds presenting with a head injury had a significantly better chance of release than with any other injury. Though no statistical significance was seen between release and wing injuries (other than humerus fractures), leg injuries and pectoral girdle injuries, some patterns emerged within these categories of injury. Dislocations and subluxations

should be considered grave injuries, although some success was seen with coxofemoral luxations. Clavicle and scapula fractures had good release rates. Radius, ulna, and tibiotarsus fractures had reasonable release rates. Femur and coracoid fractures had poor release rates and combined ulna and radius fractures and metacarpal fractures had very poor release rates.

Though useful as guidelines, the findings presented here should always be considered with the clinical picture. Species variation was shown in this study, and little information exists as to how individual species will cope with treatment and rehabilitation. Despite the release rate being lower than the not-released rate with most injuries, nearly every type of injury was represented by a bird that was released. This fact alone suggests that most injuries have some chance of successful rehabilitation. It is only the degree of chance that varies.

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