

WHEN THE BOTTLE DECIDES THE DOSE: DELIVERY-CONSTRAINED INTRAVENOUS IMMUNOGLOBULIN ADMINISTRATION IN A CHILD WITH ANTI-N-METHYL-D-ASPARTATE RECEPTOR ENCEPHALITIS

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Article Type: Research Paper (Case Report)

Short Title: Delivery-constrained immunoglobulin dosing in paediatric anti-NMDAR encephalitis

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ABSTRACT

Intravenous immunoglobulin sits awkwardly between prescribing and pharmaceuticals. The dose is calculated from body weight, yet the product reaches the bedside in fixed-volume glass bottles and is given through a rate-limited infusion protocol. We describe a 10-year-old boy weighing 30.65 kg, already known to have anti-N-methyl-D-aspartate receptor (NMDAR) encephalitis, readmitted to a tertiary teaching hospital in northern Karnataka three months after his index event for a planned course of immunoglobulin. Cerebrospinal fluid was positive for NMDAR antibody while paired serum was only weakly positive, and plain magnetic resonance imaging of the brain showed no neuroparenchymal abnormality; serological testing alone would have left the diagnosis unproven. He received a 10% glycine-stabilised human normal immunoglobulin supplied as 10 g in 100 mL, infused at a fixed 20 mL/h over five hours daily. Each infusion therefore delivered 0.33 g/kg, and five consecutive infusions delivered 50 g in total, or 1.63 g/kg — precisely what had been prescribed, and well short of the international consensus target of 2 g/kg, which would have required about 61 g in this child. Structured review using the Pharmaceutical Care Network Europe classification version 9.1 identified six drug-related problems. The dominant one was a dosing deviation produced by bottle size, the twenty-four-hour discard rule after puncture and a conservative fixed infusion rate rather than by any deliberate clinical decision. Dual atypical antipsychotic exposure in a disorder associated with neuroleptic intolerance, prophylactic anticholinergic co-prescription, absent corticosteroid-sparing measures, missing live-vaccine deferral advice and a recorded serum potassium of 6.4 mEq/L that was never repeated, never investigated electrocardiographically and never commented upon accounted for the remainder. Immunoglobulin presentations and paediatric infusion protocols deserve to be designed around the child rather than the container.

Keywords: Anti-NMDA receptor encephalitis, Human normal immunoglobulin, Drug delivery, Paediatric pharmacotherapy, Drug-related problems, Clinical pharmacy

How to cite this article: Gouroji KR, Sonar DA, Hortikar RR, Hortikar A, Shalavadi M, Hegde RS. When the Bottle Decides the Dose: Delivery-Constrained Intravenous Immunoglobulin Administration in a Child with Anti-N-Methyl-D-Aspartate Receptor Encephalitis. *Int J Drug Deliv Technol.* 2026;16(86s): 63-70; DOI: 10.25258/ijddt.16.86s.8

Source of support: Nil

Conflict of interest: None declared

INTRODUCTION

In less than two decades, anti-NMDAR encephalitis has moved from an obscure paraneoplastic curiosity to the commonest antibody-mediated encephalitis recognised in children.^{1,2} Immunoglobulin G directed against the GluN1 subunit of the NMDA receptor drives reversible internalisation of surface receptors, and the syndrome that follows is distinctive enough that experienced clinicians often reach the diagnosis before the laboratory confirms it: behavioural change, seizures, orofacial and limb dyskinesia, disrupted sleep, autonomic instability and, characteristically, loss of speech.^{2,3} Indian paediatric series describe the same picture, usually with no underlying tumour and with a substantial proportion of children left with behavioural or scholastic difficulty after the acute illness has passed.⁴

What makes the disorder worth writing about is that it answers to treatment. International consensus for children places corticosteroids at the centre of first-line therapy, with

immunoglobulin or plasma exchange added in severe disease, and rituximab preferred as second-line escalation roughly two weeks after first-line therapy has been started.⁵ The same consensus sets the immunoglobulin dose at 2 g/kg given over two to five days for a first event, and 1 to 2 g/kg over one to two days repeated monthly where prolonged first-line therapy is judged necessary.⁵

Those recommendations are written in grams per kilogram. The product is not. Ten per cent human normal immunoglobulin is licensed and distributed in fixed presentations — commonly 2.5 g, 5 g and 10 g bottles — and the summary of product characteristics requires that any remnant be discarded within twenty-four hours of the container being penetrated. Infusion rates in children are deliberately conservative because the great majority of adverse reactions are rate-dependent.⁶ Each of these is a sensible pharmaceutical safeguard taken on its own. Taken together, in a child whose weight sits between two bottle sizes, they quietly set an upper limit on what can be given in a working

day, and that limit has nothing to do with the dose the prescriber intended.

Published reports of anti-NMDAR encephalitis are written almost entirely from a neurological vantage point, and the few that address pharmacotherapy concentrate on the sequencing of immunosuppression. We were unable to find a report that examines how the physical presentation of the immunoglobulin and the local infusion protocol together determined what a child actually received. The case described here illustrates that problem plainly, and we present it alongside a structured pharmacist-led analysis of the drug-related problems identified during the admission.

CASE REPORT

A 10-year-old boy weighing 30.65 kg was admitted to the paediatric unit of a 1,000-bed teaching hospital in northern Karnataka for a scheduled course of immunoglobulin. He was already known to the unit as a case of anti-NMDAR encephalitis.

His earliest significant illness had been at about one year of age, when fever and cough were treated over fifteen days at a medical college hospital in Hubli; no sequelae were recorded. He then remained well until three months before the present admission, when he developed uprolling of the eyeballs with deviation of the angle of the mouth to the left. Intravenous levetiracetam and lorazepam were given, after which he became drowsy, although his behaviour stayed normal — he was conscious, oriented to

time, place and person, understood what was said to him and followed instructions. At about three o'clock that morning, while asleep, the eye-rolling and facial deviation returned. He was brought to this hospital and the convulsion settled thirty minutes later. Anti-NMDAR encephalitis was diagnosed and he was discharged on oral therapy.

At the present admission he was afebrile and had no cough, coryza, irritability or abnormal movements. General and systemic examination disclosed nothing abnormal; cardiovascular, respiratory and abdominal findings were unremarkable. There was no history of any preceding viral prodrome at this visit.

Investigations

The haemogram was unremarkable apart from mild hypochromia and a raised red cell distribution width; the peripheral smear was reported as a normocytic normochromic picture with erythrocytosis and neutrophilia. C-reactive protein was not raised and renal function was normal. One result stood apart from the rest: serum potassium on the second hospital day was entered as 6.4 mEq/L against a reference range of 3.5 to 5.2 mEq/L, with sodium 136 mEq/L, chloride 100 mEq/L and creatinine 0.5 mg/dL in the same sample. No repeat estimation, electrocardiogram or potassium-lowering measure appears anywhere in the record, and the child showed no arrhythmia, weakness or other manifestation attributable to hyperkalaemia at any point during the admission. The values are set out in Table 1.

Table 1: Haematological and biochemical parameters recorded during the admission

Parameter	Result	Reference range	Date
Haemoglobin (g/dL)	14.2	13.5–17.5	18/12
Total leucocyte count (cells/ μ L)	10,600	4,500–10,500	18/12
Polymorphs (%)	83	40–75	18/12
Lymphocytes (%)	12	20–40	18/12
Monocytes (%)	4	0–7	18/12
Eosinophils (%)	1	0–5	18/12
Red blood cell count (million/ μ L)	5.47	4.6–4.8 (children)	18/12
Platelet count (cells/ mm^3)	2,83,000	1,50,000–4,50,000	18/12
Haematocrit / packed cell volume (%)	43.1	37–54	18/12
Mean corpuscular haemoglobin (pg)	25.9	27–32	18/12
Mean corpuscular Hb concentration (%)	32.9	32–36	18/12
Red cell distribution width (%)	15.6	12–15	18/12
C-reactive protein (mg/L)	3.09	0–6	18/12
Serum sodium (mEq/L)	136	135–147	19/12
Serum potassium (mEq/L)	6.4	3.5–5.2	19/12
Serum chloride (mEq/L)	100	95–107	19/12
Serum creatinine (mg/dL)	0.5	0.6–1.2	19/12
Random capillary glucose (mg/dL)	141	60–140	23/12

Hb, haemoglobin. The peripheral smear showed a normocytic normochromic picture with erythrocytosis and neutrophilia.

Plain magnetic resonance imaging of the brain, performed at the time of the index illness on a 1.5 T scanner using axial T1, T2 and FLAIR sequences with coronal and sagittal T2-weighted and diffusion-weighted acquisitions, was normal. Grey–white differentiation was preserved, there was no focal mass lesion or

midline shift, no intracerebral or subdural haemorrhage or infarct, and the basal ganglia, thalami, hippocampi, mamillary bodies, brainstem and cerebellum were all unremarkable. The only abnormality was circumferential mucosal thickening in both compartments of the sphenoid sinus. Representative axial images are shown in Figure 1.

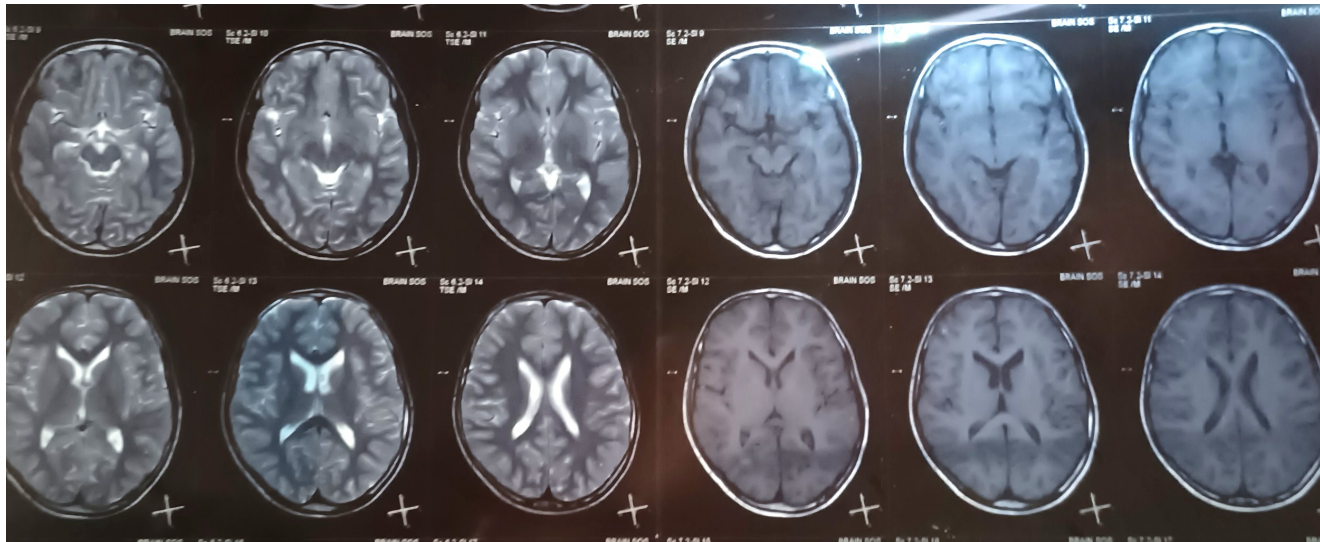


Figure 1: Representative axial T2-weighted (left three columns) and T1-weighted (right three columns) images at the basal ganglia and lateral ventricular levels. Grey–white differentiation, the basal ganglia, thalami and medial temporal structures are normal, and there is no signal abnormality or mass effect. A normal study of this kind does not exclude anti-NMDAR encephalitis.

Paired serum and cerebrospinal fluid were sent to a national neurosciences reference laboratory for an autoimmune encephalitis mosaic. Cerebrospinal fluid was positive for glutamate receptor (NMDA) antibody while the paired serum

was reported only as weakly positive; AMPA1, AMPA2, CASPR2, LGI-1 and GABA-B receptor antibodies were negative in both compartments (Table 2, Figure 2). The child therefore met the Graus criteria for definite anti-NMDAR encephalitis.³

Table 2: Autoimmune encephalitis antibody mosaic in paired serum and cerebrospinal fluid

Antibody target	Serum	Cerebrospinal fluid
Glutamate receptor, NMDA	Weakly positive	Positive
Glutamate receptor, AMPA1	Negative	Negative
Glutamate receptor, AMPA2	Negative	Negative
CASPR2 (VGKC associated)	Negative	Negative
LGI-1 (VGKC associated)	Negative	Negative
GABA-B receptor (B1, B2)	Negative	Negative

AMPA, α -amino-3-hydroxy-5-methyl-4-isoxazolepropionic acid; CASPR2, contactin-associated protein 2; GABA, gamma-aminobutyric acid; LGI-1, leucine-rich glioma-inactivated

protein 1; NMDA, N-methyl-D-aspartate; VGKC, voltage-gated potassium channel.

Autoimmune Laboratory			
MRN		Department	Neuropathology (Auto Immune Lab)
Name		Specimen	CSF
Age / Sex	10 Y/MALE	Visit Type	OP
Sample No		Collected On	20/09/2025 16:25
Lab Reference No		Received On	20/09/2025 16:26
Consulting Doctor		Reported On	23/09/2025 14:40

Test Name	Result	Comments
Autoimmune Encephalitis Mosaic - SERUM (NMDA and VGKC)		
Glutamate receptor, NMDA	Weakly positive.	
Glutamate receptor, AMPA1	Negative	
Glutamate receptor, AMPA2	Negative	
CASPR (contactin - associated protein 2/VGKC associated)	Negative	
LGI-1 (Leucine rich glioma-inactivated protein 1/ VGKC associated)	Negative	
GABAB receptor (GABAB1,B2)	Negative	
Autoimmune Encephalitis Mosaic - CSF (NMDA and VGKC)		
Glutamate receptor, NMDA	Positive.	
Glutamate receptor, AMPA1	Negative	
Glutamate receptor, AMPA2	Negative	
CASPR (contactin - associated protein 2/VGKC associated)	Negative	
LGI-1 (Leucine rich glioma-inactivated protein 1/ VGKC associated)	Negative	
GABAB receptor (GABAB1,B2)	Negative	

APPROVED

Figure 2: Reference-laboratory report of the autoimmune encephalitis mosaic in paired serum and cerebrospinal fluid. Patient identifiers have been masked. Note the discordance between a weakly positive serum result and an unequivocally positive cerebrospinal fluid result for the NMDA receptor antibody.

Pharmacotherapy during the admission

The inpatient regimen comprised trihexyphenidyl, clonazepam, brivaracetam, risperidone, prednisolone and melatonin, together with the immunoglobulin infusion (Table 3). The regimen he had

been taking at home since his index illness was the same list with quetiapine added, so that two atypical antipsychotics were in concurrent use before admission.

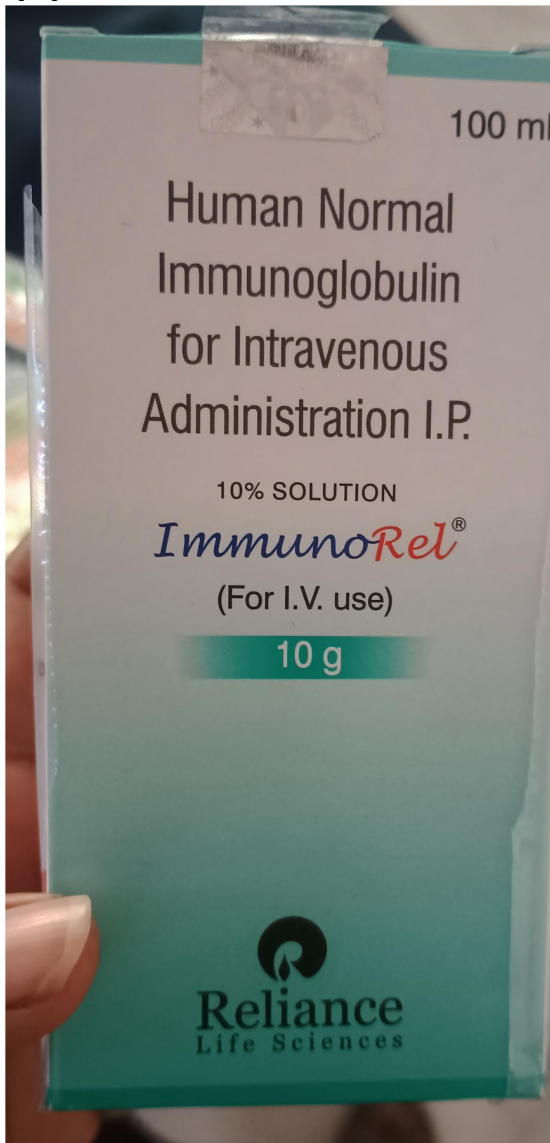
Table 3: Pharmacotherapy administered during the admission, with weight-normalised doses

Brand	Generic	Dose	Route	Frequency	Weight-normalised dose and purpose
Parkin	Trihexyphenidyl hydrochloride	2 mg	Oral	Three times daily	6 mg/day (0.20 mg/kg/day); given with antipsychotics
Clonotril	Clonazepam	0.5 mg	Oral	Twice daily	1 mg/day (0.03 mg/kg/day); seizures and agitation
Brevipil	Brivaracetam	25 mg	Oral	Twice daily	0.82 mg/kg/dose, 1.63 mg/kg/day; within the licensed paediatric band for 20–50 kg
Sizodon	Risperidone	1 mg	Oral	Twice daily	2 mg/day (0.065 mg/kg/day); behavioural symptoms
Wysolone	Prednisolone	20 mg	Oral	1–0–½	30 mg/day (0.98 mg/kg/day); maintenance immunosuppression
Nocturne	Melatonin	5 mL	Oral	At bedtime	Sleep–wake disturbance
ImmunoRel	Human normal immunoglobulin 10%	10 g in 100 mL	Intravenous	Once daily	0.33 g/kg per infusion at 20 mL/h over 5 hours

Quetiapine formed part of the home regimen in addition to the agents listed and was not charted during this admission. Melatonin was administered on the first four days only. The annotation '1.6 mg/kg/dose' carried on the brivaracetam entry in the treatment chart is a slip: 25 mg in a 30.65 kg child is 0.82 mg/kg/dose, and 1.63 mg/kg/day.

The immunoglobulin was a 10% solution of human normal immunoglobulin supplied as 10 g in 100 mL, stabilised with glycine 22.5 g/L, with an IgA content of 160 mg/L or less and a normal IgG subclass distribution, and carrying the standard instruction that contents must not be used more than twenty-four hours after the container has been penetrated (Figure 3).

(a)



(b)

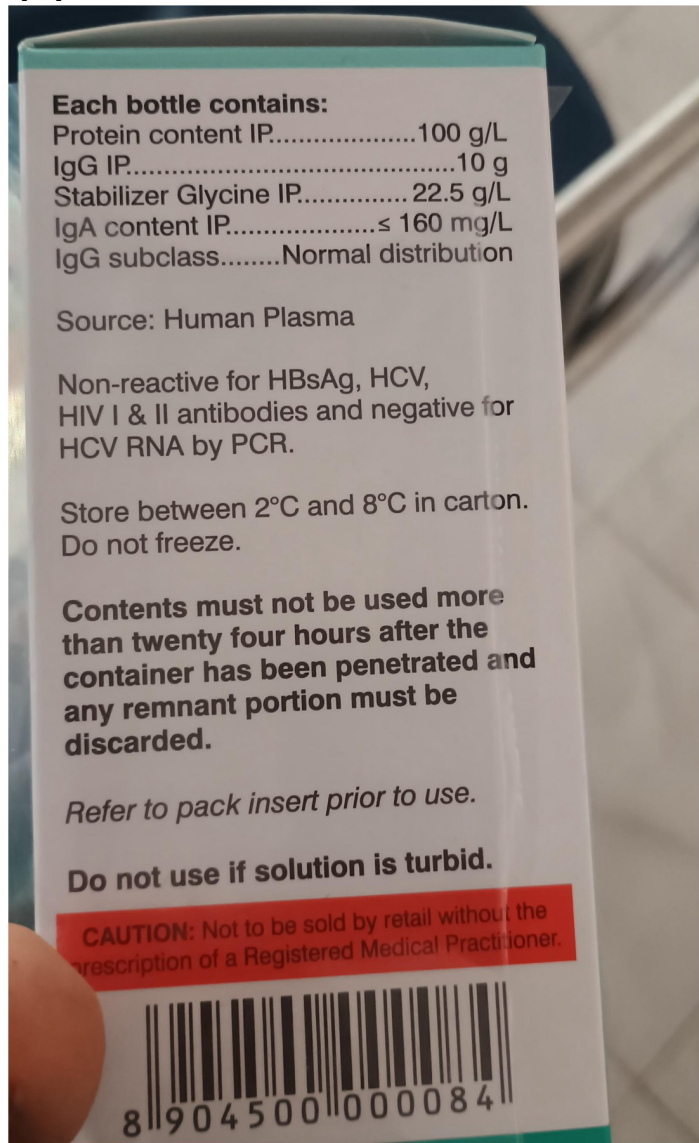


Figure 3: The immunoglobulin preparation used. (a) Carton showing the fixed 10 g in 100 mL presentation of the 10% solution. (b) Composition panel: protein 100 g/L, IgG 10 g, glycine 22.5 g/L as stabiliser, IgA 160 mg/L or less, with the twenty-four-hour discard instruction after penetration of the container. The bottle size, the stabiliser and the discard rule each shaped what reached the patient.

Course in hospital

The documented plan on day one was to start intravenous immunoglobulin 10 g daily for five days and to follow this with rituximab. That plan was executed exactly: the administration chart records ten grams given on each of the five consecutive days from 19 to 23 December, a total of 50 g, or 1.63 g/kg. The running totals entered in the follow-up sheet lag the chart by one

day and reach 40 g on the final morning, which is why the two documents appear at first sight to disagree; the administration chart is the primary record and is the figure used throughout this report. Each infusion ran at a fixed 20 mL/h and took five hours, and the rate was not escalated at any point. The day-wise record, together with blood pressure and pulse, is given in Table 4.

Table 4: Day-wise immunoglobulin administration and haemodynamic record

Date	Infusion day	Dose given (g)	Cumulative dose (g / g·kg ⁻¹)	BP (mmHg) / pulse (bpm)	Entry in the follow-up sheet
19/12	1	10	10 / 0.33	104/70, 114	Plan: IVIG 10 g daily for 5 days, then rituximab
20/12	2	10	20 / 0.65	110/80, 106	No fresh complaints
21/12	3	10	30 / 0.98	102/60, 104	'20 g of IVIG transfused'
22/12	4	10	40 / 1.31	110/70, 108	'3 doses of IVIG given (30 g)'
23/12	5	10	50 / 1.63	110/90, 76	'40 g of IVIG given'; capillary glucose 141 mg/dL; discharged

Table 4 note: BP, blood pressure; IVIG, intravenous immunoglobulin. Each infusion was 10 g in 100 mL given at a fixed 20 mL/h over five hours, equivalent to 0.33 g/kg. Cumulative figures are taken from the administration chart; the

quoted entries from the follow-up sheet were written on the morning after each infusion and therefore lag by one day. The consensus first-event target of 2 g/kg would have required approximately 61 g in this child.

He tolerated the infusions without rash, headache, vomiting or fever. Systolic pressure and pulse remained within the expected range for his age throughout. On the final infusion day the diastolic value of 90 mmHg sat above the ninety-fifth centile for a boy of this age and height, and the capillary glucose measured the same day was 141 mg/dL, marginally above the laboratory's upper limit for a random sample. Neither was repeated and neither drew a comment in the treatment advice column.

He was discharged on 23 December, the sixth day of admission and the day of his final infusion. The cranial nerve examination at that point was intact: menace reflex present, primary position of gaze normal with full movement in all directions, trigeminal sensory and motor function preserved, facial symmetry maintained, and no wasting of the neck muscles with full head turning to either side. Higher mental function, however, remained impaired — orientation and speech were both absent, and his

appearance and behaviour were recorded as apathetic. No discharge prescription was entered in the case record.

CLINICAL PHARMACIST ASSESSMENT

The medication record was reviewed prospectively by the clinical pharmacy team attached to the paediatric unit. Problems were classified using the Pharmaceutical Care Network Europe classification, version 9.1, and causes were assigned against the dose selection, drug selection and monitoring domains.⁷ Structured instruments of this kind have previously been applied by this department to establish causality and guide rechallenge in a drug-induced cutaneous reaction;⁸ the present analysis serves the analogous function in a setting where the difficulty lies not in attributing an adverse reaction but in accounting for a dose that was never delivered. Six drug-related problems were identified (Table 5).

Table 5: Drug-related problems identified, classified by PCNE version 9.1

No.	Problem	PCNE domain and code	Clinical pharmacist recommendation	Outcome
1	Immunoglobulin prescribed and given as 10 g daily for five days, a cumulative 1.63 g/kg against a consensus target of 2 g/kg; the prescription was itself a vial count, framed by the 10 g bottle, the 24-hour discard rule and a fixed 20 mL/h rate	Treatment effectiveness P1.2; cause C3.2 (drug dose too low)	Calculate the dose in g/kg first and then select bottle sizes to match; escalate the infusion rate stepwise after the first hour so that two bottles can be given within one shift	Documented and discussed; dose unchanged during this admission
2	Two atypical antipsychotics (risperidone inpatient, quetiapine at home) in a disorder with a high reported rate of neuroleptic intolerance	Treatment safety P2.1; cause C1.4 (inappropriate combination)	Rationalise to a single agent at the lowest effective dose; monitor rigidity, fever and creatine kinase at every review	Accepted for outpatient review
3	Trihexyphenidyl prescribed three times daily as prophylaxis rather than for documented extrapyramidal symptoms, adding anticholinergic load in a child with existing cognitive impairment	Treatment safety P2.1; cause C1.1 (inappropriate drug)	Withdraw unless extrapyramidal symptoms are documented; reserve for symptomatic use	Documented
4	Prednisolone 0.98 mg/kg/day continued long term without calcium, vitamin D, gastroprotection or growth and blood-pressure surveillance	Treatment safety P2.1; cause C1.6 (no or incomplete drug treatment)	Add bone and gastric protection; record height, weight, blood pressure and glucose at each visit; plan a documented taper	Accepted
5	No counselling recorded on deferral of live attenuated vaccines after high-dose immunoglobulin, and no post-infusion renal or haemolysis check	Treatment safety P2.1; cause C9.1 (inadequate monitoring)	Defer measles-, mumps-, rubella- and varicella-containing vaccines for at least eleven months; check creatinine and haemoglobin after the course	Accepted; written advice given to the parents
6	Serum potassium entered as 6.4 mEq/L with no repeat estimation, no electrocardiogram and no documented clinical response, whether the value was genuine or spurious	Treatment safety P2.1; cause C9.1 (inadequate monitoring)	Repeat the sample with attention to venepuncture technique, obtain an electrocardiogram, and record the conclusion in the notes whichever way it falls	Accepted; repeat sampling advised

PCNE, Pharmaceutical Care Network Europe.

DISCUSSION

A diagnosis that serum alone would have missed

Two features of this child's workup deserve emphasis because both are common traps. The first is the discordance between compartments. In the largest paired-sample series, every one of 250 patients with anti-NMDAR encephalitis had antibody detectable in cerebrospinal fluid, whereas only 214 had it in serum, giving sensitivities of 100% and 85.6% respectively.⁹ Low-titre serum positivity also occurs in people who do not have the disease at all, so a weakly positive serum result carries little weight on its own. Our patient's serum would have invited hesitation; his cerebrospinal fluid settled the question. Testing both compartments is not a counsel of perfection, it is the standard.^{3,9}

The second is the normal scan. Magnetic resonance imaging is unremarkable in roughly half to two-thirds of children with this condition, and a normal study has no negative predictive value for the diagnosis.^{1,4} Where a hospital's diagnostic pathway treats imaging as a gatekeeper to antibody testing, children like this one

are simply not tested. The incidental sphenoid sinus mucosal thickening here was of no relevance to the neurological illness and is worth mentioning only because such findings frequently distract.

A third point concerns what was not done. Consensus recommends a search for an underlying tumour in every child with NMDAR antibody encephalitis, since occult teratoma or germ cell tumour alters both prognosis and the threshold for escalating immunotherapy.⁵ Boys are far less often affected than post-pubertal girls, and screening is correspondingly easy to overlook, but no abdominal or testicular ultrasound and no other tumour search appears anywhere in this child's record. Whether screening was performed and simply not filed cannot now be established. Either way, a relapsing course in a child who continues to need immunoglobulin is a reason to settle the question rather than leave it standing.

The arithmetic of the bottle

The central observation of this report is almost banal once stated, which is probably why it has gone unexamined. A 30.65 kg child needs about 61 g of immunoglobulin to receive 2 g/kg. The product was stocked as 10 g in 100 mL. The institutional infusion

practice was a fixed 20 mL/h, so one bottle occupied five hours of a nursing shift. The arithmetic that follows is unavoidable: one bottle a day, 0.33 g/kg a day, five days, 1.63 g/kg. What makes the case instructive is that nothing went wrong in execution. The chart shows five infusions given on five consecutive days exactly as ordered, with no missed dose and no interruption. The shortfall was built into the prescription, which was written in the notes as 10 g for five days — a vial count, not a weight-based calculation. Had the order been written as 2 g/kg, the ward would have been obliged to confront the fact that six bottles, not five, were needed, and that two of them would have to share a day.

It would be unfair to read this as carelessness. The twenty-four-hour discard rule after penetration of the container means that a partially used bottle is a wasted bottle, and in a self-funded Indian setting the cost of immunoglobulin is a serious constraint on the family rather than an abstraction. A fixed low infusion rate is likewise a defensible safety choice, since the majority of immunoglobulin reactions are rate-related and this child came to no harm.⁶ Each decision was locally rational. The aggregate was a delivered dose that no one had chosen.

The practical remedies are modest. Dose should be calculated in grams per kilogram before bottle sizes are picked, not after; stocking smaller presentations alongside the 10 g bottle allows the arithmetic to be met without waste; and a written paediatric rate-escalation protocol, starting slowly and stepping up after the first thirty to sixty minutes if the child is comfortable, would allow two bottles to be delivered within a single shift. An audit of immunoglobulin use in a large paediatric neurology service found adverse reactions in a quarter of patients but almost all of them minor, and concluded that practice frequently diverges from published guidance.¹⁰ Our observation is of a piece with that finding, with the added point that the divergence here was manufactured by the dosage form rather than by clinical judgement.

Formulation detail that changes bedside interpretation

The composition panel in Figure 3 is not decoration. Three entries on it bear directly on how this admission should be read. Glycine as the stabiliser places the product in the sugar-free category, which matters because the historical association between immunoglobulin and osmotic nephrosis rests overwhelmingly on sucrose-stabilised preparations; renal injury with glycine-stabilised products is rare though not unknown.⁶ The IgA content of 160 mg/L or less is relevant to any future infusion in a child who has never been screened for IgA deficiency. And the absence of maltose means that the capillary glucose of 141 mg/dL recorded on the final infusion day cannot be dismissed as the well-described assay artefact seen with maltose-containing immunoglobulins; in this child it is most plausibly a corticosteroid effect, and it deserved a repeat measurement rather than silence.

A critical value that went nowhere

The potassium of 6.4 mEq/L belongs to a different order of concern. Two readings of it are possible and the record does not let us choose between them. It may have been spurious, and pseudohyperkalaemia from a difficult or haemolysed paediatric venepuncture is common enough that experienced clinicians often discount such a value on sight, the more so in a child whose smear showed erythrocytosis and who had an entirely normal sodium, chloride and creatinine in the same sample. Or it may have been real, in which case a potassium above 6 mEq/L in a 30 kg child is an emergency. What is not in doubt is that the correct response is identical under both readings: repeat the sample, obtain an electrocardiogram, and record the conclusion. None of the three appears in the case file. A critical result that is neither confirmed nor refuted leaves the question permanently open, and it is the sort of loose end a pharmacist reviewing the chart each morning is well placed to close. The same observation applies, less seriously, to the capillary glucose of 141 mg/dL and to the raised diastolic pressure on the final infusion day, neither of which was repeated and neither of which generated an entry in the treatment advice column. Immunoglobulin infusion and

continuing prednisolone are each capable of nudging blood pressure and glucose upward in a child, which is reason to recheck rather than to file.

Antipsychotic burden in a receptor disease

Among 111 adults reviewed by Lejste and colleagues, antipsychotic exposure in anti-NMDAR encephalitis was associated with intolerance in a striking proportion, with rigidity, autonomic instability and raised creatine kinase producing a picture indistinguishable from neuroleptic malignant syndrome.¹¹ A paediatric review of symptomatic management reached the same conclusion, noting a mean of eight symptomatic medications per child and a particular vulnerability to antipsychotic adverse effects.¹² This child was on risperidone in hospital and risperidone with quetiapine at home. Two agents acting on the same receptor family, in a disease defined by receptor dysfunction, is a combination that invites scrutiny. Trihexyphenidyl given three times daily as prophylaxis compounds the issue: it adds anticholinergic burden to a child whose orientation and speech are already lost, and the evidence for routine anticholinergic prophylaxis alongside second-generation antipsychotics is thin. Where behavioural symptoms must be treated, a single agent at the lowest workable dose, with benzodiazepines preferred for acute agitation, is the safer construction.^{11,12}

Corticosteroid and immunisation stewardship

Prednisolone at 0.98 mg/kg/day is an entirely conventional maintenance dose in this setting, but a child receiving it over months accrues predictable risk to bone density, growth velocity, glycaemia and gastric mucosa. None of the usual countermeasures appeared in the record. Nor was there any note about vaccination. Passively transferred antibody interferes with the response to measles-, mumps-, rubella- and varicella-containing vaccines in a dose-dependent fashion, and deferral of roughly eleven months is advised after high-dose immunoglobulin; a child who receives repeated monthly courses may be effectively unvaccinable for a long period, and the family needs to be told so rather than discovering it at a school immunisation camp. Inactivated vaccines are unaffected and should continue. Advice of this sort costs nothing and sits squarely within the pharmacist's remit.

Where this leaves the child

He left hospital with intact cranial nerves and an intact motor examination but without orientation or speech, and apathetic in manner. That combination is characteristic of the slow recovery phase of this illness rather than of treatment failure, and the documented intention to proceed to rituximab is consistent with consensus advice that second-line therapy be considered where first-line treatment has not produced the expected response.⁵ Long-term outcome in paediatric series is broadly favourable, though residual behavioural and cognitive difficulty is common and relapse occurs in a meaningful minority.^{4,13} Whether a fuller immunoglobulin dose would have altered his trajectory cannot be answered from a single case; the point we wish to make is narrower, namely that the question was never put, because the dose was decided elsewhere.

LIMITATIONS

This is a single observation from one hospital, described retrospectively from the case record, and causal inference is not available to it. The quality of the source record is itself a constraint on what can be concluded: the running totals in the follow-up sheet lag the administration chart and appear inconsistent with it, and the dose annotation carried on the brivaracetam line is arithmetically wrong. The elevated potassium was never repeated, so whether it was genuine or spurious cannot be settled. Cerebrospinal fluid cell count, protein and glucose, electroencephalography, tumour screening, repeat antibody titres and formal cognitive assessment are not recorded, and no structured outcome scale such as the modified Rankin Scale was applied at discharge. The child's subsequent course,

including whether the planned rituximab was given, falls outside the period documented here. The pharmacist's recommendations were documented, but acceptance could be verified for only some of them before discharge.

CONCLUSION

Dosage form is not a neutral container. In this child, the 10 g presentation of a 10% immunoglobulin solution, the twenty-four-hour discard rule and a fixed conservative infusion rate combined to deliver 1.63 g/kg where consensus calls for 2 g/kg, and no clinician ever made that decision. Two changes would prevent a repetition. The first is procedural: calculate immunoglobulin dose in grams per kilogram before selecting bottles, stock a range of presentations so the calculation can be honoured, and write a paediatric rate-escalation protocol that permits more than one bottle in a shift. The second belongs to the manufacturers and to the regulators who approve their presentations: weight-banded packs would make correct paediatric dosing the path of least resistance rather than an exercise in arithmetic and wastage. Clinical pharmacists are placed precisely where these two worlds meet, and immunoglobulin stewardship — dose verification, rate supervision, adverse-effect surveillance and vaccination counselling — is work they can take on today without waiting for better packaging.

ACKNOWLEDGEMENTS

The authors thank the consultants, resident doctors and nursing staff of the Department of Paediatrics, S. Nijalingappa Medical College and Hanagal Shri Kumareswar Hospital and Research Centre, Bagalkot, for the clinical care of the child and for access to the case record, and the Department of Radio-Diagnosis and Imaging of the same institution for the neuroimaging report. The authors are grateful to the parents of the child for permitting publication.

CONFLICT OF INTEREST

The authors declare no conflict of interest with respect to the research, authorship and publication of this article.

SOURCE OF FUNDING

No external funding was received for this work.

ETHICAL APPROVAL AND CONSENT

This case report was prepared in accordance with the Declaration of Helsinki. Ethics Committee approval is not required for a de-identified single-patient case report under ICMR guidelines. Written informed consent for the use of the clinical details, laboratory data and images in this report, and for its submission for publication, was obtained from the parents and legal guardians of the child before the manuscript was written; assent was obtained from the child to the extent his condition allowed. Written consent was also obtained from the treating physician of the Department of Paediatrics for the use of the case record and for publication of the case. All patient-identifying information has been removed from the images reproduced here, and the child is not identifiable from any part of this report. The signed consent forms are retained at the Department of Pharmacy Practice, BVV'S, H.S.K. College of Pharmacy, Bagalkot, and are available for inspection on request.

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