Indian Journal of Clinical Medicine

ORIGINAL RESEARCH

Study of Glasgow Coma Scale Score and QTc Interval in Prognosis of Organophosphate Compound Poisoning

Archana Deshpande[1], Nitin Gaikwad[2] and Sanjay Deshpande[3]

[1]Government Medical College, Nagpur. [2]Government Medical College, Nagpur. [3]Ex-Professor, M.D. Preventive and Social Medicine. Corresponding author email: arcsandeshpande@rediffmail.com; Nitin021@yahoo.co.in; sanjaygdeshpande2@rediffmail.com

Abstract: We assessed the applicability of the Glasgow Coma Scale (GCS) and the QT interval (QTc) to predicting outcomes in patients with organophosphate (OP) poisoning. In the hospital setting, QTc and GCS were monitored in each patient at admission. Patients with respiratory failure were compared to patients without these complications, and mortality was compared between groups. We found that the group with complications had a significantly longer QTc and a lower GCS score, a higher number of intubations, and worse outcomes ($P < 0.05$). GCS score and QTc have been shown to be equally good in predicting respiratory failure and hospital mortality in patients with OP poisoning. These results suggest that during initial out-of-hospital care of patients with OP poisoning, it is essential to monitor the QTc and the GCS score. The simplicity and promptness of these methods will allow providers to perform early and effective triage.

Keywords: organophosphate(OP), GCS score, QTc, respiratory failure (RF)

Indian Journal of Clinical Medicine 2012:3 25–31

doi: 10.4137/IJCM.S9807

This article is available from http://www.la-press.com.

Introduction

Organophosphate (OP)-based pesticides are widely used and have emerged as the major contributor to ill health associated with pesticides worldwide.

Though accidental poisoning can occur following exposure with inhalation, serious poisoning often follows suicidal ingestion. Since respiratory failure is the most common cause of death in OP poisoning, early identification and effective management will help to reduce overall mortality in OP poisoning.[1,2]

The Glasgow coma scale (GCS) remains the most widely used scale to describe the level of consciousness of the victim and is reliable for assessment and prognosis of patients with non-traumatic coma.[3–5] The GCS has been shown to be an effective clinical parameter that helps clinicians to predict the outcome of OP poisoning cases in the initial assessment.[6,7]

Poisoning with drugs influences biochemical elements of the brain and causes brain damage. This may change one's level of consciousness as well. The GCS has been performed to assess outcome and recovery of patients admitted to an intensive care unit (ICU) following drug overdose,[8] the mental status evaluation of poisoning patients,[9] the need for intubation in patients with antidepressant poisoning,[10] and to predict acute and delayed poisoning outcomes.[11,12]

The QT interval (QTc) is a measure of the time between the start of the Q wave and the end of the T wave in the heart's electrical cycle. A prolonged QTc is a biomarker for ventricular arrhythmia like torsade de pointes, and is a risk factor for sudden death.[13] A major retrospective study conducted in Taiwan by Chuang and colleagues[14] confirmed the relationship of QTc prolongation with the severity of OP poisoning in terms of respiratory failure and mortality. Shadnia and colleagues[15] also found that QTc prolongation may have prognostic value in OP compound poisoning.

The current study was performed with the aim of assessing the applicability of the GCS and QTc interval in predicting the outcome and complications of OP compound poisoning.

Methodology

This study was carried out from November 2009 to September 2011 in the ICU of the Government Medical College Nagpur in Maharashtra, India.

This is a prospective analytical study in which a total of 140 patients with organophosphate compound (OP) poisoning were included. Poisoning was confirmed by history, as well as classical features of OP in the form of hypersalivation, miosis fasciculations, characteristic odor of stomach wash and serum cholinesterase levels. It was also substantiated by examination of the container containing the compound, whenever this was brought in.

Patients who had history of alcohol consumption, chronic lung disease and cardiac disease were excluded.

In all patients, a detailed clinical examination was carried out to assess respiratory insufficiency, heurological status and cardiovascular system functioning. Special reference was given to the QTc and GCS score.

All patients underwent bio-chemical examination in the form of LFT, KFT, Blood glucose, ECG and X-ray. ECG was conducted while stabilizing the patient with a gastric lavage, atropine, oxygen and pralidoxime (PAM).

All patients were divided into two groups. Group A included those who developed respiratory failure, and group B included those who did not develop respiratory failure. Various parameters were also compared between patients who did and did not survive.

Statistical analyses

Continuous variables were presented in terms of the mean ± standard deviation. Categorical variables were expressed as percentages. Continuous variables were compared using unpaired *t*-tests for normalized data. The Wilcoxon rank-sum test was used for non-normalized data. Categorical variables were compared using the Chi-square test. Linear trends were calculated to study the relationship between various factors and respiratory failure as well as mortality. The predictive performance of GCS and QTc was assessed using an ROC curve. To discriminate between respiratory failure and no respiratory failure, as well as mortality outcomes, the selected alpha criterion was 0.05. STATA statistical software was used for data analysis.

Results and Discussion

We evaluated a total of 140 patients with OP compound poisoning. They were grouped according to the

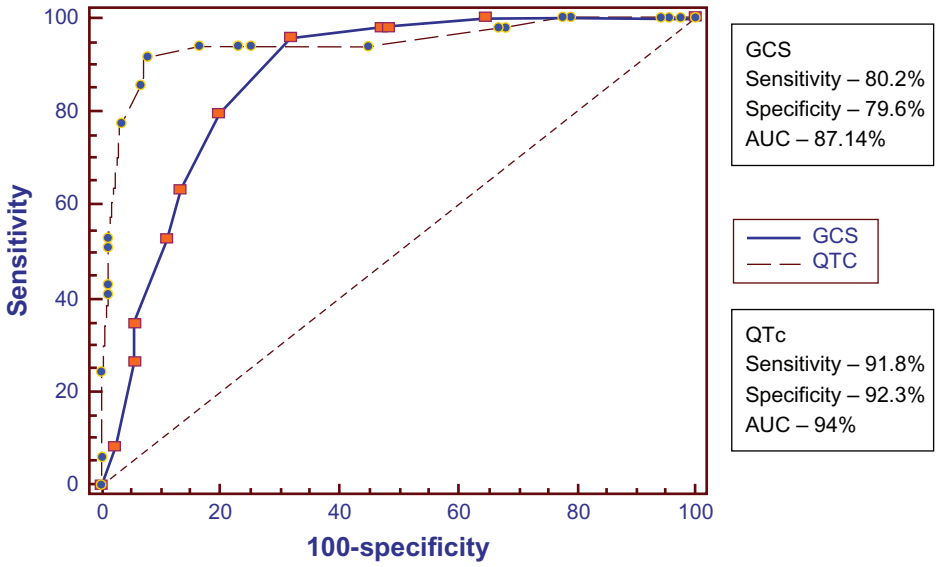

Figure 1. ROC of GCS and QTc for RF.

presence of respiratory failure (RF) in Group A who developed RF and Group B who did not develop RF.

Our study included 140 patients with OP poisoning. These patients were divided into two groups. Group A included those with RF and Group B those who did not develop RF (Table 1).

The symptoms of OP poisoning usually manifest within 30–90 minutes. Stimulation of the muscarinic parasympathetic system causes miosis, bradycardia, hypotension, bronchoconstriction, oversecretion of exocrine glands and hyperactivity of gastrointestinal smooth muscles.[16,17] Its nicotinic effects manifest in the form of tachycardia, hypertension, mydriasis, fasciculations, muscle weakness and muscle paralysis (Table 2).[18,19]

RF occurs in two forms, early and delayed. Early RF occurs at or soon after admission, while the delayed form occurs several hours to 5 days after admission.[20] The mechanism of respiratory failure is likely to involve three components, including depression of central respiratory drive from the respiratory centre, respiratory muscle weakness and direct pulmonary effects such as bronchospasm and bronchorrhea.[20] A substantial number of deaths can

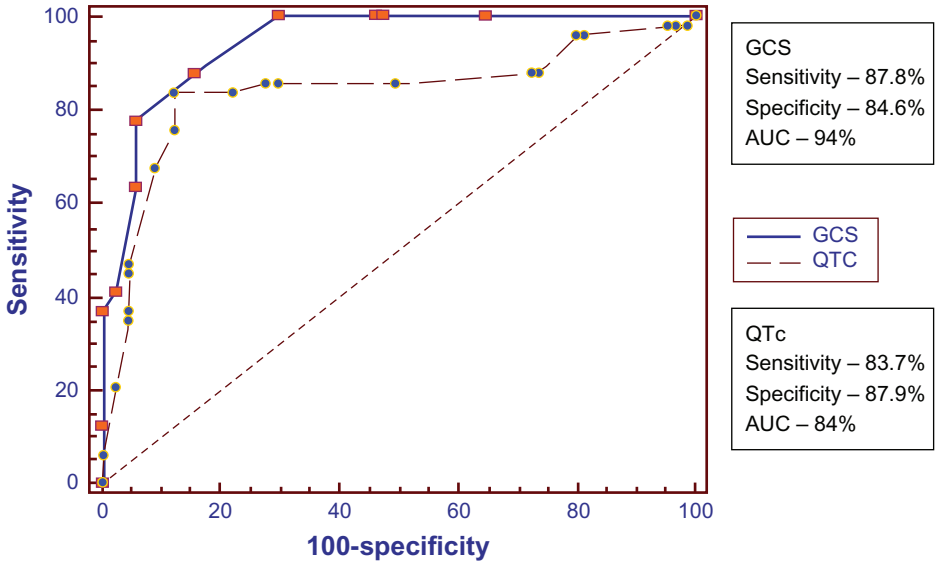

Figure 2. ROC of GCS and QTc for mortality.

Table 1. Showing demographic and clinical characteristics in OP compound poisoning patients.

Sr. no.	Parameter	Group A n = 49	Group B n = 91	*P* value
1	Mean age in years	32.08 ± 13.20	31.88 ± 9.96	>0.05
2	Gender			
	Males	42 (36.8%)	72 (63.2%)	0.339
	Females	7 (26.9%)	19 (73.1%)	
3	Intension of poisoning suicidal	47 (95.91%)	77 (84.61%)	0.045
	Accidental	2 (4.08%)	14 (15.38%)	
4	Mean time interval for hospitalization in hours	8.65 ± 8.76	7.37 ± 9.12	0.026
5	Mean GCS score	6.43 ± 2.18	10.50 ± 2.71	0.0092 c^2 6.78
6	Mean QTc interval	0.52 ± 0.05	0.41 ± 0.04	0.0017
7	Mean serum cholinesterase levels	617.51 ± 195.75	758.39 ± 291.73	0.0062

Notes: When mean age and gender was compared between the two groups, the differences were not statistically significant. However, when intension-to-poison, mean time interval for hospitalization, mean GCS score, mean QTc, and mean serum cholinesterase levels were compared, these differences were significant.

be prevented with proper management of RF. Hence, it is important to identify the factors which help in prediction of RF in early stage, which will help in the early institution of ventilatory support. This will facilitate the selection of patients needing intensive management in the ICU.[21]

In our study, 49 (35%) of 140 patients developed RF and 91 (65%) did not develop RF. Out of 91 patients who did not develop respiratory failure 10 patients died, 4 due to septicemia and 6 due to sudden cardiac arrest (Table 6).

The consciousness level of each patient was judged according to GCS score at the time of admission. From the study it was found that a lower GCS score (3–6) on admission was associated with more incidences of RF (72.2%) and more mortality (Table 3).

In our study sensitivity of QTc in predicting RF when 0.45 sec was used as best cut off was 91.8% and specificity was 92.3 % (Table 4, Fig. 1).

When best cut off of 8 was taken for GCS in predicting mortality its sensitivity is 87.8% and specificity is 84.6%. AUC when calculated by ROC is 0.94 (0.89, 0.97) (Table 5 and Fig. 2).

Although rapid changes in the level of consciousness in poisoning cases may raise a question of the role of GCS on admission in predicting outcome, Ezadi Mood and colleagues[22] showed that the admission GCS score as well as its components can be validated for poisoned patients with mixed drug ingestion.

Grmec and colleagues[23] studied 65 patients of OP poisoning. Their results showed that the group with complications had significantly different values of measured parameters, including a longer QTc interval and lower GCS score, a higher number of intubations and a worse outcome. They have concluded that GCS score and QTc interval have been shown to be equally good in predicting RF as well as hospital mortality in patients with OP poisoning.[23]

Okhan Akdur and colleagues[24] studied the effectiveness of poison severity score (PSS), GCS score and corrected QTc in predicting the outcome of acute OP poisoning. They found a significant correlation between GCS and PSS for grade 3 and grade 4 cases. They have stated that GCS is a parameter that helps clinicians to identify advanced-grade OP poisoning patients during initial assessment in the emergency department. However, ECG findings such as

Table 2. Common presenting complaints in patients of OP compound poisoning.

Sr. no.	Complaints	Total
1	Vomiting	135 (96.4%)
2	Restlessness	121 (86.4%)
3	Convulsions	39 (27.9%)
4	Increased salivation	74 (52.9%)
5	Cough	3 (21%)
6	Palpitations	11 (79%)
7	Breathlessness	10 (7.1%)

Note: These complaints are not mutually exclusive from each other.

Table 3. Comparison of various parameters in patients who did and did not survive.

Sr. no.	Parameter	Survived n = 91	Died n = 49	*P* value
1	Mean age in years	31.50	31.85	0.65
2	Gender			
	Males	72 (63.15%)	42 (36.8%)	0.339
	Female	19 (73.07%)	48 (97.95%)	c^2 0915
3	Intension of poisoning suicidal	76 (83.51%)	48 (97.95%)	c^2 6.630 0.010
	Accidental	15 (16.49%)	1 (2.05%)	
4	Mean time interval for hospitalization in hours	7.64 ± 9.30	8.14 ± 8.46	c^2 2.374 0.1233
5	Mean GCS score	10.83 ± 2.20	5.81 ± 1.95	c^2 24.676 0.0092
6	Mean QTc interval	0.41 ± 0.05	0.50 ± 0.07	c^2 55.97 0.00
7	Mean serum cholinesterase levels	768.86 ± 300.01	626.81 ± 192.68	0.000
8	Presence of respiratory failure	10 (11%)	39 (79.6%)	0.000
9	No respiratory failure	81 (89%)	10 (20.4%)	c^2 65.889

Notes: When various parameters were compared between patients who did and did not survive, age, gender, and duration of hospitalization were not significantly different. However, intension-to-poison, GCS score, QTc interval, serum cholinesterase levels and presence of RF were significantly different.

prolonged QTcs are not effective for determination of short-term prognosis, and show no relationship with the PSS.

Cander and colleagues[25] conducted a study including 25 patients with OP compound poisoning. They found that the mean GCS value was significantly lower compared to that of the group that survived.

Davies and colleagues[26] studied 1365 patients with a history of OP poisoning. They found that GCS, the International Program On Chemical Safety Poison (IPCS), and the PSS were similarly effective at predicting outcomes. Patients presenting with a GCS ≤ 13 need intensive monitoring and treatment.

Sungur and colleagues[27] studied 47 patients of OP poisoning. 10 (21.2%) patients required mechanical ventilation. The mortality rate for the patients who required mechanical ventilation was 50%. The mortality rate was 21.6% for the patients who were not mechanically ventilated. So they have concluded that since RF is the major reason for mortality, careful monitoring, appropriate management and early recognition of this components may decrease the mortality rate among these patients.

The mean serum cholinesterase levels in Group A and Group B in our study differ significantly (Tables 1 and 3). Rehiman and colleagues[28] also found a significant correlation of serum cholinesterase levels with the severity and ultimate prognosis in OP poisoning. Siu[29] showed that severity of OP poisoning can be predicted by serum cholinesterase levels. However, Nouira and colleagues[30] found that mean cholinesterase levels did not correlate with respiratory failure.

Table 4. Comparison between GCS score and QTc interval in predicting RF.

Parameters	Best cut off	Sensitivity (95% CI)	Specificity (95% CI)	AUC (95% CI)
GCS	8	80.2 (70.6–87.8)	79.6 (65.7–89.8)	0.8714 (0.81, 0.92)
QTc interval	0.46	91.8 (80.4–97.7)	92.3 (84.8–96.9)	0.94 (0.89–0.98)

Notes: When a best cut off of 8 was taken for GCS in predicting the respiratory failure its sensitivity was 80.2 (70.6–87.8) and its specificity was 79.6 (65.7–89.8) The area under the curve when calculated by ROC is 0.871 (0.81, 0.92) (Fig. 1). When QTc used for predicting RF with the best cut off of 0.46, its sensitivity is 91.8 (80.4–97.7) and specificity is 92.3 (84.8–96.9). The area under the curve when calculated by ROC is 0.94 (0.89, 0.98).

Table 5. Comparison between GCS score and QTc interval in predicating mortality.

Parameters	Best cut off	Sensitivity (95% CI)	Specificity (95% CI)	AUC (95% CI)
GCS	8	87.8 (75.2–95.4)	84.6 (75.5–91.3)	0.94 (0.89, 0.97)
QTc interval	0.46	83.7 (70.3–92.7)	87.9 (79.4–93.8)	0.84 (0.77, 0.89)

Notes: When a best cut off of 8 was taken for GCS in predicting mortality, its sensitivity was 87.8 and its specificity was 84.6. When QTc was used for predicting mortality, the best cut off was 0.46, its sensitivity was 83.7 and its specificity was 87.9.

Our study shows that RF in patients with OP compound poisoning can be predicted by simple variables such as the presence of lower GCS on admission, and prolonged QTc on admission. These prognostic parameters can help doctors at peripheral health centers successfully predict outcomes. This way, high-risk cases can be referred to higher centers for expert management without wasting time, after necessary initial treatment such as doses of Atropine to assist with ventilation in patients with respiratory failure (Table 4).

In this way, the incidence of compilation and hence mortality due to OP compound poisoning can be reduced. For this reason it is necessary to train the doctors at the periphery, making them realize the importance of early treatment in OP poisoning and how to identify high-risk patients.

One limitation of our study is that the type of OP ingested could not be identified in all patients.

Author Contributions

Conceived and designed the experiment: AD, NG. Analysed the data: AD, NG. Wrote the first draft of manuscript: AD, NG. Contributed to the writing of manuscript: SD, AD. Agree with the manuscript, results and conclusions: AD, NG, SD. Jointly developed the structure and arguments for the paper: All authors. Made critical revisions and approved final version: All authors.

Table 6. Outcome in patients with OP compound poisoning.

	Group A n = 49	Group B n = 91
Survived	10	81
Died	39	10

Notes: Out of 10 patients who did not develop RF, 4 patents died of septicemia and 6 died of sudden cardiac arrest.

Funding

Author(s) disclose no funding sources

Competing Interests

Author(s) disclose no potential conflicts of interest.

Disclosures and Ethics

As a requirement of publication author(s) have provided to the publisher signed confirmation of compliance with legal and ethical obligations including but not limited to the following: authorship and contributorship, conflicts of interest, privacy and confidentiality and (where applicable) protection of human and animal research subjects. The authors have read and confirmed their agreement with the ICMJE authorship and conflict of interest criteria. The authors have also confirmed that this article is unique and not under consideration or published in any other publication, and that they have permission from rights holders to reproduce any copyrighted material. Any disclosures are made in this section. The external blind peer reviewers report no conflicts of interest.

References

1. Eddleston M. Patterns and problems of deliberate self-poisoning in the developing world. *QJM*. 2000;93:715–31.
2. Du Toit PW, Muller FO, van Tonder WM, Ungerer MJ. Experience with the intensive care management of organophosphate insecticide poisoning. *S AfrMed J*. 1981;60:227–9.
3. Teasdale G, Jennett B. Assessment of coma and impaired consciousness. A practical scale. *Lancet*. 1974;2:81–4.
4. Levy DE, Bates D, Caronna JJ, et al. Prognosis in nontraumatic coma. *Ann Internal Med*. 1981;94:293–301.
5. Chan B, Gaudary P, Grattan-Smith TM, McNell R. The use of Glasgow Coma Scale in poisoning. *J Emerg Med*. 1993;11:579–82.
6. Forsberg S, Hojer J, Ludwigs U. Prognosis in patients presenting with non-traumatic coma. *Crit Care*. 2010;14:333.
7. Bilgin TE, Camdeviren H, Yapici D, et al. The comparison of the efficacy of scoring systems in organophosphate poisoning. *Toxicol Ind Health*. 2005;21:141–6.
8. O' Brien BP, Murphy D, Conrick- Martin I, Marsh B. The functional outcome and recovery of patients admitted to an intensive care unit following drug overdose: a follow up study. *Anaesth Intensive Care*. 2009;37:802–6.

9. Heard K, Bebarta VS. Reliability of the Glasgow Coma scale for the emergency department evaluation of poisoned patients. *Hum Exp Toxicol*. 2004;23:197–200.
10. Unverier P, Atilla R, Karcioglu O, Topacoglu H, Demiral Y, Tuncok Y. A retrospective analysis of antidepressant poisonings in the emergency department: 11-year experience. *Hum Exp Toxicol*. 2006;25:605–12.
11. Budhathoki S, Poudel P, Shah D, et al. Clinical profile and outcome of children presenting with poisoning or intoxication: a hospital based study. *Nepal Med Coll J*. 2009;11:170–5.
12. Ku HL, Yang KC, Lee YC, Lee MB, Chou YH. Predictors of carbon monoxide poisoning induced delayed neuropsychological sequelae. *Gen Hosp Psychiatry*. May–Jun 2010;32(3):310–4.
13. Bonow RO, Mann DL. *Braunwald's Heart disease: A Textbook of Cardiovascular Medicine, 9th ed*. 2011; Philadelphia: Saunders.
14. Chuang FR, Jang SW, Lin JL, Chern MS, Chen JB, Hsu KT. QTc prolongation indicates poor prognosis in patients with OP poisoning. *J Emerg Med*. 1996;14:451–3.
15. Shadnia S, Okazi A, Akhlaghi N, Sasanian G, Abdollahi M. Prognostic value of long QT interval in acute and severe organophosphate poisoning. *J Med Toxicol*. 2009;5:196–9.
16. Shannon MW, Borron SW, Burns MJ. *Shannon: Haddad and Winchester's Clinical Management of Poisoning and Drug Overdose, 4th ed.* 2007; St. Louis: W.B. Saunders.
17. [No authors listed]. World Health Organization: The WHO recommended classification of pesticides by hazard. 2004; Geneva: Who Publications.
18. Temple WA, Smith NA. Organophosphorous pesticides. 2012; IPCS INTOX Databank. Available at: http://www.inchem.org/documents/pims/chemical/pimg001.htm. Accessed Oct 13, 2012.
19. Karalliedde L, Henry JA. Effects of organophosphates on skeletal muscle. *Hum Exp Toxicol*. 1993;12:289–96.
20. Eddleston M, Mohamed F, Davies JO. Respiratory failure in organophosphorous self-poisoning. *QJ Med*. 2006;99:513–22.
21. Goel A, Joseph S, Dutta TK. Organophosphate poisoning; predicting the need for ventilatory support. *J Assoc Physicians India*. 1998;46:786–90.
22. Eizadi Mood N, Sabzghabaee AM, Yadegarfar G, Yaraghi A, Ramazani Chaleshtori M. Glasgow coma scale and its components on admission: are they valuable prognostic tools in acute mixed drug poisoning? *Crit Care Res Pract*. 2011;2011:952–6.
23. Grmec S, Mally S, Klemen P. Glasgow Coma Scale score and QTc interval in the prognosis of organophosphate poisoning. *Acad Emerg Med*. 2004; 11:925–30.
24. Akdur O, Durukan P, Ozkan S, et al. Poisoning severity score, Glasgow coma scale, corrected QT interval in acute OP organophosphate poisoning. *Hum Exp Toxicol*. 2010;29:419–25.
25. Cander B, Dur A, Yildiz M, et al. The prognostic value of the Glasgow coma scale, serum acetylcholinesterase and leukocyte levels in acute organophosphorous poisoning. *Annals Saudi Med.* 2011;31:163–6.
26. Davies JO, Eddleston M, Buckley NA. Predicting outcome in Acute Organophosphorous poisoning with a poison severity score or the Glasgow coma scale. *QJM*. 2008;101:371–9.
27. Sungur M, Guven M. Intensive care management of organophosphate insecticide poisoning. *Crit Care*. 2001;5:211–5.
28. Rehiman S, Lohani SP, Bhattarai MC. Correlation of serum cholinesterase level, clinical score at presentation and severity of organophosphorous poisoning. *JNMA J Nepal Med Assoc*. 2008;47:47–52.
29. Siu AYC, Tsoi LCH, Lo WCB, Chung CCH. QT prolongation due to organophosphophate poisoning. *Hong Kong J Emerg Med*. 2000;7:234–5.
30. Nouira S, Abroug F, Elactrous S, Boujdaria R, Bouchoucha S. Prognostic value of serum cholinesterase in organophosphate poisoning. *Chest*. 1994; 106:1811–4.